

1021 E. Miramar Avenue Claremont, California 91711-2052 Los Angeles County

MIRAGRAND WELL EQUIPPING IMPROVEMENTS

PROJECT NO. 58463
PROJECT SPECIFICATIONS
BID NO. _____
April 2021

Civiltec Engineering, Inc. 118 W. Lime Avenue Monrovia, CA

CONFORMED DOCUMENTS FOR CONSTRUCTION

THE ADDENDA ISSUED DURING THE BID PERIOD ARE INCORPORATED INTO THESE DOCUMENTS. IF DISCREPANCIES BETWEEN THESE DOCUMENTS AND THE RESPECTIVE BIDDING DOCUMENTS INCLUDING ADDENDA ARE FOUND, THE BIDDING DOCUMENTS WITH THE ORIGINAL ADDENDA SHALL GOVERN.

BIDS WILL BE RECEIVED UNTIL <u>2:00PM WEDNESDAY MAY 26, 2021</u> AT 1021 E. MIRAMAR AVENUE, CLAREMONT, CA 91711 AND THEN PUBLICLY OPENED. CONTACT: <u>BEN PERALTA</u> (909) 621-5568

THREE VALLEYS MUNICIPAL WATER DISTRICT MIRAGRAND WELL EQUIPPING PROJECT PROJECT NO 58463

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THREE VALLEYS MUNICIPAL WATER DISTRICT 1021 E. Miramar Avenue, Claremont Los Angeles County, California

SECTION A NOTICE INVITING BIDS FOR MIRAGRAND WELL EQUIPPING IMPROVEMENTS PROJECT PROJECT NO. 58463

A-1 Invitation for Bids

NOTICE IS HEREBY GIVEN, that sealed bids from qualified bidders will be received by Three Valleys Municipal Water District, hereinafter referred to as "the District", for furnishing all labor, services, materials, tools, equipment, supplies, transportation, utilities, and all other items and facilities necessary therefor, as provided in the Contract Documents for the acceptable completion of the work described in Section A-4, together with all appurtenances thereto, in strict accordance with the Specifications and Drawings on file at the office of the District.

A-2 DATE OF OPENING OF BIDS

Bids will be received at the offices of the District, 1021 East Miramar Avenue, Claremont, California 91711-2052, until **2:00 PM WEDNESDAY MAY 26, 2021** and will be opened and publicly read. The District will review and evaluate the Bids and decide on selection at a later time. Bids shall be timely submitted in sealed envelopes marked as directed in Section A-13. Facsimile or emailed bids will not be accepted. Bids received after said deadline time will be returned unopened to the bidder.

A-3 PRE-BID MEETING

The District will conduct a **mandatory** pre-bid meeting on **TUESDAY MAY 4**, **2021 AT 9:00 AM** at the offices of the District, the address of which is given in Section A-2.

A-4 DESCRIPTION OF WORK

Phase two consists of equipping a new production well (TVMWD Miragrand Well), installation of a pump, motor, discharge piping, isolation valves, flow meter, feed system for disinfection, and associated controls, new electrical service (transformer and equipment), appurtenances, and testing of the new municipal supply water well.

The principal components of work to be performed under these Specifications are as follows:

- Installation of a vertical turbine well pump and 100 hp motor, well enclosure building, discharge piping, valves, magnetic flow meter, and appurtenances.
- Installation of 50 L.F. of 8-inch diameter DIP, 15 L.F. of 12-inch diameter DIP discharge piping, related valves, and tie-in to existing 12-inch DIP.
- New Electrical service to bring power to the well, including transformer (installed by SCE), Motor Control Center (MCC), Variable Frequency Drive (VFD), electrical improvements, SCADA integration, and related appurtenances.
- Installation of 800 L.F. of wrought iron fencing with fieldstone pilasters, two 16' wide motorized rolling gates, and 520 L.F. of rock drainage swale.

A-5 TIME FRAME FOR WORK

A Notice to Proceed is expected to be issued approximately two weeks after anticipated board authorization of construction (WEDNESDAY JUNE 16, 2021). All work must otherwise be completed within 250 calendar days after Notice to Proceed is issued to the contractor.

A-6 AWARD OF CONTRACT

Each bid shall be made on the Proposal forms furnished by the District and shall be in accordance with the Specifications and Drawings, and other documents. The District reserves the right, after opening bids, to reject any or all bids, or to make award to the lowest responsible bidder.

A-7 SITE CONDITIONS

Each bidder shall carefully examine the Drawings, read the Specifications and the forms of the Contract Documents, and shall visit the site (located at 675 E. Miramar Avenue in Claremont, CA) of the proposed work to fully inform themselves as to all existing conditions and limitations that may affect the execution of Work under the Contract, and each such bidder shall include in the prices bid the cost of all incidentals and appurtenances. The failure or omission of any bidder to receive or examine any form, instrument, addendum, or other document, or bidder's failure to visit the work site and acquaint themselves with conditions at the construction site, shall in no respect relieve any such bidder from any obligation imposed by bidder's bid or by the Contract. The submittal of a bid shall be taken as prima facie evidence of compliance with all instructions contained herein.

A-8 CERTIFIED CHECKS AND BONDS

a. Each bid shall be under sealed cover and must be accompanied by a Bid Guarantee in the form of either cash, a certified or cashier's check, or by a corporate surety bond on the form furnished by the District and made payable to the Three Valleys Municipal Water District as a guaranty that the bidder will, if an award is made to bidder in accordance with the terms of bidder's bid, promptly secure any insurance required by the Contract

Documents, execute a contract in the required form, and furnish satisfactory bonds for the faithful performance of the Contract and for the payment of claims of all persons supplying labor and materials for the construction of the Work. Should the successful bidder fail to so perform, the District shall be entitled to retain the moneys represented by said cash, check or bond as liquidated damages on account of the delay and inconvenience occasioned to the District, it being expressly agreed and understood that the amount of said cash, check or bond constitutes reasonable damages and that it is impracticable or extremely difficult to ascertain actual damages. Said cash, check, or bond shall be in an amount not less than ten percent (10%) of the amount of the bid. The Faithful Performance Bond shall be not less than one hundred percent (100%) of the total amount of the bid price named in the Contract.

- b. The District reserves the right to reject any bond, if in the opinion of the Engineer or the District's Attorney, the Surety's acknowledgment is not legally sufficient. All sureties utilized by bidders shall be legally qualified to do business in the State of California, shall carry a current Best's Insurance Guide rating of "A" or better, and shall furnish such reports as to their financial condition, from time to time, as may be requested by the District, including the Financial Statement of Bonding Company furnished with the Bond. The premiums for all said bonds shall be paid by the bidder. If any surety becomes unacceptable to District in the absolute judgment and discretion of District, then the bidder/Contractor shall promptly furnish at its own expense such additional bonds as may be required by the District to protect the District's interests and the interests of persons supplying labor or materials in the prosecution of the work contemplated by these Contract Documents.
- c. In the event of any conflict between the terms of the Contract Documents and the terms of the bonds, the terms of the Contract Documents shall control, and the bonds shall be deemed to be amended thereby. The District shall be entitled to exercise any and all rights granted by the Contract Documents in the event of default, without control by the surety, provided that District promptly notifies the surety at the time or before the exercise of such rights. The exercise by District of such rights shall not affect the liability of the surety under the bonds.
- d. Bid security of the unsuccessful bidder(s) will be returned within sixty (60) calendar days of the time of the Contract execution by the District.

A-9 CONTRACT RETENTION

At the request and expense of the Contractor and pursuant to Public Contract Code Section 22300, securities equivalent to any amount withheld by District to ensure the Contractor's performance under the Contract shall be deposited with the District as substitute security or, at the Contractor's request, with a state or

federally chartered bank in California as the escrow agent. Escrow instructions shall conform to the requirements of Public Contract Code Section 22300.

A-10 WAGE RATES

Bids shall be made in accordance with the **prevailing hourly rate** of per diem wages for this locality and project as determined by the Director of Industrial Relations pursuant to Labor Code section 1770 et seq., a copy of which wage rate schedule is on file at the office of the District and by this reference incorporated herein. The Contractor shall post a copy of said documents at the job site. The Contractor and any Subcontractor under Contractor shall pay not less than the specified prevailing rate of per diem wages for general, holiday and overtime work to all workers employed in the execution of this Contract.

A-11 USE OF APPRENTICES

If the Project requires the employment of workers in any apprenticeable craft or trade, once awarded, the Contractor or Subcontractors must apply to the Joint Apprenticeship Council unless already covered by local apprenticeship standards under Labor Code Section 1777.5.

A-12 CONTRACT DOCUMENTS

- a. The Contract Documents shall consist of the Notice Inviting Bids, the Instructions to Bidders, the accepted Proposal and Proposal Bidding Schedule, the Agreement, the Bid Security/Proposal Bond, the Faithful Performance Bond, the Payment Bond, the Non-Collusion Affidavits, the Notice to Proceed, Technical Specifications and Drawings, and any change order or Addenda setting forth any modifications or interpretations of any of said Documents, all of which documents are on file or will be on file in the office of the District, 1021 East Miramar Avenue, Claremont, CA 91711-2052, and which are hereby referred to and made a part of this Notice Inviting Bids.
- b. Complete sets of said Contract Documents, Drawings, and Technical Specifications may be downloaded from the District website via www.threevalleys.com/Reports-Documents/Projects.aspx.

A-13 Address and Marking of Proposal

The envelope enclosing the Proposal shall be sealed and addressed to Three Valleys Municipal Water District and mailed or delivered to 1021 East Miramar-Avenue, Claremont, CA 91711-2052. The envelope shall be plainly marked in the upper left-hand corner with the name and address of the bidder and shall bear the words "Proposal for", followed by the title of the Specifications for the work and the date and hour for opening of bids. The certified or cashier's check, money order, or bidder's bond, where applicable, shall be made payable to Three Valleys Municipal Water District. The bid security shall be enclosed in the same envelope with the Proposal.

Date: April 12, 2021

Three Valleys Municipal Water District

Ву:

General Manager/Chief Engineer

SECTION B INSTRUCTIONS TO BIDDERS

B-1 FORM OF BID AND SIGNATURE

- a. The Proposal shall be submitted on the form attached hereto and shall be enclosed in a sealed envelope marked and addressed as provided in the Notice Inviting Bids.
- b. Each bidder shall state the unit price or the specific sums, as the case may be, for which they propose to supply the labor, materials, supplies, or equipment, and perform the Work required by the Contract Documents. If the unit price and the total amount named by a bidder for any items are not in agreement, the unit price times the estimated quantity will be considered as representing the bidder's intention and the totals will be corrected to conform thereto.
- c. If the Proposal is made by an individual, it shall be signed and his or her full name and his or her address shall be given; if it is made by a partnership firm, it shall be signed with the partnership name by a partner of the firm, who shall also sign his or her own name, and the name and address of each partner shall be given; and if it is made by a corporation, the Proposal shall be signed on behalf of the corporation by its duly authorized officer or officers and attested by the corporate seal. No oral, telephonic, telegraphic, or electronic Proposal or modification of a Proposal will be considered.

B-2 PREPARATION OF THE PROPOSAL

- a. Blank spaces in the Proposal and Bid Sheet(s) shall be properly filled. The wording of the Proposal must not be changed and no additions shall be made to the items mentioned therein. Unauthorized conditions, limitations, or provisos attached to a Proposal will render it informal or nonresponsive and may cause its rejection. Alterations by erasure or interlineation must be noted and initialed by the bidder. Alternative Proposals will not be considered unless specifically requested.
- b. Any bidder may withdraw their Proposal before the hour fixed for opening bids by submitting a written request to the District, and their Proposal will be returned or mailed unopened to the bidder. No Proposal may be withdrawn after the hour fixed for opening of bids without rendering the Bid Security subject to retention by District as liquidated damages, and not as a penalty. Unless otherwise stated herein, all bids shall be valid for a period of forty-five (45) calendar days after the opening date, notwithstanding any award of the contract to another bidder.
- c. No Proposal received after the time fixed or at any place other than the place stated in the Notice Inviting Bids will be considered. All Proposals will be opened and declared publicly. Bidders, their representatives, and others interested are invited to be present at the opening. The District reserves the right to waive any informality in any Proposal, to reject any or all Proposals, to reject one part of a Proposal and accept the other, and to make award to the lowest responsible bidder as the interest of the District may require. Each Bid shall identify the surety or sureties that have agreed to furnish the required bonds.

B-3 Interpretation of Drawings and Specifications

If any person or entity contemplating the submittal of a bid for the proposed contract is in doubt as to the true meaning of any requirement of the Contract Documents, or they find any discrepancies in or omissions from the Contract Documents, they shall submit to the Engineer a written request for an interpretation or correction thereof. The written request must be received at least five (5) calendar days prior to the date fixed for opening of bids. The person or entity making the request will be responsible for its prompt delivery. Interpretations or corrections will be made only by addenda to specifications or by dated revisions of drawings with a copy of each addition or change being furnished, through the District, to each prospective bidder.

B-4 LOWEST RESPONSIBLE BIDDER

In selecting the lowest responsible bidder, consideration will be given not only to the general competency but also to the financial standing of the bidder for the performance of the work covered by the bid. To receive favorable consideration, a bidder shall be required to present evidence that they or their associates are personally competent to manage the proposed undertaking and to carry it forward to a successful conclusion. Professional integrity and honesty shall be essential requirements. The District shall have absolute discretion as to the evaluation of past work performance of any bidder, and its decision relating thereto shall be deemed correct and shall be conclusive and binding.

B-5 CONTRACTORS' EXPERIENCE

Contractors shall submit, along with their proposal, an all-inclusive list of similar projects performed by the Contractor within the past five (5) year period. This list shall include the size of the project in dollars, the agency or client-owner for whom the work was performed and the name and title of the agency or client contact person and a current phone number and email address. The list must include at least two (2) well equipping projects similar in size and scope to that contemplated herein. Failure to submit a complete list or to have that list include at least two (2) well equipping projects similar in size and scope to that contemplated herein, may render a proposal informal or nonresponsive and may result in its rejection by District.

B-6 REGISTRATION OF CONTRACTORS

Before submitting bids, Contractors shall be licensed in accordance with the provisions of Division 3, Chapter 9, of the Business and Professions Code of the State of California, and shall provide proof of current licensing status as provided in the Proposal. The Contractor shall maintain the required license in good standing throughout the course of the Work. Contractors shall also be registered with the Department of Industrial Relations pursuant to Labor Code Section 1725.5.

B-7 INFORMATION REQUIRED OF BIDDER

Each bidder shall verify that the project site was visited to inspect conditions that may affect the work. Said verification shall be made on the form provided.

Each bidder shall submit a statement verifying experience in performing work comparable to that required under this Contract in the form attached hereto. Bids will be considered only from general contractors who can demonstrate a record of experience satisfactory to the District.

Each bidder shall also disclose any material financial relationships and/or political contributions made to current District Board member(s) or employees; or alternatively, sign a statement noting no such relationship(s) or contributions exists. Said verification shall be made on the form provided.

The bidder shall provide annual financial statements for the two (2) most recent years or such other evidence of their qualifications as may be requested by the District. If a bidder fails to promptly furnish the information requested, it shall be considered sufficient grounds for rejection of such bidder's entire bid.

B-8 Local Conditions

- a. Bidder shall read the specifications, examine the drawings and all other Contract Documents, and make their own estimates as to all conditions and limitations, including the character of equipment and facilities needed preliminary to and during the prosecution of the Work, the uncertainty of weather, site accessibility, groundwater level, soil conditions in the vicinity of the Work, and all other contingencies that can in any way affect the Work to be done. Bidders shall make such investigation and review such records and drawings as they deem necessary to satisfy themselves that they are familiar with the condition and location of existing underground facilities and other potential sources of interference with the work contemplated under the Contract Documents. Failure to do so will not release bidders from the responsibility for estimating properly the difficulty or cost of successfully performing the Work. By providing access to drawings or other records in its possession, the District makes no representations or guarantees as to the accuracy of such drawings or records. The District will not be responsible for any understanding or representations concerning conditions made by any of its officers or agents, including the Engineer or his assistants, prior to the execution of the Contract.
- b. Bidders shall satisfy themselves by personal examination of the location of the proposed work and by such other means as they may choose as to actual conditions and requirements and as to the accuracy of the quantities stated in the Bid Schedule. Information derived from the maps, plans, specifications, profiles, or drawings, or from the Engineer or its assistants, shall not relieve the bidder of this responsibility, and the interpretation of the data disclosed by borings or other preliminary investigations is not guaranteed by the District.
- c. The quantities of Work or material stated in the unit price items of the Bid Schedule are supplied only to give an indication of the general scope of the work and as a basis for the comparison of bids. The District does not expressly or by implication warrant that the actual amount of work or material will correspond therewith, but reserves the right to increase or decrease the quantity of any unit-price item(s), or to omit portions, or all of such work as may be deemed necessary or expedient by the Engineer without a change in the unit price. The District, likewise, reserves the absolute right to delete quantities of work or material which are the subject of "lump sum" bids.
- d. Bidders shall not at any time after the submittal of a bid make or have any claim for damages or anticipated profits or loss of profit or otherwise because of any difference between the quantities of work actually done and material furnished and those stated in said unit-price items or lump sum items of the Bid Schedule.

B-9 SUBCONTRACTS

In accordance with the provisions of Sections 4100 through 4114, inclusive, of the Public Contract Code of the State of California, each Proposal shall include the name and business address of each proposed subcontractor who will perform work or labor or render service to the principal Contractor in an amount greater than one-half of one percent (0.5%) of the principal Contractor's bid, and shall state the portions of the work which will be done by each such subcontractor. Each subcontractor shall be registered pursuant to Labor Code Section 1725.5, and shall provide satisfactory evidence that they are currently registered and qualified to perform public work. Any additional information required by the District regarding listed subcontractors may be provided by the bidder up to 24 hours after the hour set for opening bids. The Contractor shall not enter into any subcontract with a subcontractor which has been debarred by the Labor Commissioner pursuant to Sections 1777.1 and 1777.7 of the Labor Code.

B-10 BIDDERS INTERESTED IN MORE THAN ONE BID

No person, firm, or corporation shall make, file, or be interested in more than one Proposal for the same work; provided, however, that a person, firm, or corporation who has submitted a sub-proposal to a bidder, or who has quoted prices of materials to a bidder, is not hereby disqualified from submitting a sub-proposal or quoting prices to other bidders.

B-11 Non-Collusion Affidavits

In accordance with the provisions of Section 7106 of the Public Contract Code, each Bidder shall execute and submit with their bid a Non-Collusion Affidavit in the form attached hereto.

B-12 Brokerage of Work not Favorably Considered

In general, the brokerage of work will not be favorably considered and the subletting of the entire Contract or of substantial complete units of it will be permitted only upon an adequate showing of the necessity involving some new condition not reasonably foreseen at the time of the Proposal.

B-13 Assignment of Contract

The Contractor shall not assign the Contract Documents or any part thereof, or any funds to be received thereunder, without the prior written approval of both the District and Surety. Notwithstanding the foregoing, and to the extent permitted by law, District has the absolute right to refuse, on any ground or no grounds, any and all assignments or attempted assignments of the Contract Documents or of any rights to payment pursuant thereto.

B-14 EQUALIZING FACTORS

Wherever applicable, equalizing elements or factors not specifically mentioned or provided for herein, such as interest during construction, cost of transportation, inspection (including salaries and travel subsistence expenses), installation and operation, or any other factor or element in addition to that of price which would affect the total cost or value to the District, will be taken into consideration in comparing bids for award of the Contract.

B-15 SERVICING AND MAINTENANCE

Each bidder must, if requested, furnish evidence that there is an efficient service organization that regularly carries a stock of repair parts for the proposed equipment to be furnished and installed in the work and that the organization is conveniently located for prompt service.

B-16 BID SECURITY

Each bidder shall submit with their bid either cash, an unconditional certified or cashier's check, or a bidder's bond with a responsible corporate surety, on the form attached to the proposal. The Bid Security shall be in a sum not less than ten percent (10%) of the amount of the bid, and shall be made payable to or for the benefit of Three Valleys Municipal Water District as a guaranty that the bidder will, if an award is made to them in accordance with the terms of their Proposal, promptly execute a contract in the required form, secure payment of worker's compensation, and furnish satisfactory Performance and Payment Bonds and proof of insurance coverage, and such other information as may be required of bidder.

B-17 Execution of Contract

The District reserves the right to accept or reject bids for a period of thirty (30) days after date of opening, and no bid can be withdrawn during said period. A bidder to whom award is made shall execute the form of Agreement provided in the Contract Documents, secure the payment of worker's compensation, furnish bonds as required herein, provide evidence of insurance, and provide a financial statement or other information requested by District pursuant to the Contract Documents, within fifteen (15) days, or such additional time as may be allowed by the District, from the date the District mails notice to the bidder that their proposal has been accepted. The failure or refusal of a bidder to whom award is made to enter into contract or otherwise perform hereunder will result in damages being sustained by the District. Such damages are impracticable and extremely difficult to ascertain. In the event of such failure or refusal to comply with the requirements of the Contract Documents, the Bid Security shall become the property of the District as liquidated damages and not as a penalty, and the award will be revoked. At the discretion of the District, a new award may be made to the second lowest responsible bidder and such bidder shall fulfill the requirements set forth herein as if they were the party to whom the first award was made. A corporation to which an award is made shall be required, before the contract is finally executed, to furnish evidence of its corporate existence, of its right to do business in California, and of the authority of the officer signing the contract and bonds for the corporation.

B-18 Bonds

a. In conformance with the Notice Inviting Bids, a bidder to whom the contract is awarded shall, within the time specified in Section B-17 above, furnish a bond with a responsible corporate surety or corporate sureties conditioned upon the faithful performance of said bidder of all covenants and stipulations in the Contract Documents. Said bond, hereinafter referred to as the Faithful Performance Bond, shall be on the mandatory form included as a part of these Contract Documents, and shall be in an amount that is not less than one hundred percent (100%) of the total amount payable under the Contract Documents.

- b. Within the time specified in Section B-17 hereof, the bidder to whom the contract is awarded shall also furnish a Payment Bond, approved by the District, in accordance with the provisions of Civil Code Sections 8152 and 8154, and Sections 3247-3252, inclusive. Said Payment Bond shall be in a sum not less than one hundred percent (100%) of the total amount payable under the Contract Documents. The form of Payment Bond set forth in these Contract Documents is a mandatory form.
- c. The surety or sureties on all bonds furnished must be satisfactory to the District. Any power of attorney provided, evidencing the authority of the person executing the bonds to bind the surety, shall be an unrevoked power. If during the continuance of the contract any of the sureties, in the sole discretion of the District, are or become insufficient, the District may require additional sufficient sureties which the Contractor shall furnish to the satisfaction of the District within fifteen (15) days after written notice, and in default thereof the contract may be suspended and the work completed as provided in the General Conditions. The party required to furnish bonds pursuant to these instructions shall furnish such bonds at their own cost and expense.
- d. Said bonds shall be of a form satisfactory to the District and shall be obtained from responsible corporate sureties acceptable to the District. All sureties utilized by bidders shall be legally qualified to do business in the State of California, shall carry a current Best's Insurance Guide rating of "A" or better. Said sureties shall furnish reports as to their financial condition from time to time as requested by the District. The premiums for said bonds shall be paid by the bidder.
- e. In the event of any conflict between the terms of the Contract and the terms of said bonds, the terms of the Contract shall govern and said bonds shall be deemed to be amended thereby. Without limiting the foregoing, the District shall be entitled to exercise all rights granted to it by the Contract in the event of default, without control thereof by the surety, provided that the District gives the surety notice of such default at the time or before the exercise of any such right by the District, and, regardless of the terms of said bonds, the exercise of any such right by the District shall in no manner affect the liability of the surety under said bonds.

B-19 Public Liability and Property Damage Insurance

a. A bidder to whom the contract has been awarded shall furnish to the District a policy or certificate of protective liability insurance in which the District, the District's Engineer and the District's Representative shall be named as additional insureds with the bidder. Where requested by the city, county or other governmental agency in whose jurisdiction the work is being performed, or in the discretion of the District, the city, county or other governmental agency shall be named as an additional insured. The policy shall insure the District, the Engineer and the District's Representative and each of their officers, employees, agents and volunteers as additional named insureds; the bidder, its employees and its subcontractors and each of their employees, and their heirs, agents, and employees, while acting within the scope of their duties, against all claims arising out of or in connection with the Work to be performed and shall remain in full force provide and effect until the Work is accepted by the District. The bidder shall also such additional named insured endorsements [Insurance Services Office (ISO) Form Number CG 2010 11 85 or equivalent] as may be required by the District, in the District's sole discretion.

- b. The District, the Engineer and the District's Representative and each of their directors, officers, employees, agents and volunteers are to be covered as insureds as respects: liability arising out of activities performed by or on behalf of the Contractor, products and completed operations of the Contractor; premises owned, occupied or used by the Contractor; or automobiles owned, leased, hired or borrowed by the Contractor. The coverage shall contain no special limitations on the scope of protection afforded the additional insureds.
- c. The above-referenced insurance policy (or policies) shall be furnished at the bidder's expense, in a form and with insurance companies authorized to do business and have an agent for service of process in California and have a "A-" policyholder's rating and a Financial Size Category rating of at least VII in accordance with the most recent Best's Insurance Guide or other comparable rating service, or as otherwise approved by the District. Such insurance, in addition to the multiple additional named insured endorsements set forth above, shall be commercial general liability insurance in the amounts set forth below, and shall contain additional endorsements as follows: (i) Providing blanket contractual liability coverage for the bidder's indemnification obligations to District and others pursuant to the Contract Documents; (ii) Providing coverage for explosion, collapse, underground excavation and removal of lateral support; (iii) Providing that the insurance may not be canceled or reduced until thirty (30) days after the District and its Engineer have actually received written notice of such cancellation or reduction; (iv) Providing that coverage shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability; and (v) Providing that any other insurance maintained by District, the Engineer or any other named insured is excess insurance, and not contributing insurance with the insurance required herein. The amount of coverage shall be no less than the following:
 - 1) General bodily injury and property damage -- \$2,000,000 per occurrence, \$5,000,000 in aggregate.
 - 2) Automobile bodily injury and property damage -- \$2,000,000 per occurrence, including owned, non-owned and hired autos, and providing coverage for loading and unloading, \$5,000,00 in aggregate
- d. The bidder shall, within the time specified in Section B-17 hereof, file with the District evidence of insurance from an insurer or insurers certifying to the coverage of all required insurance. Such evidence shall include original copies of the ISO CG 2010 11 85 (or insurer's equivalent) signed by the insurer's representative and certificate(s) of insurance (Accord Form 25 or equivalent) reflecting the existence of the required insurance. If required by the District, the bidder shall furnish a complete copy of the policy or policies, and all endorsements thereto. Commercial general liability insurance must include District's and Contractor's Protective Coverage, Products Completed Operations Coverage, Premises Operations Coverage, and must provide for coverage of District's facilities during the course of construction. Notwithstanding the foregoing, bidder is not hereby required to provide insurance with respect to liability for damages resulting solely from error or omission in design which is not due to or contributed to by negligence or fault of the contractor, its subcontractors, agents, employees or officers.

Three Valleys Municipal Water District Los Angeles County, California

PROPOSAL FOR

MIRAGRAND WELL EQUIPPING PROJECT

PROJECT NO. 58463

Proposals received until 2:00PM THURSDAY MAY 26, 2021

To the Board of Directors, Three Valleys Municipal Water District 1021 E. Miramar Avenue Claremont, California 91711-2052

In the addition to the lump sum total required withing this section, bidders shall complete subsection Form 04.b "Bid Breakdown Sheet". Bidders are referenced to Section T01 22 00 UNIT PRICES for description of Bid Line Items. Any cost item not explicitly indicated by the project documents in a unit price line necessary to complete work shall be included into an associated line item for bidding.

The undersigned hereby proposes to perform all work for which a contract may be awarded the and to furnish any and all plant, labor, services, material, tools, equipment, supplies, transporta utilities, and all other items and facilities necessary therefor as provided in the Contract Documents, and to do everything required therein for the construction of				
as specifically set forth in documents entitled				

together with addenda thereto, all as set forth on the drawings and in the specifications and other Contract Documents (hereinafter the "Work"); and they further propose and agree that, if this Proposal is accepted, they will contract in the form and manner stipulated to perform all the Work called for by drawings, specifications, and other Contract Documents, and to complete all such Work in strict conformity therewith within the time limits set forth therein, and that they will accept as full payment therefor the prices set forth in the Bid Sheet(s) forming a part hereof.

\$
is included inCash,a Cashier's check,a Certified check, ora Bid Bond (check one) properly made payable to Three Valleys Municipal Water District, hereinafter designated as the Owner. The above amount is not less than 10 percent of the total amount of this bid, is attached hereto, and is given as a guarantee that the undersigned will execute the Agreement and furnish the required bonds and insurance if awarded the contract and, in case of failure to do so within the time provided, the
 (check one) □cash shall be retained as liquidated damages by the Owner □ proceeds of said check shall be retained as liquidated damages by the Owner □ Surety's liability to the Owner for the face amount of the Bond shall be considered as established.

It is understood and agreed that:

- 1. The undersigned has carefully examined all the Contract Documents, as defined in Section A-12 of the Notice Inviting Bids, including, but not limited to, the bid quantities, any specifications regarding materials to be used, the contract provisions relating to payment for extra work and the procedures for seeking extensions of time.
- 2. The undersigned, by investigation at the site of the work, by review of any records available for inspection at the offices of utilities in the area affected by the Work, at any applicable public works departments, and otherwise, is satisfied as to the nature and location of the work and is fully informed as to all conditions and matters which can in any way affect the work or the cost thereof, including the location of all underground facilities in the area affected by the Work.
- 3. The undersigned fully understands the scope of the Work and has checked carefully all words and figures inserted in this Proposal and further understands that the Owner will in no way be responsible for any errors or omissions in the preparation of this Proposal.
- 4. The undersigned will execute the Agreement and furnish the required Performance and Payment Bonds and proof of insurance coverage within fifteen (15) days (not including Sundays and holidays) after Owner's notice of acceptance of this Proposal; and further, that, unless otherwise specified in the Special provisions, this Proposal may not be withdrawn for a period of forty-five (45) days after the date set for the opening thereof, notwithstanding the award of contract to another bidder. If the undersigned bidder withdraws this Proposal within said period, said bidder shall be liable under the provisions of the Bid Security, or said bidder and their surety shall be liable under the Bid Bond, as the case may be.
- 5. The undersigned hereby certifies that this Proposal is genuine and not sham or collusive or made in the interest or on behalf of any person not herein named, and the undersigned has not directly or indirectly induced or solicited any other bidder to put in a sham bid, or any other person, firm, or corporation to refrain from bidding; the undersigned has not in any manner sought by collusion to secure for themselves an advantage over any other bidder.

6. In conformance with current statutory requirements of the Labor Code of the State of California, the undersigned certifies as follows:

I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this contract.

The bidder further declares that the surety or sureties named in the spaces provided below have agreed to furnish bonds in the form and aggregate amounts set forth in Paragraph B-18 of the Instructions to Bidders, in the event Contract is awarded on the basis of this Proposal.

NOW, in compliance with the Notice Inviting Bids and all the provisions hereinbefore stipulated, the undersigned, with full cognizance thereof, hereby proposes to perform the entire work for the prices set forth in the attached Bid Sheet(s) upon which award of contract will be made.

The undersigned bidder declares that the license held by them is theirs, is current and valid, and is in a classification appropriate to the work to be undertaken.

The undersigned declares use the foregoing is true and correct			er the laws of the State of California that , California.
Dated:	_, 20	Bidder:_	
		By:_	
		Title:_	
	Contracto		
	Ex		
		_	
Bidder's post office address:			
		Telephone #:_	
		Facsimile #:_	

CONTRACTORS ARE REQUIRED BY LAW TO BE LICENSED AND REGULATED BY THE CONTRACTORS' STATE LICENSE BOARD WHICH HAS JURISDICTION TO INVESTIGATE COMPLAINTS AGAINST CONTRACTORS IF A COMPLAINT IS FILED WITHIN THREE YEARS OF THE DATE OF THE ALLEGED VIOLATION. ANY QUESTIONS CONCERNING A CONTRACTOR MAY BE REFERRED TO THE REGISTRAR,

CONTRACTORS' STATE LICENSE BOARD, P.O. BOX 26000, SACRAMENTO, CALIFORNIA 95826.

Names and addresses of all members of the firm or names and titles of all officers:	Corporation organized under the laws of the State of
	Surety or Sureties

BID PROPOSAL BREAKDOWN SHEET PROJECT NO. 58463 MIRAGRAND WELL IMPROVEMENTS

NO.	ITEM	Quantity	Unit	Unit Price	Total
1	Mobilization and Demoblization, Bonds, SWPPP, and Permits	1	LS		
2	Traffic Control	1	LS		
3	Well House Building w/Fieldstone Façade, Doors/Walls/Roofing/Painting and Coattings	1	LS		
4	Building HVAC (AC and Ventilation)	1	LS		
5	Asphalt Drive, Base and Prep	1	LS		
6	Fieldstone Storm Swale on Grand Ave/Miramar Ave	1	LS		
7	Wrought Iron Fencing and Fieldstone Pilasters	1	LS		
8	Export Native Soil Materials, grading/etc	1	LS		
9	Concrete Access Drives, Pads Curbing, and Misc	1	LS		
10	Well Header Piping and Appurtenances	1	LS		
11	Yard Piping and Pond Outlet Structure	1	LS		
12	Provide and Install Vertical Turbine Pump & Motor	1	LS		
13	Electrical: MCC & Switchboard, Portable Generator Connection, etc.	1	LS		
14	SCADA and telemetry	1	LS		
15	Yard Lighting, Electrical and Security, Future Condutis	1	LS		
16	Misc Elect Improvements	1	LS		
17	Pressure testing and disinfection of piping and equipment	1	LS		
18	Start up and testing and Training	1	LS		
			TOTA	L BASE BID \$	

BID OPTIONS

0-1	TVMWD Option for Noise Abatement Materials and Installation	1	LS		
		TO	OTAL OI	PTIONS BID \$	
			TOTAL	BID PRICE \$	

INFORMATION REQUIRED OF BIDDER

SITE INSPECTION AND UNDERGROUND UTILITIES REVIEW – Describe when, by whom, and in what manner (a) the site for this proposed Work was inspected and (b) records of local utility providers were reviewed on behalf of the bidder (NOTE: Failure to demonstrate diligent effort in ascertaining local conditions which may affect the Work and non-attendance at Mandatory Pre-Bid Meeting or substitute will render this Proposal informal or nonresponsive and will result in its rejection):
COMPARABLE PROJECT EXPERIENCE – In accordance with Section B-5 of the Instructions to Bidders, describe all comparable projects completed by bidder within the past five (5) year
period, including dates completed, location of work, size of project in dollars, names, addresses, and phone-numbers of persons in charge of project construction, and the name and address of the public agency or owner/firm for whom the project was constructed (NOTE: Failure to include at least two (2) production well equipping projects similar in size and scope to that contemplated under the Contract Documents will render this Proposal informal or nonresponsive and may result in its rejection): [Attach additional sheets as needed]
addresses, and phone-numbers of persons in charge of project construction, and the name and address of the public agency or owner/firm for whom the project was constructed (NOTE: Failure to include at least two (2) production well equipping projects similar in size and scope to that contemplated under the Contract Documents will render this Proposal informal or
addresses, and phone-numbers of persons in charge of project construction, and the name and address of the public agency or owner/firm for whom the project was constructed (NOTE: Failure to include at least two (2) production well equipping projects similar in size and scope to that contemplated under the Contract Documents will render this Proposal informal or
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addresses, and phone-numbers of persons in charge of project construction, and the name and address of the public agency or owner/firm for whom the project was constructed (NOTE: Failure to include at least two (2) production well equipping projects similar in size and scope to that contemplated under the Contract Documents will render this Proposal informal or

FINANCIAL CONTRIBUTIONS STATEMENT – In accordance with the District's Policy Manual Subsection 2.5.3, list all material financial relationships and/or political contributions your company has or has had with or has made to current District Board member(s) or employees. (NOTE: Failure to include information to that contemplated under the Contract Documents will render this Proposal informal or nonresponsive and may result in its rejection) [Attach additional sheets as needed]
Our company does not have any material financial relationships and/or has not made political contributions to or at the behest of a District Board member or employee
Signature
Printed Name
Title
FINANCIAL RESOURCES – In accordance with Section B-7 of the Instructions to Bidders, provide annual financial statements for the two (2) most recent years. (NOTE: Failure to provide financial statements will render this Proposal informal or nonresponsive and may result in its rejection): [Attach financial statements]

l

PROPOSAL BOND KNOW ALL MEN BY THESE PRESENTS

That we,	as Principal(s) (hereinafter called the
Principal) and the	as Surety (hereinafter called the
Surety), are held and firmly bound unto THREE VA	ALLEYS MUNICIPAL WATER DISTRICT, LOS
ANGELES COUNTY, CALIFORNIA (hereinafter	called the Obligee) in the penal sum of ten percent (10%)
of the amount of accompanying bid (dollars) for the payment of which,
well and truly to be made, we bind ourselves, our he	eirs, administrators, executors, successors, and assigns,
jointly and severally, firmly by these presents.	
WHEREAS, said Principal is submitting he	erewith a bid, or proposal for CONSTRUCTION OF
THE MIRAGRAND WELL EQUIPPING IMPI	ROVEMENTS PROJECT.
NOW, THEREFORE, if the bid or proposa	al is not withdrawn within thirty (30) days after the date set
for the opening of bids, and notwithstanding the awa	ard of the Contract to another bidder, if the bid or
proposal of said Principal shall be accepted, and the	Contract for such Work be awarded to the Principal
thereupon by the said Obligee, and said Principal sh	nall within the period specified in the Specifications for
Project No. 58463 enter into a written Contract and	d obtain insurance and faithful performance and labor and
material bonds of the type and character and in the a	amount as may be specified, then this obligation shall be
null and void; otherwise to be and remain in full for	ce and effect.
In witness whereof, we hereunto set our har	nds and seals this day of, 20
	(SEAL)
_	(Principal)
	, , ,
By	
	(SEAL)
_	(0 1)
	(Surety)
By	

NOTE: This bond must be acknowledged before a Notary Public, and a legally sufficient power of attorney must be attached to the bond to verify the authority of any party signing on behalf of a surety.

Page 1 of 1 Proposal Bond

CONTRACTOR'S LICENSING STATEMENT

The undersigned is licensed in accordance with the laws of the State of California providing for the registration of Contractors.

Contractor's License Number(s)	Type(s)	Expiration Date(s)
,	71 \ /	
Name of Individual Contractor (print or type):		
Signature of Owner:		
	OR	
Name of Partnership or Firm:		
Business Address:		
Name, Title, Address, and Signature	of partners signing	on behalf of the partnership:
Name, Title, Address, and Signature (Name (please print)	Name	(please print)
Signature	Signat	ure
T:Al -	Tide	
Title	Title	
Address	Addre	SS

Name of Corporation:	
Business Address:	
Dusiness Address.	
Corporation organized under	the laws of the State of:
	Signature of Secretary of Corporation
	Signature of Secretary of Corporation
SEAL	

NOTE: CURRENT COPIES OF ALL APPLICABLE LICENSES MUST BE ATTACHED TO THIS PROPOSAL.

LIST OF SUBCONTACTORS

The bidder is required to furnish the following information in accordance with the provisions of Sections 4100 to 4114, inclusive, of the Public Contract Code of the State of California.

Subcontractors must be listed if they will provide work, labor or service in an amount in excess of one-half (1/2) of one percent (1%) of the total bid.

THAT PORTION OF THE WORK TO BE PERFORMED BY SUBCONTRACTORS SHALL, IN THE AGGREGATE, NOT EXCEED 40% OF ALL WORK PERFORMED, BASED UPON THE TOTAL DOLLAR VALUE OF THE WORK.

Subcontractor Name/Address	License No. & Type	% of Total Dollar Value Work	Description of Subcontract Task(s)

(attach additional sheets if necessary)

LIST OF EQUIPMENT MANUFACTURERS/SUPPLIERS

The bidder shall indicate opposite each item of equipment or material listed below, the name of the manufacturer or supplier of the equipment or material proposed to be furnished under the bid. Failure to comply with this requirement will render the proposal informal and may cause its rejection. Awarding of a contract under this bid will not imply approval by the District of the manufacturers or suppliers listed by the bidder. No substitution will be permitted after award of contract unless equipment or material of the listed manufacturer or supplier cannot meet the specifications.

Equipment / Material	Manufacturer / Supplier
(attach additional sheets if necessary)	

To be executed by Bidder and submitted with bid.

BIDDER NON-COLLUSION AFFIDAVIT

COUNTY OF	
	haina
	, being (Name)
first duly sworn, deposes and says that h	
, , ,	ne/she is (sole owner, a partner, president, secretary, etc.)
of	, the (Bidder Name)
party making the foregoing bid covering	
	(Name of Project)
that the hid is not used in the interest of	, or on behalf of, any undisclosed person, partnership,
profit, or cost element of the bid price, or against the public body awarding the con all statements contained in the bid are truindirectly, submitted his/her bid price or a information or data relative thereto, or pair company, association, organization, bid other individual except to such person or	ce of the bidder or any other bidder, or to fix any overhead of that of any other bidder, or to secure any advantage intract or anyone interested in the proposed contract; that ue; and, further, that the bidder has not, directly or any breakdown thereof, or the contents thereof, or divulged and will not pay any fee to any corporation, partnership depository, or to any member or agent thereof, or to any persons as have a partnership or other financial interest less.
with said bidder in his/her general busine	
with said bidder in his/her general busine Dated:	Signed:
-	
Dated:	Signed: Title:
Dated: Subscribed and sworn to before me this	Signed: Title: day of, 20, by
Dated: Subscribed and sworn to before me this	Signed: Title: day of, 20, by
Dated: Subscribed and sworn to before me this	Signed: Title:
Dated: Subscribed and sworn to before me this	Signed: Title:
Dated: Subscribed and sworn to before me this	Signed: Title:, 20, by

To be executed by each Awardee of a Subcontract.

SUBCONTRACTOR'S NON-COLLUSION AFFIDAVIT

STATE OF CALIFORNIA > ss		
COUNTY OF		
		, being
(Name	•	
first duly sworn, deposes and says that he/she		r, a partner, president, secretary, etc.)
of(Subcont	,	, the
(Subcont	ractor Name)	
party making the foregoing bid covering		
		;
(Describe na that the bid is not made in the interest of, or	ture of subcontract)	
has not in any manner, directly or indirectly, so with anyone to fix the bid price of the bidder or a element of the bid price, or of that of any other body awarding the contract or anyone interest contained in the bid are true; and, further, that his/her bid price or any breakdown thereof, or trelative thereto, or paid and will not pay ar association, organization, bid depository, or trelative theoreto, or paid and will not pay ar association, organization, bid depository, or trelative thereto, or paid and will not pay ar association, organization, bid depository, or trelative thereto, or paid and will not pay ar association, organization, bid depository, or trelative thereto, or paid and will not pay ar association, organization, bid depository, or trelative thereto, or paid and will not pay ar association, organization, bid depository, or trelative thereto, or paid and will not pay ar association, organization, bid depository, or trelative thereto, or paid and will not pay ar association, organization, bid depository, or trelative thereto, or paid and will not pay ar association, organization, bid depository, or trelative thereto, or paid and will not pay ar association, organization, bid depository, or trelative thereto, or paid and will not pay ar association, organization, bid depository, or trelative thereto, or paid and will not pay are association.	ny other bidder, or idder, or to secure sted in the proporthe bidder has not he contents there by fee to any color any member of ave a partnership ons of this affidaviated a sub-propostaterials or work to	r to fix any overhead, profit, or cost e any advantage against the public sed contract; that all statement ot, directly or indirectly, submitte of, or divulged information or dat rporation, partnership, company or agent thereof, or to any other or other financial interest with sai t shall not be held as disqualifying all to one bidder from submitting
Dated:	Signed:	
Subscribed and sworn to before me this	day of	, 20, by
		proved to me on the basis of
satisfactory evidence to be the person who app	eared before me.	
Notary Public		SEAL

AGREEMENT

	THIS AGREEMENT, made and entered into this day or
20	, by and between the Three Valleys Municipal Water District, hereinafter called the "District
an	d, hereinafter called the
"C	ontractor."
	The District and the Contractor agree as follows:
1.	This Contract is for the _THREE VALLEYS MUNICIPAL WATER DISTRICT
	MIRAGRAND WELL EQUIPPING PROJECT NO. 58463.

- 2. The Contract includes all of the Contract Documents, to wit: The Notice Inviting Bids, the Instructions to Bidders, the accepted Proposal and Proposal Bid Schedule, the Bid Security/Proposal Bond, the Information Required of Bidders, the Agreement, the Proposal Bond, the Faithful Performance Bond, the Non-Collusion Affidavits, the Notice to Proceed, the Specifications and Drawings, and any change order(s) or Addenda setting forth any modifications or interpretations of any of said Documents. All said Documents are hereby incorporated in and made a part of this Agreement.
- 3. In consideration of the payments and agreements to be made and performed by the District as set forth in said Contract Documents, the Contractor shall furnish at its owns cost and expense all labor, services, materials, tools, equipment, supplies, transportation, utilities, and all other items and facilities necessary therefor, and do everything required therein to perform in good and workmanlike manner all Work under the Contract for the District in strict conformity with the Specifications and Drawings and to the approval and entire satisfaction of the Engineer and District.
- 4. In accordance with the provisions of Section 3700 of the Labor Code, the Contractor will secure payment of compensation of its employees by acquisition of workers' compensation insurance or by qualification as a self-insurer.
- 5. The Contractor shall provide for payments on all required insurance policies, and shall obtain all necessary permits and licenses. The Contractor shall furnish and remove and replace as necessary all plant, temporary work or structures, tools, and equipment necessary to accomplish the Work contemplated in this Agreement and the Contract Documents, and shall be responsible for all loss and damage arising out of the nature of the Work during its progress and prior to District's acceptance, from the action of the elements and from any unforeseen difficulties which may arise or be encountered in the prosecution of the Work, and for all other risks of any description connected with the Work. Any such damage shall be immediately repaired by Contractor, and, upon failure to do so, the District may remedy the same and deduct the cost thereof from any amount due or to become due Contractor. The Contractor shall also be responsible for all expenses incurred by or in consequence of the suspension or discontinuance of Work, except where the Contract Documents expressly stipulate otherwise. In consideration of the foregoing, and for completing the Work within the time and in the manner set forth in the Contract Documents and in accordance with the requirements of the Engineer, the District shall pay, and the Contractor shall receive in full compensation therefor, the prices set forth in the accepted Proposal. The total compensation to be paid shall be

- computed on the basis of the units of work actually performed in accordance with the requirements of the Contract Documents and paid for at the prices stated by the Contractor in the Bid Sheet(s) for completion of the Work. All time limits stated in the Contract Documents are of the essence of this Agreement.
- 6. The District agrees to employ, and does hereby employ, Contractor to provide the materials and to do the Work according to the terms and conditions herein contained and referred to, for the price aforesaid, and hereby contracts to pay the same at the time, in the manner, and upon the conditions set forth in the Contract Documents.
- 7. No work, services, material, or equipment shall be performed or furnished under this Agreement unless and until a Notice to Proceed has been given to the Contractor by the District. The Work under this Agreement shall be completed to the approval and entire satisfaction of the District and its Engineer.
- 8. This Agreement shall be binding upon and shall inure to the benefit of the parties hereto, as well as their heirs, successors and assigns.
- 9. To the fullest extent permitted by law, Contractor shall immediately defend and indemnify and hold harmless the District, and its Engineer and their respective directors, officers, employees, agents and volunteers, and each of them from and against:
 - a. Any and all claims, demands, causes of action, damages, costs, expenses, losses or liabilities, in law or in equity, of every kind and nature whatsoever for, but not limited to, injury to or death of any person including, the District, the Engineer, and/or the Contractor, or any of their directors, officers, employees, agents or volunteers, and damages to or destruction of property of any person, including but not limited to, the District, the Engineer and/or the Contractor and any of their directors, officers, employees, agents or volunteers, arising out of or in any manner directly or indirectly connected with the Work to be performed under this Agreement, however caused, regardless of any negligence of the District, its Engineer or any of their directors, officers, employees, agents or volunteers (including passive negligence), except the sole negligence or willful misconduct or active negligence of the District, its Engineer, or any of their directors, officers, employees, agents or volunteers; upon tender by the District, Contractor shall immediately defend, at Contractor's own cost, expense and risk, any and all such claims, suits, actions or other legal proceedings of every kind that may be brought or instituted against District, its directors, officers, agents, employees or volunteers, notwithstanding whether Contractor's liability is or can be established.
 - b. Any and all actions, proceedings, damages, costs, expenses, penalties or liabilities, in law or in equity, of every kind or nature whatsoever, arising out of, resulting from or on account of the violation of any governmental law or regulation, compliance with which is the responsibility of Contractor.
 - Contractor shall defend, at the Contractor's own cost, expense and risk, any and all such aforesaid suits, actions or other legal proceedings of every kind arising out of or connected with the Work that may be brought or instituted against the District, its Engineer or any of their directors, officers, employees, agents or volunteers.

Contractor's obligation to indemnify shall survive the termination or completion of the Work for the full period of time allowed by law and shall not be restricted by the insurance requirements of these Contract Documents or to insurance proceeds, if any, received by the District, or its directors, officers, employees, agents or volunteers.

Contractor's defense and indemnity obligation herein includes, but is not limited to, damages, fines, penalties, attorney's fees and costs arising from claims under the Americans with Disabilities Act (ADA) or other federal or state disability access or discrimination laws arising from Contractor's work during the course of construction of the improvements or after the Work is complete, as the result of defects or negligence in Contractor's construction of the improvements.

Contractor shall pay and satisfy any judgment, award or decree that may be rendered against the District, its Engineer or any of their directors, officers, employees, agents or volunteers, in any such suit, action or other legal proceeding.

Contractor shall reimburse the District, its Engineer or any of their directors, officers, employees, agents and/or volunteers, for any and all legal expenses and costs incurred by each of them in connection therewith or in enforcing the indemnity herein provided.

Contractor agrees to carry insurance for this purpose as set out in the specifications. Contractor's obligation to indemnify shall not be restricted to insurance proceeds, if any, received by the District, its Engineer or any of their directors, officers, employees, agents and/or volunteers.

- c. Any and all liens, claims, demands and costs, including attorney's fees, for labor and material furnished by the Contractor or any of his subcontractors in connection with the performance of this Contract. In the event that the Contractor or any of his subcontractors shall fail to pay for any material or labor used in the performance of this Contract, or any lien is filed against the property on which the Work is being performed, or any claim is asserted or action filed on any Bond, by any person claiming to have furnished labor or materials to the Contractor or any of his subcontractors in connection with the performance of this Contract, the District shall be entitled, at its sole discretion, to pay for said material or labor, or discharge any such lien, or to pay or settle any such claim or action and to deduct the amount so paid, together with any and all costs and attorney's fees incurred by or on behalf of the District in connection with any such payment, discharge, or settlement, from amounts due or to become due the Contractor hereunder. The District may also deduct from any amounts due or to become due to the Contractor, any other amounts owing by the Contractor to the District, including the cost of any materials, labor, services, equipment, or facilities supplied by the District as to which the Contractor has the obligation to supply the same hereunder. In the event that the balance which otherwise would be due the Contractor shall be insufficient to so reimburse the District, the Contractor shall pay the District any deficiency upon demand.
- d. Any and all royalties and license fees. Contractor shall, at his own cost, expense, and risk, defend any and all suits or claims for infringement of any patent rights and shall save the Engineer and the District and its directors, officers, employees, agents and/or volunteers harmless from loss on account thereof; except that the District shall be responsible for all such loss when a particular manufacturer is specified by it, but if the Contractor has information that the process or article specified is or may be an infringement of a patent, Contractor shall be responsible for such loss unless he/she promptly gives such information, in writing, to the Engineer.
- 10. If any provision of this Agreement is found by a court of competent jurisdiction to be invalid, void or unenforceable for any reason, the remaining provisions shall continue in full force and effect without being impaired or invalidated in any way.
- 11. In employing Contractor to perform the Work contemplated under the Contract Documents, the District has relied on the experience, expertise and integrity of the Contractor. The rights and

- obligations of the Contractor under this Agreement shall therefore not be assignable without the prior express written consent of the District.
- 12. This Agreement constitutes the entire Agreement of the parties, and no amendment or modification of its terms is binding except by written amendment approved by the parties.
- 13. This Agreement shall be governed by the laws of the State of California. Venue for all purposes shall be deemed to lie within Los Angeles County, California.

IN WITNESS WHEREOF: The parties hereto have caused this Agreement to be executed as of the day and year first above written.

(DISTRICT SEAL)	Three Valleys Municipal Water District
	By: General Manager/Chief Engineer
(CORPORATE SEAL)	Contractor
	Ву:
	Its:
	(Title)
	Ву:
	lts:(Title)

BID SECURITY FORM

(Check or Cash to Accompany Bid)

Accompanying this Proposal is (check one):		
☐ Cash		
Cashier's check payable to the order of	Three Valleys Municipal Water District ("Owner"))
Certified check payable to the order of T	hree Valleys Municipal Water District ("Owner")	
in the amount of this amount being not less than ten percent (10° referred to as "Bid Security").	(\$	_),
Owner through action of its legally constituted of to execute a contract and furnish the required P insurance coverage, and other information requ within the time set forth in the Contract Docume the undersigned. The Bid Security shall also be	ne Owner provided this Proposal is accepted by to contracting authorities and the undersigned shall the erformance and Payment Bonds, proof of ested and set forth in the Instructions to Bidders ested and set forth in the Instructions to Bidders ents; otherwise, the Bid Security shall be returned become the property of the Owner if the undersigner the date set for bid opening, and notwithstand	fail d to ed
_		
	BIDDFR	

NOTE: IF THE BIDDER DESIRES TO USE A BOND INSTEAD OF CHECK OR CASH, THE BID BOND FORM ON THE FOLLOWING PAGES SHALL BE EXECUTED -- THE SUM OF THIS BOND SHALL BE NOT LESS THAN 10 PERCENT OF THE TOTAL AMOUNT OF THE BID.

Page 1 of 3 Bid Security

NOTE: THE FOLLOWING FORM SHALL BE USED WHERE THE BIDDER DESIRES TO FURNISH A BOND INSTEAD OF CHECK OR CASH.

BID SECURITY FORM BID BOND

KNOW ALL MEN BY THESE PRESENTS:

That we,		, as principa
and		, as surety,
are held and firmly bound unto	o Three Valleys Municipal Water District (hereinafter "C)wner,") in the
sum of \$	_, to be paid to the Owner, its successors, and assigns	s, for which
payment, well and truly to be	made, we bind ourselves, our heirs, executors, adminis	strators,
successors and assigns, joint	ly and severally, firmly by these presents.	
THE CONDITION OF	THIS OBLIGATION IS SUCH that if the certain Propos	sal of the
above Principal for construction	on of the MIRAGRAND WELL EQUIPPING PROJECT	as specifically
set forth in documents entitled	I THREE VALLEYS MUNICIPAL WATER DISTRICT M	<u> 1IRAGRAND</u>
WELL EQUIPPING PROJEC	T NO. 58463.	

all in accordance with the Contract Documents, including specifications and drawings on file at the offices of the Owner, is not withdrawn within the period of **45** days after the date set for the opening of bids or as otherwise provided in the Special Provisions, notwithstanding the award of the contract to another bidder, and that if said Proposal is accepted by the Owner through action of its legally constituted contracting authorities and if the above bound principal, its heirs, executors, administrators, successors and assigns, shall duly enter into and execute a contract for such construction and shall execute and deliver the required Performance and Payment Bonds and proof of insurance coverage within twelve (**12**) days (not including Sundays and holidays) after the date of notification by and from said Owner, then this obligation shall become null and void, otherwise it shall be and remain in full force and effect.

Page 2 of 3 Bid Security

IN WITNESS WHEREOF, we hereunto set our h	hands and seals this	day of
, 20		
	(SEAL)	
(Principal)		
By	(SEAL)	
(Surety)	(OL)	
By		

- (1) This bid bond form is a mandatory form.
 (2) The bid bond form should specify an exact number of dollars which shall not be less than ten percent
- (10%) of the total amount of the bid.
 (3) The bid bond form must be acknowledged before notary publics, and a legally sufficient power of attorney must be attached to the bid bond to verify the authority of the party signing on behalf of the surety.

FAITHFUL PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS:
That we,,
hereinafter referred to as "Contractor," as principal, and
, as surety, are held and firmly bound unto Three Valleys Municipal Water District, hereinafter referred to as "District," in the sum of
\$
The condition of the foregoing obligation is such that,
WHEREAS, said Contractor has been awarded and is about to enter into a contract with
District for construction of <u>VERTICAL TURBINE PUMP</u> , <u>MOTOR</u> , <u>DISCHARGE PIPING</u> , <u>RELATED VALVES</u> , <u>WELL ENCLOSURE STRUCTURE</u> , <u>SCADA INTEGRATION</u> , <u>AND ELECTRICAL WORK</u> .
as specifically set forth in documents entitled MIRAGRAND WELL EQUIPPING PROJECT NO. 58463.
is required under the terms of the Contract Documents to give this bond in connection with the execution of said contract:

NOW THEREFORE, if said Contractor shall well and truly do and perform all of the covenants and obligations of said contract on its part to be done and performed at the times and in the manner specified herein, then this obligation shall be null and void, otherwise it shall be and remain in full force and effect;

PROVIDED, that any alterations in the work to be done, or the material to be furnished, which may be made pursuant to the terms of said contract, shall not in any way release either the Contractor or the surety thereunder, nor shall any extensions of time granted under the provisions of said contract release either the Contractor or the surety, and notice of such alterations or extensions of the contract is hereby waived by the surety.

FURTHER PROVIDED, that upon termination, if the direct and indirect costs of completing the Work, including, but not limited to, all costs to District arising from professional services and attorneys' fees and all costs generated to insure or bond the work of substituted contractors or subcontractors utilized to complete the Work, exceed the balance due the Contractor, on failure of Contractor to pay, the Surety shall pay on demand by District. Any portion of such difference not

paid by Surety within thirty (30) days following the mailing of a demand for such costs by District shall earn interest at the rate of ten percent (10%) per annum or the maximum rate authorized by California law, whichever is lower.

If any action is brought upon this bond by said District and judgment is recovered (or settlement is made which is favorable to District), then said surety shall pay all costs incurred by said District in such action, including a reasonable attorney's fee.

day of	IN WITNESS WHEREOF, WE have, 20	e hereunto set our hands and seals t	his
Contrac	ctor:	Surety:	
By:		Ву:	
Title:		Title:	
By:		Home Office	
Title:			
		Phone:	
		Atty-in-Fact:	
		Address:	
	(Seal)	Phone:	

NOTE: This bond must be acknowledged before a Notary Public, and a legally sufficient power of attorney must be attached to the bond to verify the authority of any party signing on behalf of a surety

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS:

That we,		
ereinafter referred to as "Contractor," as principal, and		
Valleys Municipal Water District	, as surety, are held and firmly bound unto Three t, hereinafter referred to as "District," in the sum of	
	, lawful money of the United States of America, for the payment of	
which sum (100% of the total C	ontract amount payable by the District under the terms of the	
	nade, we bind ourselves, our heirs, executors, administrators, ntly and severally, firmly by these presents.	

The condition of the foregoing obligation is such that,

WHEREAS, said Contractor has been awarded and is about to enter into a contract with

District for construction of <u>VERTICAL TURBINE PUMP</u>, <u>MOTOR</u>, <u>DISCHARGE PIPING</u>, <u>RELATED VALVES</u>, <u>WELL ENCLOSURE STRUCTURE</u>, <u>SCADA INTEGRATION</u>, <u>AND ELECTRICAL WORK</u>. as specifically set forth in documents entitled <u>MIRAGRAND WELL</u> EQUIPPING PROJECT NO. 58463.

and is required under the terms of the Contract Documents to give this bond in connection with the execution of said contract:

NOW, THEREFORE, if Contractor or any of its subcontractors, fails to pay for any materials, equipment, or other supplies, or for rental of same used in connection with the performance of work contracted to be done or for work or labor thereon of any kind, or fails to pay any of the persons named in Section 9100, California Civil Code or amounts due under the Unemployment Insurance Code with respect to work or labor performed by any such claimant or for any amounts required to be deducted, withheld and paid to the Employment Development Department from the wages of employees of the Contractor and its subcontractors pursuant to Section 13020 of the Unemployment Insurance Code with respect to such work and labor and all other applicable laws of the state of California and rules and regulations of its agencies, then said Surety will pay for the same in an amount not exceeding the sum specified above. This bond shall inure to the benefit of any persons named in Civil Code Section 9100, so as to give a right of action to them or their assigns in any suit brought upon this bond. This bond shall be subject to and include all of the provisions of Titles 1 and 3, applicable, of Part 6 of Division 4 of the Civil Code of the State of California relating to Payment Bond for Public Works, including but not limited to Civil Code Sections 8152 and 8154 and 9550-9560, inclusive.

Page 1 of 2 Payment Bond

PROVIDED, that any alterations in the work to be done, or the material to be furnished, which may be made pursuant to the terms of said contract, shall not in any way release either the Contractor or the surety thereunder, nor shall any extensions of time granted under the provisions of said contract release either the Contractor or the surety, and notice of such alteration or extensions of the contract is hereby waived by the surety.

IN WITNESS WHEREOF, WE have hereunto set our hands and seals this day of, 20			
Contractor:		Surety:	
Ву:		By:	
Title:		Title:	
Ву:		Home Office Address:	
Title:			
		Phone:	
		Atty-in-Fact:	
		Address:	
	(Seal)	Phone:	

NOTE: This bond must be acknowledged before a Notary Public, and a legally sufficient power of attorney must be attached to the bond to verify the authority of any party signing on behalf of a surety



To:

1021 E. Miramar Avenue Claremont, California 91711 Phone: 909.621.5568

FAX: 909.625.5470

NOTICE TO PROCEED

FROM:	Matthew H. Litchfield, P.E. General Manager/Chief Engineer Three Valleys MWD
PROJECT	MIRAGRAND WELL EQUIPPING IMPROVEMENTS PROJECT NO. 58463
	ereby given that you are authorized and directed to proceed with the above- project in accordance with the associated Contract Documents.
	nents checked off below have been received and are on file with the Three unicipal Water District:
	Executed Contract
	Faithful Performance Bond (100%)
	Payment Bond (100%)
	Worker's Compensation Insurance Certificate
	Liability Insurance Policy or Certificate w/ Endorsements
	Non-Collusion Affidavits (Sub-contractors)
	Financial Statements for last two years
after the da	terms of the Contract Documents, work is to start within ten (10) work days ate set forth below and is to be completed within the time set forth in the locuments and/or Special Provisions.
DATE:	By:
	Matthew H. Litchfield, P. E. General Manager/Chief Engineer Three Valleys MWD

SECTION C GENERAL PROVISIONS

C-1 DEFINITIONS

The following terms, as used in any of the Contract Documents, are respectively defined as follows:

- a. "Contract Documents" The Notice Inviting Bids, the Instructions to Bidders, the accepted Proposal and Proposal Bidding Schedule, the Information Required of Bidders, the Agreement, the Proposal Bond, the Faithful Performance Bond, the Non-Collusion Affidavits, the Notice to Proceed, the Specifications and Drawings, and any change order or Addenda setting forth any modifications or interpretations of any of said Documents.
- b. "Contract" The Contract Documents executed by the authorized officers of the District and the Contractor.
- c. "District" or "TVMWD" The Three Valleys Municipal Water District with principal offices in Los Angeles County, California.
- d. "Board of Directors" or "Board" The Board of Directors of the District.
- e. "Engineer" Unless otherwise stated, **Civiltec Engineering**, acting either directly or through a properly authorized representative.
- f. "Contractor" The bidder who submitted the accepted Proposal and who executed an Agreement to furnish articles or materials in accordance with these Specifications, and the legal representatives of said party.
- g. "District's Construction Contractor" The individual or company contracted, by the District, to furnish, transport and install materials supplied under this Contract.
- h. Whenever in the Specifications or upon the Drawings the words DIRECTED, REQUIRED, PERMITTED, ORDERED, DESIGNATED, PRESCRIBED, or words of like import are used, it shall be understood that the direction, requirement, permission, order, designation or prescription of the Engineer is intended, and similarly the words APPROVED, ACCEPTABLE, SATISFACTORY, or words of like import, shall mean approved by, acceptable to, or satisfactory to the Engineer, unless otherwise expressly stated.
- i. "AASHTO" The American Association of State Highway and Transportation Officials.
- j. "ACI" The American Concrete Institute.
- k. "AISC" The American Institute of Steel Construction.
- I. "AISI" The American Iron and Steel Institute.
- m. "ASME" The American Society of Mechanical Engineers.
- n. "ASTM" The American Society for Testing and Materials.

- o. "AWS" The American Welding Society.
- p. "AWWA" The American Water Works Association.
- q. "IEEE" (formerly AIEE) The Institute of Electrical and Electronics Engineers.
- r. "IPCEA" The Insulated Power Cable Engineers Association.
- s. "NEMA" The National Electrical Manufacturers Association.
- t. "SSPC" The Steel Structures Painting Council.
- u. "USAS" (formerly ASA) The United States of America Standard(s) Institute.
- v. "State", "DWR" Respectively, the State of California and the State Department of Water Resources.
- w. "State Standard Specifications" Standard Specifications issued by the State of California, Department of Transportation, latest edition.
- x. "County" County of Los Angeles, California.
- y. The figures given in the Specifications or upon the Drawings after the word ELEVATION, or an abbreviation of it, shall mean distances in feet above U.S. Coast and Geodetic Survey sea level datum, as established by the Engineer.

C-2 CORRELATION AND INTENT OF DOCUMENTS

The Contract Documents are complementary, and what is called for in any one shall be as binding as if called for in all. The intention of the Contract Documents is to require a complete and finished piece of Work including all labor, materials, equipment, facilities, and transportation necessary for the proper execution of the Work, with the exception of such items as are definitely stated in the Specifications or on the Drawings to be furnished by the District. Should there be a conflict between the Specifications and the Drawings, the Specifications shall be controlling.

C-3 ASSIGNMENT

Neither party to the Contract shall assign the Contract nor sublet it as a whole without the prior written consent of the other, nor shall the Contractor assign any money due or to become due to him hereunder without prior written consent of the Engineer.

C-4 SUBCONTRACTS

- a. The attention of the Contractor is directed to the provisions of Public Contract Code, Section 4100 et seq. as amended, and said provisions are by this reference incorporated herein and made a part hereof.
- b. Each subcontract shall contain a suitable provision for the suspension or termination thereof should the Work be suspended or terminated or should the subcontractor neglect or fail to conform to every provision of the Contract Documents insofar as such provisions are relevant. The Contractor shall be as fully responsible to the District for the acts or omissions of his subcontractors and of the persons either directly or indirectly employed by them as he is for the acts or omissions of persons directly employed by Contractor. Nothing contained in the Contract Documents shall create any contractual relation between any subcontractor and the District. If a legal action against the District is initiated by a

subcontractor, the Contractor shall reimburse the District for the amount of legal expenses incurred by the District in defending itself in said action.

C-5 SUSPENSION OF WORK — DAMAGES FOR DELAY

- a. The Engineer may at any time, by notice in writing to the Contractor, suspend any part of the Work for such period of time as may be necessary to prevent improper execution of the Work on the project, and the Contractor shall have no claim for damages or additional compensation on account of any such suspension.
- b. The District may at any time suspend any part or all of the Work upon ten (10) work days' written notice to the Contractor, who shall thereupon discontinue all Work suspended except for all operations to prevent loss or damage to Work already executed as may be directed by the Engineer. The Contractor shall be paid on the same basis as Extra work for costs of work performed in accordance with such orders of the Engineer during such suspension, provided that this shall not include any costs pertaining to Work not suspended by said notice. Work shall be resumed by Contractor after such suspension on ten (10) work days' written notice from the District. In the event of suspension of the entire Work by the District, the Contractor shall be paid the sum of one-hundred fifty dollars (\$150.00) for each calendar day during which the entire Work shall have been suspended. Said sum is hereby mutually agreed upon as fixed and liquidated damages in full settlement of all costs and expenses, losses and damages resulting to the Contractor from such suspension.
- c. In the event of any suspension of the Work in whole or in part, the Contractor shall be entitled to an extension of time to complete the Work to the extent of the delay caused by the Contractor.

C-6 TIME OF WORK — TERMINATION FOR DELAY — TIME EXTENSIONS

- The Contractor shall at all times employ such force, plant, materials, and tools as a. will be sufficient, in the opinion of the Engineer, to prosecute the Work at not less than the rates fixed under the terms of the Contract and to complete the Work or any separable portions thereof within the time limits fixed therein. If the Contractor refuses or fails to prosecute the Work, or any separable part thereof, with such diligence as will insure its completion within the time specified in the Contract, or any extension thereof, or fails to complete said Work within such time, the District may, by written notice to the Contractor, terminate Contractor's right to proceed with the Work or such part of the Work as to which there has been delay. In such event, the District may take over the Work and prosecute the same to completion, by contract or otherwise, and may take possession of and utilize in completing the Work such materials, appliances, equipment, and plant as may be on the site of the Work and necessary therefor. Whether or not the Contractor's right to proceed with the Work is terminated, he and his sureties shall be liable for all damages, including attorney's fees, sustained or incurred by the District by reason of such default and in enforcing the provisions hereof against the Contractor.
- b. The Contractor's right to proceed shall not be so terminated nor the Contractor charged with resulting damage if:

- The delay in the completion of the Work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor, including but not restricted to Acts of God (herein to include only the following occurrences or conditions and effect: earthquakes in excess of a magnitude of 3.5 on the Richter Scale and tidal waves), acts of the public enemy, acts of the District in either its governmental or contractual capacity, acts of another Contractor in the performance of a contract with the District, fires, floods, (excluding site flooding due to groundwater), epidemics, quarantine restrictions, strikes, lockouts, freight embargoes, unusually severe weather, or delays of subcontractors or suppliers arising from unforeseeable causes beyond the control and without the fault or negligence of either the Contractor or such subcontractors and suppliers; and
- 2. The Contractor, within ten (10) work days from the beginning of any such delay (unless the Engineer grants a further period of time before the date of final payment under the Contract), notifies the Engineer in writing of the causes of delay and requests an extension of time. The Engineer shall ascertain the facts and the extent of the delay and extend the time for completing the Work when, in Contractor's judgment, the findings of fact justify such an extension, and his findings of fact shall be final and conclusive on the parties.
- c. The rights and remedies of the District provided in this clause are in addition to any other rights and remedies provided by law or under this contract.
- d. A request for an extension of time, or the granting of an extension of time, shall not constitute a basis for any claim against the District for additional compensation. The Contractor shall be deemed to have waived any claim for additional compensation and does hereby so waive any such claim.
- e. Contract time extensions will be granted as provided in this paragraph; however, the Contractor is advised that weather-related time extensions will be granted only if conditions are such that it is impossible to perform any productive Work. The Contractor shall make every effort to protect the Work from adverse weather and shall minimize delays and time extensions by taking mitigative measures such as pumping of surface water, utilizing equipment best suited for adverse weather, etc.

C-7 TERMINATION FOR REASONS OTHER THAN DELAY

a. If the Contractor should be adjudged bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed for the Contractor on account of his insolvency and not be discharged within ten (10) work days after his appointment, or if the Contractor should fail to make prompt payment to subcontractors or for material or labor, or should persistently disregard laws, ordinances, or the instructions of the Engineer, or otherwise be guilty of a substantial violation of any provisions of the Contract, then the District, upon the certification of the Engineer that sufficient cause exists to justify such action, may without prejudice to any other right or remedy, and after giving the Contractor ten (10) work days written notice, terminate the employment of the Contractor and take possession of the premises and of all equipment, materials,

tools and other facilities thereon and finish the Work by whatever method the District may deem expedient. In such case, the Contractor shall not be entitled to receive any further payment until the Work is finished. If, upon completion of the Work, the total cost to the District, including attorney's fees, in connection therewith shall be less than the amount which would have been paid if the Work had been completed by the Contractor in accordance with the terms of the Contract, then said difference shall be paid to the Contractor in the same manner as the final payment under the Contract. If the expense, including attorney's fees, incurred by the District on account of termination of employment of the Contractor and subsequent completion of the Work by the District by whatever method the District may deem expedient shall exceed said amount which the Contractor would otherwise have been paid, the Contractor and his sureties shall be liable to the District for the full amount of such excess expense.

In addition to its rights under Paragraph C-7, Subsection (a) hereof, if at any time b. before completion of the Work under the Contract it shall be determined by the District that reasons beyond the control of the parties hereto render it impossible or against the interests of the District to complete the Work, or if the Work shall be stopped by an injunction of a court of competent jurisdiction or by order of any competent authority, the District may, upon ten (10) work days written notice to the Contractor, discontinue the Work and terminate the Contract. Upon service of such notice of termination, the Contractor shall discontinue the Work in such manner, sequence, and at such times as the Engineer may direct, continuing and doing after said notice only such Work until such time or times as the Engineer may direct. The Contractor shall have no claim for damages for such discontinuance or termination, nor any claim for anticipated profits on the Work thus dispensed with, nor any other claim except (1) for the Work actually performed up to the time of complete discontinuance, including any Extra Work ordered by the Engineer to be done, and (2) for any liquidated damages due hereunder in accordance with the provisions relating to Suspension of Work.

C-8 AUTHORITY OF THE ENGINEER

The Engineer shall give all orders, lines, grades, and directions contemplated under the Contract. The Engineer may determine the adequacy of the Contractor's methods, tools, plant, equipment, and appurtenances, and he shall determine in all cases the quantity, quality, acceptability, and fitness of the several kinds of Work and materials which are to be paid for. The Engineer shall have the authority to determine all questions in relation to said Work and the construction thereof and decide in all cases questions which may arise relative to the fulfillment of this Contract on the part of the Contractor. The Engineer shall also have the authority to reject all Work and materials which do not conform to the Contract and to stop the Work when necessary to prevent its improper execution. Should any discrepancy appear or any misunderstanding arise as to the import of anything contained in the Specifications or Drawings, the matter shall be referred to the Engineer, who shall decide the same in accordance with the true intent and meaning. Any differences or conflicts which may arise between the Contractor and other contractors of the District in regard to their work will be adjusted and determined by the Engineer. All instructions, rulings, and decisions of the Engineer shall be made promptly and in writing, if so requested, and they shall be final and binding.

- b. If at any time the Contractor's work force, tools, plant, or equipment appear to the Engineer to be insufficient, inefficient, or inappropriate to secure the required quality of work or the proper rate of progress, the Engineer may order the Contractor to increase their efficiency, improve their character, to augment their number, or to substitute other personnel, new tools, plant, or equipment, as the case may be, and the Contractor shall comply with such order.
- c. The undertaking of inspections by the Engineer or the giving of instructions as herein authorized shall not be construed as supervision of the actual construction or make the Engineer or the District responsible for providing a safe place for the performance of Work by the Contractor, subcontractor, or suppliers or for access, visits, use, work, travel, or occupancy by any person.

C-9 CHANGES

- a. If the Engineer finds it impracticable to comply strictly with these Specifications, he may prescribe a modification of requirements or of methods of work; for such purposes, the Engineer may at any time during the life of the Contract, by written order, make such changes as he shall find necessary in the design, line, grade, form, locations, plan, or material of any part of the Work or equipment hereinafter specified, or in the quantity or character of the Work or equipment to be furnished. If such changes increase or diminish the quantity or amount of the Work to be done, they shall not constitute the basis for a claim for damages or anticipated profits on the Work that may be dispensed with; provided, that if such changes or alterations render useless any work already done or materials already furnished or used in the Work, the Engineer will make reasonable allowance therefor, which action shall be binding upon both parties.
- b. In the event a change is ordered, the total amount of Work actually done or materials or equipment furnished shall be paid for according to the unit price established for such Work under the Contract. If such unit price has not been established in the Contract, then the cost of such changes shall be determined as hereinafter provided with respect to extra work.
- c. The consent of the Contractor's sureties shall not be required for any change or extra work, and the liability under the Contractor's bonds shall be increased or decreased accordingly, without notice to the sureties.

C-10 EXTRA WORK

If, during the performance of the Contract, it shall, in the opinion of the Engineer, become necessary or desirable for the proper completion of the Contract to order work done or materials or equipment furnished which, in the opinion of the Engineer, are not susceptible to classification under the unit price items named in the Bidding Schedule and are not included in any item for which a lump sum is bid, the Contractor shall do and perform such work and furnish such materials and equipment. Such labor, materials, and/or equipment will be classed as Extra Work and shall be ordered in writing before such work is started. No extra work will be paid for unless ordered in writing. Extra work and material will ordinarily be paid for at a lump sum or unit price agreed on in writing by the Engineer and the Contractor prior to the time when the Engineer ordered the extra work to be done. The performance of any extra work or the furnishing of any extra material which, in the judgment of the Engineer, is of like character to and susceptible to

classification under the unit price items of the Contract as specified shall, if the order of the Engineer shall so provide, be paid for at the unit price named for such Work in the Bidding Schedule. Whenever, in the judgment of the Engineer, such extra work or such extra material, as the case may be, is not of like character to and susceptible to classification under the unit price items of the Contract as specified, and it is impracticable because of the nature of the Work, or for any other reason, to fix the price before order for the extra work shall be issued, the Contractor shall be entitled to the sum of the following costs of doing the extra work:

- a. Direct Labor Costs Charges for cost of all of the labor furnished and used by the Contractor shall be made for manual classifications up to and including general foreman. It will not include charges for Assistant Superintendents, Superintendents, Office Personnel, Timekeepers and Maintenance Mechanics. The time charges to extra work shall be subject to the daily approval of the Engineer and evidence of such daily approval shall be submitted with the billing. Labor rates used to calculate the costs shall be those basic wages including current employer contributions for fringe benefits and including applicable subsistence and travel allowances, all as actually paid to workers under collective bargaining agreements, or as a regular practice of the employer. No time or charges will be allowed except when the workers are actually engaged in the proper, efficient, and diligent performance or completion of the extra work as authorized. Overtime shall not be worked without prior approval by the Engineer.
- b. Equipment Costs Charges for the rental and operation of the equipment furnished and used by the Contractor shall be made for all prime construction and automotive equipment. It shall not include charges for listed equipment or major tools with a new cost of five-hundred dollars (\$500) or less. Equipment time charges shall be subject to the daily approval of the Engineer and evidence of such daily approval submitted with the billing. The equipment rental and operation rates used shall be those agreed upon by the Engineer and Contractor prior to commencement of the extra work and shall include an approved allowance for depreciation. No time or charges will be allowed except when equipment is actually being used for the proper and efficient performance or completion of the extra work as authorized.
- c. Material Costs Charges for the cost of materials furnished by the Contractor shall be made, providing such furnishing was specifically authorized in the extra work order and the actual use verified by the Engineer. Charges shall be net cost to the Contractor delivered at the job, including all applicable sales taxes, and vendor's invoice must accompany the billing along with verification of use of such materials by the Engineer.
- d. Tools, Supplies, Overhead, Supervision, and Profit A charge for major tools, supplies, overhead, supervision and profit will be allowed for the following items, as defined above, in the following amounts: twenty percent (20%) for direct labor costs, fifteen percent (15%) for equipment costs, and fifteen percent (15%) for material costs. These markups shall apply only to the Contractor or subcontractor which actually performs the extra work. If a subcontractor performs the extra work, the Contractor may mark up the subcontractor's costs by five percent (5%). Only a single five percent markup will be allowed on the subcontractor's work, regardless of the number of subcontractors between the subcontractor which actually performs the work and the Contractor.

C-11 RIGHT-OF-WAY—CONSTRUCTION ROADS

- a. The right of way for the Work to be constructed under these Specifications will be provided by the District. Nothing herein contained, however, and nothing marked on the Drawings, shall be interpreted as giving the Contractor exclusive occupancy of the territory provided. When two or more contracts are being executed at one time on the same or adjacent land in such a manner that work on one contract may interfere with that on another, the Engineer shall decide which contractor shall cease Work, and which shall continue, or whether the work on both contracts shall progress at the same time, and in what manner. When the territory of one contract is the necessary or convenient means of access for the execution of another contract, such privilege of access or any other reasonable privilege may be granted by the Engineer to the Contractor so desiring, to the extent, amount, in the manner, and at the time permitted. No such decision as to the method or time of conducting the Work or the use of territory shall be the basis of any claim for delay or damage.
- b. Lands to be furnished by the District for construction operations will be specifically shown on the Drawings or provided for in the Special Conditions. Should the Contractor find it necessary to use additional land for his purposes during the construction of the Work, he shall provide for the use of such lands at his own expense. A copy of each written agreement between the Contractor and affected landholder(s) for the use of additional lands shall be filed with the Engineer prior to the use of land.
- c. The Contractor shall construct and maintain all roads necessary to reach the various parts of the Work and for the transportation thereto of construction material and personnel. The cost of constructing and maintaining such roads shall be borne by the Contractor.

C-12 NOTICE AND SERVICE THEREOF

Any notice required or given under the contract shall be in writing, be dated, be signed by the party giving such notice or his duly authorized representative, and be served as follows:

- a. If to the District, by personal delivery or by deposit in the United States mail;
- b. If to the Contractor, by personal delivery to the Contractor or to his authorized representative at the site of the project or by deposit in the United States mail;
- c. If to the surety or any other person, by personal delivery to said surety or other person or by deposit in the United States mail;
- d. All mailed notices shall be in sealed envelopes, shall be sent by certified mail with postage prepaid, and shall be addressed to the addresses in the Contract Documents or such substitute addresses which a party designates in writing and serves as set forth herein; and,
- e. Any notice served in accordance with this Section C-12, shall be deemed received by the addressee seventy-two (72) hours after deposited, postage prepaid, in the United States mail.

Nothing herein contained shall be deemed to preclude or render inoperative the service of any notice, letter, or other communication upon the Contractor personally.

C-13 Personal Attention

The Contractor shall give his personal attention constantly to the faithful prosecution of the Work, and shall be present, either in person or by duly authorized and competent representative, on the site of the Work continually during its progress to receive directions or instructions from the Engineer. Whenever the Contractor is not present on any part of the Work, and where it may be desired to give instructions or directions, they may be given by the Engineer and they shall be received and obeyed by the superintendent or foreman who may have charge of the particular part of the Work in reference to which said instructions or directions are given.

C-14 CONSTRUCTION PROGRAM

To insure completion of the Work within the time limit specified and to assist the District in the scheduling of other work, Contractor shall submit to the Engineer upon receipt of the Notice to Proceed, a detailed schedule showing the proposed dates of beginning and completion of all significant items of Work. If the actual progress of the Work varies materially from the proposed program or if the Contractor proposes to change the program for any reason, he shall submit to the Engineer the revised construction program which he proposes to follow. The proposed original and revised programs shall be adequate, in the opinion of the Engineer, to meet the requirements for completion of the Work as herein set forth. If, in the opinion of the Engineer, the Contractor's proposed program or the actual progress of the Work is insufficient to meet the specified requirements, Contractor shall take such steps as are necessary to accomplish the required progress and completion.

C-15 SURVEY REQUIREMENTS

The District will furnish all land surveys and will furnish information from basic surveys and monumented property corners necessary for locating the principal component parts of Contract Work. In addition, the District will establish and furnish bench marks through the Contract Work area. From the above information provided by the District, the Contractor shall develop and make all detail surveys needed for construction such as slope stakes, batter boards, stakes for pipe locations and all other working points, lines and elevations as required for Contract construction. The Contractor shall carefully preserve bench marks, reference points and stakes and, in case of willful or careless destruction, he shall be charged with the resulting expense and shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance. Contractor shall compile and maintain all survey notes in an approved form and shall furnish to the Engineer one copy of said notes as they are compiled and, upon completion of Contract Work, Contractor shall furnish to the Engineer all original survey notes.

C-16 SPECIFICATIONS AND DRAWINGS

Drawings furnished herewith are for bidding purposes. The Engineer will furnish the Contractor, free of charge, all electronic copies of working Drawings and Specifications reasonably necessary for the execution of the Work. The Contractor shall have no claim for excusable delay on account of the failure of the Engineer to deliver necessary Drawings or Specifications unless the Engineer shall have failed to deliver the same within two (2) weeks after receipt of written demand therefor from the Contractor. The Contractor shall keep one (1) hard copy of all current Drawings and Specifications relating to the Work, in good order, accurately marked with RED-LINES all changes

made in the field, available to the Engineer and his representatives convenient to the working site. If the Contractor, in the course of the Work, finds any discrepancy between the Drawings and the physical condition of the locality, or any errors or omissions in the drawings, or in the layout as given by points and instructions, it shall be his duty to inform the Engineer in writing, and the Engineer will promptly verify the same. Any work done after such discovery, until authorized, will be done at the Contractor's risk. All Drawings, Specifications, and copies thereof furnished by the Engineer shall not be reused on other work and, with the exception of the signed Contract sets, are to be returned to him, on request, at the completion of the Work.

C-17 INSPECTION OF WORK

- a. The Engineer and his representatives shall at all times have access to the Work wherever it is in preparation or progress, and the Contractor shall provide safe and convenient facilities for such access and for inspection. If the Specifications, the Engineer's instructions, laws, ordinances, or any public authority require any material, equipment or work to be specially tested or approved, the Contractor shall give the Engineer timely notice of its readiness for inspection, and if the inspection is by an authority other than the Engineer, of the time fixed for inspection. Inspections by the Engineer will be made promptly and, where practicable, at the source of supply.
- b. Work performed without inspection may be required to be removed and replaced under proper inspection and the entire cost of removal and replacing, including the cost of District-furnished materials used in the Work, shall be borne by the Contractor, regardless of whether or not the Work exposed is found to be defective. Examination of questioned Work may be ordered by the Engineer and, if so ordered, the Work must be uncovered by Contractor. If such Work is found to be in accordance with the Contract Documents, the District will pay the cost of reexamination and replacement. If such Work is found to be not in accordance with the Contract Documents, Contractor shall pay such cost, unless he shall show that the defect in the Work was caused by another contractor, and in that event the District will assume responsibility for such costs.
- c. The inspection of the Work shall not relieve the Contractor of his obligation to fulfill the Contract as herein prescribed, or in any way alter the standard of performance provided by Contractor, and defective work shall be made good and unusable materials may be rejected, notwithstanding that such work and materials have been previously overlooked by the Engineer and accepted or estimated for payment. If the Work or any part thereof shall be found defective, Contractor shall, within ten (10) work days, make good such defect in a manner satisfactory to the Engineer. If the Contractor shall fail or neglect to make ordered repairs of defective work or to remove the condemned materials from the Work within ten (10) work days after direction by the Engineer in writing, the District may make the ordered repairs, or remove the condemned materials, and deduct the cost thereof from any moneys due the Contractor.
- d. The Contractor shall furnish promptly, without additional charge, all facilities, labor and materials reasonably needed by the Engineer for performing all inspection and tests. Contractor shall be charged with any additional cost of inspection when material and workmanship are not ready at the time specified by the Contractor for its inspection.

C-18 CONDITIONS AFFECTING WORK

The Contractor shall be responsible for ascertaining the nature and location of the Work, and the general and local conditions which can affect the Work or the cost thereof. Any failure by the Contractor to do so will not relieve him from responsibility for successfully performing the Work without additional expense to the District. Except as expressly provided to the contrary in the Contract, the Contractor assumes all risk with respect to unforeseen difficulties which may be encountered in performance of the Work, including without limiting the generality of the foregoing, obstacles, obstructions or adverse ground water conditions in or along the line of Work and variance of the quality or quantity of surface and subsurface materials from that which was assumed.

C-19 COMPLIANCE WITH LAWS — PERMITS — TAXES

The Contractor is an independent contractor and shall, at his sole cost and expense, comply with all laws, rules, ordinances, and regulations of all governing bodies having jurisdiction over the Work, obtain all necessary permits and licenses therefor, pay all manufacturers' taxes, sales taxes, use taxes, processing taxes, and all Federal and State taxes, insurance and contributions for Social Security and Unemployment which are measured by wages, salaries, or any remuneration paid to the Contractor's employees, whether levied under existing or subsequently enacted laws, rules, or regulations. The Contractor shall also pay all property tax assessments on materials or equipment used until acceptance by the District. Without limitation, materials furnished and performance by the Contractor hereunder shall comply with rules and regulations established by Cal-OSHA.

The Contractor, upon request, shall furnish evidence satisfactory to the Engineer and/or to the District that any or all of the foregoing obligations have been or are being fulfilled. The Contractor warrants to the District that he is licensed by all applicable governmental bodies to perform this Contract and will remain so licensed throughout the progress of the Work, and that he has, and will have, throughout the progress of the Work, the necessary experience, skill, and financial resources to enable him to perform this Contract.

C-20 INDEMNIFICATION

- a. The Contractor shall assume the defense of and indemnify and save harmless the District and the Engineer and their respective officers, servants and agents from any and all loss, damage, liability, claims or causes of action of every nature whatsoever for damage to or destruction of property, including the District's property, or for injury to or death of persons, including Contractor's employees, in any manner, including that alleged to have been caused by the negligence of the indemnitees or any of them, arising out of or incident to the performance of this Contract; provided, however, that the Contractor shall have no such obligation with respect to such of the foregoing as are actually caused by the sole negligence or willful misconduct of the indemnitees or any of them; and provided further, that the Contractor shall not be liable for damages resulting solely from error or omission in design which were not due to or contributed to by negligence or fault of the Contractor, his subcontractors, agents or employees.
- b. The Contractor shall at all times preserve and protect the Work installed and performed hereunder, and assume full responsibility for the condition thereof until

final acceptance by the District. The Contractor shall be liable for any loss or damage to any Work in place and to any materials on the job site which may be caused by the Contractor, his employees, agents or guests. Any such damage shall be immediately repaired by the Contractor, and, upon failure to do so, the District may remedy the same and deduct the cost thereof from any amount due or to become due the Contractor.

- The Contractor shall assume the defense of and indemnify and save harmless C. the District and the real property upon which the Work called for by this Contract is being performed, against any and all liens, claims, demands and costs, including attorney's fees, for labor and material furnished to the Contractor or any of his subcontractors in connection with the performance of this Contract. In the event that the Contractor or any of his subcontractors shall fail to pay for any material or labor used in the performance of this Contract, or any lien is filed against the said property, or any claim is asserted or action filed on any Bond, by any person claiming to have furnished labor or materials to the Contractor or any of his subcontractors in connection with the performance of this Contract, the District shall be entitled, at its option, to pay for said material or labor, or discharge any such lien, or to pay or settle any such claim or action and to deduct the amount so paid, together with any and all costs and attorney's fees incurred by or on behalf of the District in connection with any such payment. discharge, or settlement, from amounts due or to become due the Contractor hereunder. The District may also deduct from any amounts due or to become due to the Contractor, any other amounts owing by the Contractor to the District, including the cost of any materials, labor, services, equipment or facilities supplied by the District as to which the Contractor has the obligation to supply the same hereunder. In the event that the balance which otherwise would be due the Contractor shall be insufficient to so reimburse the District, the Contractor shall pay the District any deficiency upon demand.
- d. The Contractor shall pay all royalties and license fees. He shall, at his own cost, expense and risk, defend any and all suits or claims for infringement of any patent rights and shall save the Engineer and the District and its Directors, officers and agents harmless from loss on account thereof; except that the District shall be responsible for all such loss when a particular manufacturer is specified by it, but if the Contractor has information that the process or article specified is or may be an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information, in writing, to the Engineer.

C-21 PROTECTION OF WORK SITE, EXISTING STRUCTURES, ROADWAYS, UTILITIES, VEGETATION AND PRIVATE PROPERTY

- a. The Contractor shall effectively secure and protect adjacent property and structures, livestock, crops and other vegetation.
- b. The Contractor shall open fences on or crossing the right of way and install temporary gates of sound construction thereon so as to prevent the escape of livestock. Adjacent fence posts shall be adequately braced to prevent the sagging or slackening of the wire. Before such fences are opened, the Contractor shall notify the owner or tenant of the property and, where practicable, the opening of the fences shall be in accordance with the wishes of said owner or tenant. The Contractor shall be responsible that no loss or inconvenience shall

accrue to the owner or tenant by virtue of his fences having been opened or the gate not having been either shut or attended at all times. Where special types of fences are encountered, the Contractor shall install temporary gates made of similar materials and of suitable quality to serve the purposes of the original fences. In all cases where the Contractor removes fences to obtain work room, he shall provide and install temporary fencing as required, and on completion of construction shall restore the original fence to the satisfaction of the Engineer. All cost of providing, maintaining and restoring gates and fencing shall be borne by the Contractor.

- c. The Contractor shall use extreme care during construction to prevent damage from dust to crops and adjacent property. The Contractor, at his own expense, shall provide adequate dust control for the right of way and take other preventive measures as directed by the Engineer.
- d. The Contractor shall be responsible for all damage to any property resulting from trespass by the Contractor or his employees in the course of their employment, whether such trespass was committed with or without the consent or knowledge of the Contractor.
- e. The Contractor shall see that the Work site is kept drained and free of all standing water.
- f. The Contractor shall be responsible for any damage caused by drainage or water runoff from construction areas and from construction plant areas.
- g. In the event of an emergency or unusual conditions endangering life, the Work, or adjacent property, the Contractor may, without special instructions or authorization, act at his discretion to prevent or eliminate such danger. Should the Engineer deem an emergency condition to exist, the Contractor shall immediately do those things and take those steps ordered by the Engineer. The decision of the Engineer in this respect shall be final. Any claims for compensation made by the Contractor on account of emergency work shall be determined by agreement.
- h. The Contractor shall be responsible for locating, removal, relocation and protection of all public and private utility facilities, including irrigation facilities in the nature of utilities, located on the site of the construction project and the Contractor shall not be entitled to any extension of time or claim for damages or extra compensation in connection therewith. Provided however, if and to the extent that existing main or trunkline public utility facilities as defined by Government Code Section 4215 ("Public Utility Facilities") are not identified in the Contract Documents, as between the Contractor and the District, the District will be responsible for the costs of locating, repairing damage not due to the failure of the Contractor to exercise reasonable care, and removing or relocating Public Utility Facilities not indicated in the plans and specifications with reasonable accuracy, and for equipment on the project necessarily idled during such work regarding said Public Utility Facilities, as the case may be, but the Contractor shall perform any such work in conformance with applicable provisions of Paragraphs C-9 and C-10 if so directed by the Engineer. The Contractor will not be assessed liquidated damages for delay in completion of the project, when such delay was caused by the failure of the public agency or the owner of the Public Utility Facilities to provide for removal or relocation of any Public Utility

Facilities. If the Contractor, while performing the Contract Work, discovers utility facilities not identified by the District in the Contract Documents, he or she shall immediately notify the Engineer in writing.

- i. Subject to the provisions of Paragraph C-21, Subsection (h), where the Work to be performed under the Contract crosses or otherwise interferes with existing streams, water courses, canals, farm ditches, pipelines, drainage channels, or water supplies, the Contractor shall provide for such water courses or pipelines and shall perform such construction during the progress of Work so that no damage will result to either public or private interests, and the Contractor shall be liable for all damage that may result from failure to so provide during the progress of the Work.
- j. The facilities to be constructed under this Contract may cross existing underground features and the District has made a determined effort to gather and incorporate into these Specifications and Drawings all available information regarding existing underground features. The District's investigation included review of as-built drawings and available maps. The Contractor shall proceed with caution and make every effort to further identify underground features during excavation procedures in order to minimize the hazard of damaging any unidentified underground feature. The responsibility for locating, removal, relocation and protection of all public and private underground utilities, including petroleum facilities in the nature of utilities, shall be as specified. Within thirty (30) days of the Notice to Proceed, the Contractor shall confirm, mark and determine the depth of all underground utilities that are crossed by excavations under this Contract. The information obtained shall be provided to the Engineer for review prior to any construction, including the manufacture of farm turnout pipe and/or pipe specials. Unless otherwise specified or directed, all utilities shall be maintained in continuous service during all Contract operations. The Contractor shall not interfere with any roadway or utility system without the approval of the Engineer. At all times adequate access shall be provided for use of the utility owner or operating entity.

C-22 RESPONSIBILITY FOR REPAIR OF FACILITIES

All existing District facilities or other public or private facilities, including but not limited to pipelines, structures, telephone or power cables, roadways and driveways and embankments disturbed by the Contract construction shall be repaired and replaced to match existing. In addition, the Contractor shall be responsible for any settlement damage to such facilities or adjoining areas, for a period of one (1) year after District acceptance of such repaired facilities.

C-23 Relief from Duty of Protecting Work

The Contractor's responsibility for protection of, and liability for, damage to the Work shall be as stated in the Contract Documents. However, the District may issue written permission to relieve the Contractor of the duty of maintaining and protecting portions of the Contract Work which have been completed in all respects in accordance with applicable requirements of these Specifications. Relief from the duty of maintaining and protecting any portion of the Contract Work shall not release the Contractor from Contractor's obligations under Paragraph C-26 of the General Conditions.

C-24 WORKERS AND WAGES

- a. Character of Workers Only qualified, careful and efficient workers shall be employed. When required in writing by the Engineer, the Contractor or any subcontractor shall remove from the Work any person who is, in the opinion of the Engineer, incompetent, unfaithful, disorderly, or otherwise unsatisfactory, and shall not again employ such person on the Work except with the consent of the Engineer. Such removal shall not be the basis for any claim for compensation or damages against the District, or any of its officers or agents.
- b. Convicts No convict labor shall be directly employed by the Contractor or any subcontractor in the performance of any Work done under this Contract.
- Hours of Work Eight (8) hours of labor shall constitute a legal day's work upon C. all the Work hereunder and the time of service of any worker employed by the Contractor or by any subcontractor under him shall be limited and restricted to eight (8) hours during any one (1) calendar day, except that work performed by employees in excess of eight (8) hours per day and forty (40) hours in any one (1) calendar week will be permitted upon compensation for all hours worked in excess of said limitations at not less than one and one-half times the basic rate of pay or as otherwise may be required by applicable law. The Contractor and all subcontractors under him shall keep record of hours worked as required by Section 1812 of the California Labor Code. As required by Section 1813 of the California Labor Code, the Contractor shall forfeit as a penalty to the District twenty-five dollars (\$25) for each worker employed in the execution of the Contract by him or by any subcontractor under him for each calendar day during which such worker is required or permitted to work more than eight (8) hours in any one (1) calendar day and forty (40) hours in any one (1) calendar week in violation of the provisions of this subsection.
- d. Compliance with State Requirements for Employment of Apprentices The Contractor's attention is directed to Section 1777.5 of the California Labor Code; provisions of said section pertaining to employment of registered apprentices are hereby incorporated by reference into these Specifications. As applicable, the Contractor or any subcontractor employed by him in the performance of Contract Work shall take such actions as necessary to comply with provisions of said Section 1777.5.
- e. Wage Rates Pursuant to Article 2 (commencing at Section 1770), of the California Labor Code, the Director of the State of California, Department of Industrial Relations has ascertained the generally prevailing rate of per diem wages and the generally prevailing rates for legal holiday and over-time work in the locality in which the Work is to be performed, for each craft or type of worker needed to execute the Contract. The Contractor and all subcontractors under him shall pay not less than said specified rates to all workers employed in the execution of the Contract, a copy of which wage rate schedule is on file at the office of the District and by this reference incorporated herein. The Contractor shall post a copy of said documents at each job site. As required by Section 1775 of the California Labor Code, the Contractor shall, as a penalty to the District, forfeit an amount determined by the Labor Commissioner, not more than fifty dollars (\$50), for each calendar day, or portion thereof, for each worker paid less than the specified prevailing rates for Work done under the Contract by him

or by any subcontractor under him. The Contractor and all subcontractors under him shall keep records of wages paid as required by Section 1776 of the California Labor Code. The Contractor and each sub-contractor shall pay travel and subsistence payments to each worker needed to execute the Work required by the Contract, as such travel and subsistence payments are defined in the applicable collective bargaining agreements filed in accordance with Section 1773.8 of the California Labor Code. The labor rates determined by the Department of Industrial Relations are set forth in a schedule located at the District office, and are available to any interested party upon request.

- f. Worker's Compensation Insurance In accordance with the provisions of Section 3700 of the California Labor Code, every Contractor shall secure the payment of compensation to his employees. Contractor prior to commencing Work shall sign and file with the District a certification as follows: "I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for worker's compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the Work of this Contract."
- g. Labor Discrimination The Contractor's attention is directed to Section 1735 of the California Labor Code. The Contractor agrees to comply with provisions of said section that read as follows:

"No discrimination shall be made in the employment of persons upon public works because of the race, religious creed, color, national origin, ancestry, physical handicap, mental condition, marital status or sex of such persons, except as provided in Section 12940 of the Government Code, and every contractor for public works violating this section is subject to all the penalties imposed for a violation of this chapter."

The Contractor's attention is further directed to Section 1777.6 of the California Labor Code, and the Contractor agrees to ensure compliance with the provisions of said section which provide as follows:

"It shall be unlawful for an employer or a labor union to refuse to accept other-wise qualified employees as registered apprentices on any public works, on the ground of the race, religious creed, color, national origin, ancestry, sex or age, except as provided in Section 3077, of such employee."

h. Contractors submitting proposals shall be registered with the Department of Industrial Relations, as provided in Labor Code Section 1725.5, and shall include evidence that they are so registered with their proposal, and remain registered throughout the contract period.

C-25 CLEAN-UP

During the progress of the Work, the Contractor shall maintain the site and related structures and equipment in a clean, orderly condition and free from unsightly accumulation of rubbish. Upon completion of the Work and before the final estimate is submitted, the Contractor shall at his own cost and expense remove from the vicinity of

the Work all plants, buildings, rubbish, unused work materials, concrete forms, and temporary bridging and other like material, belonging to him or used under his direction during construction. In the event of his failure to do so, the same may be removed by the District after ten work days notice to the Contractor at the expense of the Contractor. Where the construction has crossed yards or driveways, the yards and driveways shall be restored by the Contractor to the complete satisfaction of the Engineer at the Contractor's expense.

C-26 SAFETY

- a. The Contractor shall be solely and completely responsible for the conditions of the job site, including safety of all persons and property during performance of the Work. This requirement shall apply continuously and not be limited to normal working hours. Safety provisions shall conform to all applicable Federal, State, County and local laws, ordinances, and codes, and to the rules and regulations established by Cal-OSHA, and to other rules of law applicable to the Work.
- b. The duty of the Engineer to conduct construction review of the Contractor's performance and the undertaking of inspections by the Engineer or the giving of instructions as authorized herein is not intended to include review of the adequacy of the Contractor's safety measures in, on, or near the construction site and shall not be construed as supervision of the actual construction nor make the Engineer or the District responsible for providing a safe place for the performance of Work by the Contractor, subcontractors, or suppliers; or for access, visits, use, work, travel or occupancy by any person.
- c. The Contractor will use all precautions to prevent fires and shall provide adequate facilities and equipment for extinguishing fires at no cost to the District. Waste disposal by burning will not be allowed at any time.

C-27 ACCIDENTS

The Contractor shall provide, at the site, such equipment and medical facilities as are necessary to supply first aid service to anyone who may be injured in connection with the Work. The Contractor must promptly report in writing to the Engineer all accidents whatsoever arising out of, or in connection with the performance of the Work, whether on or adjacent to the site, which cause death, personal injury, or property damage, giving full details and statements of witnesses. In addition, if death or serious injury or serious damage is caused, the accident shall be reported immediately by telephone or messenger to the Engineer. If any claim is made by anyone against the Contractor or any subcontractor on account of any accident, the Contractor shall promptly report the facts in writing to the Engineer, giving full details of the claim.

C-28 GUARANTEE

In addition to warranties, representations and guarantees stated elsewhere in the Contract and in addition to any warranties implied by law, the Contractor unconditionally guarantees all materials and workmanship furnished hereunder, and agrees to replace at his sole cost and expense, and to the satisfaction of the Engineer and the District, any and all materials which may be defective or improperly installed, whether such defects of material and installation are of patent or latent nature.

C-29 PAYMENTS TO CONTRACTOR

- a. Breakdown of Lump Sum Prices On lump sum Contracts, or lump sum items within a unit price Contract, the Contractor shall, within fourteen (14) work days after receiving the Notice to Proceed, furnish a complete itemized listing of prices and quantities of his bid to be used by the Engineer as an aid in determining the proper amount of progress payments. Said listing shall be in such form and contain such detail as may be required by the Engineer. Payments to the Contractor may be withheld until such listing is received by the Engineer.
- b. Progress Estimates For each calendar month of Contract Work, the Engineer will prepare a progress estimate of all Work performed under the Contract up to and including the given day of each such work month specified under Section D of these Specifications. Within the first ten (10) work days of each succeeding calendar month, the Engineer will make in writing and certify to the District, an estimate which in his opinion is a fair approximation of the value of all Work under the Contract, including any amounts due the Contractor for extra work or pursuant to approved claims for extra cost to the given day of the preceding month specified under Section D. In arriving at the value of the Work done, the Engineer will give consideration to the value of major items which have been delivered to the job site for incorporation in the Work and for which payment in full has been made by the Contractor. Consideration will not be given to preparatory work done or other materials on hand.
- c. Progress Payments The District will pay the Contractor ninety-five percent (95%) of the amount of each progress estimate on or before the last day of the month following the month for which the estimate was made. Five percent (5%) of the amount of each estimate shall be retained by the District until final completion and acceptance of all Work under the Contract. Subject to Public Contract Code, the District may elect to pay more than ninety-five percent (95%) of the amount of any progress estimate upon recommendation of the Engineer. However, such payment shall not constitute a waiver of the District's right to retain five percent (5%) of subsequent progress payments. No partial payment or estimate shall constitute an acceptance of the Work or any portion thereof.
- d. Acceptance and Final Payment - Whenever the Contractor shall deem all Work under this Contract to have been completed in accordance therewith, he shall so notify the Engineer in writing, and the Engineer will promptly ascertain whether such be the fact and, if not, shall advise the Contractor in detail and in writing of any additional work required. When all the provisions of the Contract have been fully complied with to the satisfaction of the Engineer, he will proceed with all reasonable diligence to determine accurately the total value of all Work performed by the Contractor at the prices set forth in the accepted Proposal or fixed by Change Orders and the total value of all Extra Work, all in accordance with the Contract. The Engineer will then certify to said final estimate and to the date of completion of the Work, and shall file copies thereof with the District and the Contractor. Within ten (10) work days after completion, the District will file in the Office of the County Recorder a Notice of Completion of the Work herein agreed to be done by the Contractor. On the expiration of forty-five (45) work days after the recordation of such Notice of Completion the difference between said final estimate and all payments theretofore made to the Contractor shall be due and payable to the Contractor, subject to any requirements concerning the

furnishing of a maintenance bond, and excepting only such sum or sums as may lawfully be withheld in accordance with the provisions of this Contract. All prior certifications upon which partial payments may have been made, being merely estimates, shall be subject to correction in the final certificate. Acceptance by the Contractor of said payment made in accordance with said final estimate shall operate as and shall be a release to the District, its officers, agents, and employees from all claims and liability to the Contractor for anything done or furnished or withheld, and for anything relating to the Work or any act or neglect of the District, its officers, agents, and employees, excepting only claims against the District for any amounts withheld by the District at the time of such payment.

- e. Right of District to Withhold Payments In addition to all other rights and remedies of the District hereunder and by virtue of law, the District may withhold or nullify the whole or any part of any partial or final payment to such extent as may reasonably be necessary to protect the District from loss on account of:
 - 1. Defective work not remedied, irrespective of when any such work is found to be defective;
 - 2. Claims or liens filed or reasonable evidence indicating probable filing of claims or liens;
 - 3. Failure of the Contractor to make payments properly for labor, materials, equipment, or other facilities, or to subcontractors;
 - 4. A reasonable doubt that the Work can be completed for the balance then unearned;
 - 5. A reasonable doubt that the Contractor will complete the Work within the agreed time limits;
 - 6. Costs to the District resulting from failure of the Contractor to complete the Work within the proper time;
 - 7. Damage to Work or property.

At the request and expense of the Contractor and pursuant to Public Contract Code section 22300, securities equivalent to any amount withheld by District to ensure the Contractor's performance under the Contract shall be deposited with the District as substitute security, or, at the Contractor's request, with a state or federally chartered bank in California as the escrow agent. Escrow instructions shall conform to the requirements of Public Contract Code section 22300.

Whenever the District shall, in accordance herewith, withhold any monies otherwise due the Contractor, written notice of the amount withheld and the reasons therefor will be given the Contractor. After the Contractor has corrected the enumerated deficiencies the District shall promptly pay to the Contractor the amount so withheld. When monies are withheld to protect the District against claims or liens of mechanics, materialmen, subcontractors, etc., the District may at its discretion permit the Contractor to deliver a surety bond in terms and amount satisfactory to the District, indemnifying the District against any loss or expense, and upon acceptance thereof by the District, the District shall release to the Contractor monies so withheld.

C-30 SATISFACTION OF LIENS

If any liens or claims remain unsatisfied after final payment to the Contractor, the Contractor shall pay or refund to the District any money that the latter may be compelled to pay to discharge such liens and costs together with reasonable attorney's fees incurred by the District in enforcing the Contractor's obligations hereunder.

C-31 CLAIMS AGAINST THE DISTRICT

In the event that any litigation of any nature between the District and the Contractor becomes necessary to enforce or interpret all or any portion of this Contract, it is mutually agreed that the prevailing party therein shall receive from the other, in addition to such sums as may be reduced to judgment, an amount sufficient to reimburse such prevailing party for reasonable attorney's fees and litigation costs paid or owing as a result of such litigation.

C-32 WAIVER OF INTEREST IN CERTAIN SITUATIONS

The District shall have no obligation to pay and the Contractor hereby waives the right to recover interest with regard to monies which the District is required to withhold by reason of judgment, order, statute, or judicial process.

C-33 ASSIGNMENTS OF ANTITRUST ACTIONS

In entering into a public works contract or subcontract to supply goods, services, or materials pursuant to a public works contract, the Contractor or subcontractor offers and agrees to assign to the awarding body all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. Section 15) or under the Cartwright Act (Chapter 2 [commencing with Section 16700] of Part 2 of Division 7 of the Business and Professions Code), arising from purchases of goods, services, or materials pursuant to the public works contract or the subcontract. This assignment shall be made and become effective at the time the awarding body tenders final payment to the Contractor, without further acknowledgment by the parties.

In submitting a bid to a public purchasing body, the bidder offers and agrees that if the bid is accepted, it will assign to the purchasing body all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (Chapter 2 [commencing with Section 16700] of Part 2 of Division 7 of the Business and Professions Code), arising from purchases of goods, materials, or services by the Bidder for sale to the purchasing body pursuant to the bid. Such assignment shall be made and become effective at the time the purchasing body tenders final payment to the Bidder.

SECTION D SPECIAL PROVISIONS

D-1 THE REQUIREMENT

It is required that the MIRAGRAND WELL EQUIPPING IMPROVEMENTS PROJECT NO. 58463 be constructed in accordance with the Contract Documents, which includes the Specifications and Drawings. The Work is to be performed on the District's property located at 675 E. Miramar Avenue in Claremont, CA 91711.

The Contract will be awarded to a single contractor for the Project. A Notice to Proceed is expected to be issued in late **June 2021**. All Work must otherwise be completed within the number of workdays stated in the Notice Inviting Bids.

D-2 TIME PERIOD DURING WHICH BIDS REMAIN VALID

All bids shall remain valid for a period of forty-five (45) days after the date specified in the Notice Inviting Bids for the opening of bids by the District. After that period has expired, and in all events within sixty (60) days after the date set for opening bids, the Bid Security submitted with their Proposal will be returned to the unsuccessful bidders.

D-3 QUALIFICATIONS OF BIDDERS

In addition to certifying financial ability to perform Contract Work, the Contractor is directed to complete all information associated with its experience in performing work comparable to that required under this Contract. Bids will be considered only from general contractors who can demonstrate a record of experience satisfactory to the District.

D-4 BEGINNING AND COMPLETION OF WORK

Unless otherwise ordered by the Engineer, as hereinafter provided, the Contractor shall begin the Work within ten (10) workdays after issuance of the Notice to Proceed. All Work must be completed within **two-hundred and fifty (250) calendar days** from the Notice to Proceed.

D-5 PRE-CONSTRUCTION MEETING

A pre-construction meeting shall be scheduled prior to start of construction with the following people present: Contractor, Contractor's Superintendent and Foreman, Three Valleys Municipal Water District, the Engineer, or their designated representatives. At a minimum, the pre-construction meeting will address the following items:

- 1. Introduction and acquaintance of the key project personnel. The Contractor is expected to be represented at the meeting by his assigned superintendent and foreman. Any major subcontractors should also be present.
- Designated contacts for each entity.
- 3. Construction Schedule and discussion of major long-lead items.
- 4. Shop drawing submittals and procedures.

- 5. Cost breakdown of major bid items and progress payment processing in excel format
- 6. Field inspections for project specialty and milestone components (**to be scheduled between Monday through Thursdays** unless otherwise agreed).
- 7. Clarification of any questionable areas of the Work & existing utilities/yard piping to be protected in place.

D-6 Breakdown of Contract Price

For use in preparing estimates of completed work on which to base claims for partial payments, the Contractor shall prepare an itemized breakdown of the contract price indicating quantities and unit prices for the various elements of the work.

The breakdown shall be a true representation of the contract price for work covered by the Specifications and drawings and shall be subject to approval by the District. An unbalanced breakdown will not be acceptable.

Values assigned to the price breakdown will be used only as a basis for partial payment and not as a basis for additions to or deductions from the contract price.

D-7 LIQUIDATED DAMAGES FOR DELAYS

It will be impractical or extremely difficult to fix the actual damages that may result from any delays in completion of the Work beyond the date agreed upon. It is, therefore, stipulated and agreed, that if all the Work is not completed on or before the expiration of the completion time or times specified in Paragraph D-4, or within such time as may be granted, the District may retain the sum of one-thousand dollars (\$1,000) each day thereafter, Sundays and holidays included, until said work is satisfactorily completed or until the District may reasonably procure the completion thereof by another contract, or complete the same itself. Exclusions for rainy days will be allowed. Which sum is agreed upon as the proper measure of liquidated damages which the District will sustain per day by the failure of the Contractor to complete the Work at the time stipulated, and this sum is not to be construed in any sense a penalty or forfeiture?

D-8 PROTECTION OF EXISTING UTILITIES

The facilities to be constructed under this Contract may cross existing underground features and the District has made a determined effort to gather and incorporate into these Specifications and Drawings all available information regarding existing underground features. The District's investigation included review of as-built drawings and available maps. The Contractor shall proceed with caution and make every effort to further identify underground features during excavation procedures to minimize the hazard of damaging any unidentified underground feature. The responsibility for locating, removal, relocation, and protection of all public and private underground utilities, including petroleum facilities in the nature of utilities, shall be as specified under this paragraph and in Paragraph C-21. Within thirty (30) days of the Notice to Proceed, the Contractor shall confirm, mark, and determine the depth of all underground utilities that are crossed by excavations under this Contract. The information obtained shall be provided to the Engineer for review prior to any construction, including the manufacture of farm turnout pipe and/or pipe specials. Unless otherwise specified or directed, all utilities shall be maintained in continuous service during all Contract operations. The Contractor shall not interfere with any roadway or utility system

without the approval of the Engineer. At all times adequate access shall be provided for use of the utility owner or operating entity.

D-9 Shop and Fabrication Drawings

Drawings furnished to the Contractor by the District shall not be construed as shop or fabrication drawings. The Contractor shall furnish to the Engineer six (6) copies of all shop and fabrication drawings which are required prior to the fabrication or placement of any or all items. The Contractor shall review and accept all shop and fabrication drawings prior to submittal. With each shop drawing submittal, an accompanying letter of transmittal shall be provided. Shop drawings for equipment shall show all installation dimensions and details for the specific items to be furnished. Catalog cuts or generic drawings will not be accepted. All shop drawings submitted must bear the stamp of approval of the Contractor as evidence that the drawings have been checked by the Contractor. Any drawings submitted without this stamp of approval will not be considered and will be returned to the Contractor for proper resubmission. If the shop drawings show variances from the requirements of the Contract because of standard shop practice or other reason, the Contractor shall make specific mention of such variation(s), including reasons therefore, in the accompanying letter of transmittal in order that, if acceptable, suitable action may be taken for proper adjustment; otherwise the Contractor will not be relieved of the responsibility for executing the work in accordance with the Contract Specifications and Specifications Drawings, even though such shop drawings have been reviewed by the Engineer. Shop and fabrication drawings for all items of work to be furnished and installed under this Contract shall be submitted at least thirty (30) calendar days before the specified installation date for the first scheduled shipment of materials and equipment. The Contractor shall include the dates of shop drawing submittals in the Construction Schedule specified in Section C-14. Within ten (10) calendar days after receipt of shop or fabrication drawings, the Engineer will return one copy of the drawings to the Contractor appropriately marked. The Contractor shall then revise the shop or fabrication drawings as requested by the Engineer or submit an alternative to the revision and perform the work in accordance with the revision or approved alternative, therefore. The Contractor shall furnish the Engineer one transparency of the approved and revised shop and fabrication drawings immediately upon finishing the requested revisions or entering the approved alternative on the shop drawings and prior to delivery or installation of any material shown thereon. The District reserves the right to require, at no additional cost over the prices stated in the Bidding Schedule, such modifications or alterations as deemed necessary by the Engineer. Notwithstanding the above provisions, the Contractor shall be responsible for obtaining proper fit and dimensions, and adequate strength to withstand specified dynamic and static loadings on materials and equipment furnished by Contractor. Review by the Engineer is for general conformance with the Contract Documents. Fabrication or other work done prior to the Contractor's receipt of the reviewed shop and fabrication drawings will be done entirely at the Contractor's risk. No extension of time will be allowed because of delays caused by revisions to or resubmittals of shop drawings.

D-10 RESPONSIBILITY FOR REPAIR OF FACILITIES

All existing District facilities or other public or private facilities, including but not limited to pipelines, structures, telephone or power cables, roadways and driveways and embankments disturbed by the Contract construction shall be repaired and replaced to match existing. In addition, the Contractor shall be responsible for any settlement damage to such facilities or adjoining areas, for a period of one (1) year after District acceptance of such repaired facilities.

D-11 CONNECTION TO OTHER FACILITIES

Connections to other facilities, as may be shown on the drawings, shall be performed only when authorized by the District. The Contractor shall notify the District or District's representative no less than five days prior to the date that such connections are due to be performed. Dewatering the existing lines and operation of all valves shall be performed or coordinated by the District.

If the pipelines to which connections are to be made do not exist at the time said connections are ready to be made, the Contractor shall install blind flanges until such time that said "existing" pipelines are installed and placed into service. No extra payment will be allowed for any delays resulting from the requirements of this Section.

D-12 TEMPORARY USE OF FACILITIES

Subject to the approval of the District, the Contractor will be permitted to make temporary use of District-owned land available in the vicinity of the Contract Work site for construction work sites or storage areas. Upon termination of such usage, all such areas shall be returned to a neat and presentable condition as approved by the Engineer.

D-13 WORKING AREA AND WORKING HOURS

- The Contractor shall limit Contractor's activities to the areas of Work shown on the Drawings. The Contractor shall provide temporary sanitary facilities for the use of its workers.
- The Contractor shall schedule Contractor's work between the hours of 7:00 AM and 5:00 PM, Monday through Friday or as otherwise allowed in the Specifications. Working hours for construction within the street right-of-way may need to be scheduled between the hours of 8:30 AM and 4:00 PM.

D-14 ROADWAY ACCESS

To execute the Work, the Contractor will need to ingress and egress the Working Area from public dedicated roadways. The Contractor shall determine and follow required guidelines for ingress and egress from the Working Area to the dedicated roadway from the governing agency of the dedicated roadway. The Contractor shall have sole responsibility to provide all temporary traffic control measures (per WATCH manual), warning signs, flagman, guardrails, barricades, and lighting and to obtain any necessary permits to execute the Work.

D-15 COOPERATION WITH OTHERS

At all times, the Contractor shall extend full cooperation to all others performing work authorized by the District within or adjacent to Contract Work areas, including all landholders performing private work. The Contractor shall not commit or permit any act, which will interfere with the performance of work by any other contractor or by District employees. The Contractor shall have no claim for damages on account of interference. Exact methods of coordination of Work involving the Contractor and others will be as determined by the Engineer, whose decision will be final.

D-16 Excavation Safety Plan

- Not less than fifteen (15) days before beginning excavation required under this Contract, the Contractor shall furnish to the Engineer for review working Drawings of Contractor's excavation safety plan. Contractor shall not begin excavation until said plan has been reviewed by the Engineer.
- 2. The excavation safety plan shall include all the Contractor's excavation operations. Working Drawings shall be a detailed plan showing the design of shoring, bracing, sloping, or other provisions to be made for worker protection from the hazard of caving ground. Plans varying from the shoring system standards established by the Construction Safety Orders of the Cal/OSHA or the Federal Safety Standards of the U.S. Department of Labor Occupational Safety & Health Administration (OSHA) must be prepared by a civil or structural engineer registered in the State of California. In no event shall the Contractor use a shoring, sloping, or protective system less effective than that required by said Construction Safety Orders, or less effective than that required by said Federal Safety Standards.

D-17 RIGHT TO OPERATE UNSATISFACTORY EQUIPMENT

If, following installation of any equipment or facilities furnished by the Contractor, defects are found requiring correction by the Contractor, the District shall have the right to operate such unsatisfactory equipment and make reasonable use thereof until the equipment can be shut down for correction of defects without injury to the District.

D-18 USE OF UTILITIES

The Contractor shall be responsible for acquiring a temporary construction meter from Golden State Water Company – Claremont for construction water needs and dust control.

If Work is ON the District's Miramar Plant property:

To the extent that it is able, based on operational conditions, the District will furnish an adequate supply of water for the purpose of construction, testing and disinfecting all the works under the Specifications. The Contractor will coordinate and plan with District staff to determine the proper location from which to draw its construction water supply, and the District will provide its own meter for the connection. However, all other costs incurred in connecting to existing facilities shall be borne by the Contractor.

Contractor shall provide Contractor's own electrical generation equipment.

D-19 SANITATION

All parts of the work shall be maintained daily in a neat, clean, and sanitary condition. All wastes and refuse from sanitary facilities provided by the Contractor or from any other source related to the Contractor's operations shall be kept in a sanitary manner, satisfactory to the District and in accordance with laws and regulations pertaining thereto. Fixed and portable toilets, which are made inaccessible to flies, shall be provided for use of employees and their use shall be strictly enforced.

The Contractor shall furnish all the facilities and means for the proper sanitation of the work and shall protect and hold harmless the District, its Engineer, officers, and employees from any liability resulting from improper or insufficient sanitation measures.

D-20 DRIVEWAY MAINTENANCE AND DUST ABATEMENT

During the performance of all work included in the Contract, the entrances and exits used as access to the sites shall be maintained by the Contractor.

During the performance of all work included in the Contract or any operations appurtenant thereto, the Contractor shall furnish all the labor, equipment and means required and shall carry out proper and efficient measures wherever and **as often as necessary**, to prevent its operations from producing dust in amounts damaging to property or **causing a nuisance to persons occupying buildings and homes in the vicinity**.

D-21 REPAIR OF PAVEMENT

Pavement damaged by construction operations shall be repaired and replaced in kind, provided, however, that where reconstruction of any right-of-way is subject to the inspection and approval of any governmental agency other than the District, the Contractor agrees to repair and replace those portions of such right-of-way damaged during construction to the complete satisfaction of such agency or its authorized representative. Any requirements as to reconstruction of such rights-of-way shall not form the basis of a claim by the Contractor for additional compensation or for an extension of time.

D-22 Prevention of Water Pollution

The Contractor shall take appropriate measures (BMPs) as necessary to effect water pollution control. Construction operations shall be so conducted as to prevent discharge of wastes and pollutants into surface waters and underground water sources. Such water pollution control measures shall be directed toward eliminating discharge, or averting accidental spillage, of such industrial and domestic wastes as oils, gasses, fuels, sewage, toxic materials, and other substances which may be hazardous to public health and welfare or harmful to fish and wildlife. The Contractor shall be responsible for compliance with applicable State and local regulations for prevention and abatement of pollution of surface and underground water. The Contractor's pollution control methods shall be subject to approval of the Engineer. The District shall have the right to require the Contractor, at Contractor's expense, to initiate and maintain such pollution control measures as deemed necessary to eliminate pollution of water caused by or resulting from the Contractor's operation. No separate payment will be made for prevention of water pollution, the costs for all Work and materials required under this paragraph shall be borne by the Contractor.

D-23 NOT USED

D-24 NOT USED

D-25 LANDSCAPE PRESERVATION

- 1. General The Contractor shall exercise care to preserve the landscape and irrigation and shall conduct Contractor's construction operations to prevent any unnecessary destruction, scarring, or defacing of the surroundings in the vicinity of the Work. Except where clearing is required for permanent works and/or excavation operations, all trees, native shrubbery, and vegetation shall be preserved and shall be protected from damage which may be caused by the Contractor's construction operations and equipment. No special reseeding or replanting will be required under these Specifications; however, on completion of the Work, all work areas shall be smoothed and graded in a manner to conform to the natural appearance of the landscape. Where unnecessary destruction, scarring, damage, or defacing may occur as a result of the Contractor's operations, the same shall be repaired, replanted, reseeded, re-mulched, or otherwise corrected at the Contractor's expense.
- 2. Contractor's "Office" The Contractor's office, and yard area shall be located and arranged in a manner to preserve trees, vegetation, and irrigation to the maximum practicable extent. On abandonment, all camp, storage, and construction buildings, including concrete footings and slabs, and all construction materials and debris shall be removed from the site. The camp area shall be left in a neat and natural appearing condition.
- D-26 NOT USED
- D-27 NOT USED
- D-28 NOT USED
- D-29 NOT USED
- D-30 NOT USED

D-31 CONTRACT DRAWINGS

The location of the work and existing and new facilities and appurtenant works are shown on the drawings made a part of these Specifications as listed herein.

When deemed necessary by the Engineer, additional detailed drawings will be furnished the Contractor during the progress of the work. The Contractor will be furnished such number of copies of the drawings and Specifications as may be required for carrying out the work. Contact prints of the original drawings will be furnished the Contractor for construction purposes, upon request.

The Specification Drawings for the Contract are listed below.

		SHEET INDEX
SHEET NO.	DWG. NO.	SHEET TITLE
SHEET NO.	DVVG. NO.	TITLE SHEET, VICINITY MAP, LOCATION MAP, LIST OF
1	G-1	DRAWINGS
2	G-2	GRADING NOTES
3	G-3	GENERAL NOTES, SYMBOLS, LEGEND, AND ABBREVIATIONS
4	G-4	HYDRAULIC PROFILE
5	C-1	TOPOGRAPHIC PLAN
6	C-2	GENERAL SITE PLAN
7	C-3	GRADING PLAN
8	C-4	GRADING PLAN
9	C-5	GRADING SECTIONS
10	C-6	WROUGHT IRON FENCE AND GATE DETAILS
11	C-7	EROSION CONTROL PLAN
12	C-8	GRADING DETAILS
13	M-1	WELL BUILDING PLAN AND PIPING
14	M-2	WELL PIPING SECTIONS
15	M-3	WELL DETAILS
16	M-4	MECHANICAL DETAILS
17	M-5	MECHANICAL DETAILS
18	A-1	ARCHITECTURAL NOTES
19	A-2	ARCHITECTURAL SPECIFICATIONS
20	A-3	BUILDING FLOOR PLAN
21	A-4	VENTILATION FLOOR PLAN
22	A-5	BUILDING ELEVATIONS
23	A-6	BUILDING DOOR AND LOUVER SCHEDULES
24	A-7	ARCHITECTURAL DETAILS
25	A-8	ARCHITECTURAL DETAILS II
26	S-1	STRUCTURAL NOTES I
27	S-2	STRUCTURAL NOTES II
28	S-3	STRUCTURAL NOTES III
29	S-4	FOUNDATION AND FLOOR PLAN
30	S-5	ROOF FRAMING PLAN
31	S-6	WELL BUILDING SECTIONS
32	S-7	FOUNDATION SECTIONS
33	S-8	STRUCTURAL DETAILS I
34	S-9	STRUCTURAL DETAILS II
35	S-10	METAL STUD DETAILS
36	S-11	ROOF SECTIONS AND DETAILS
37	E-1	ELECTRICAL NOTES, SYMBOLS, AND ABBREVIATIONS
38	E-2	SINGLE LINE DIAGRAM
39	E-3	PUMP ELEMENTARY DIAGRAM
40	E-4	ELECTRICAL SITE PLAN
41	E-5	BUILDING ELECTRICAL PLAN
42	E-6	MISCELLANEOUS WIRING DIAGRAMS
43	E-7	GATE OPERATOR, WIRING, AND DETAIL

D-8 Special Provisions

44	E-8	CONTROL BLOCK DIAGRAM
45	E-9	ELECTRICAL DETAILS
46	I-1	PID NOTES, SYMBOLS, AND ABBREVIATIONS
47	I-2	PID
48	I-3	PID-2
49	T-1	TRUCK HAUL ROUTE

D-32 DRAWINGS AND DATA REQUIRED TO BE SUBMITTED BY CONTRACTOR

General

The Engineer's review and approval of drawings and of data required to be submitted herein shall not relieve the Contractor from the full responsibility for the correctness of details and dimensions, and for compliance with the Specifications. The Contractor shall assume all responsibility and risk for misfits due to any errors on the drawings.

Fabricated Materials

- 1. At a time sufficiently early to allow review as hereinafter specified and to accommodate the rate of construction progress required under the Contract, the Contractor shall submit to the Engineer for review, complete shop, assembly, and layout drawings of the fabricated materials to be furnished and installed under the contract.
- 2. Said drawings shall indicate type of material proposed to be used and **electronic** copies (portable document format **pdf**) shall be submitted prior to manufacture or fabrication of the respective articles.
- 3. The Engineer will, within ten (**10**) days, return a pdf copy of each drawing to the Contractor with corrections indicated, which drawings shall be considered as the only drawings or prints used for fabrication. If in the opinion of the Engineer, a general revision of drawings is required to prove compliance with the Specifications, the Contractor shall revise said drawings and resubmit them for review.

Equipment

- 1. Within thirty (30) calendar days after executing the contract, the Contractor shall submit to the engineer for review an electronic set of shop drawings and catalogue data on equipment to be furnished under the contract. The required drawings shall include complete outline and assembly drawings of the equipment, details of electrical connections, schematic control diagrams, foundation requirements and the location, size, and length of any required anchor bolts, and shall clearly indicate clearance, casting and machining dimensional tolerances and quality of surface finishes.
- The drawings submitted for review by the Contractor shall also disclose the details of construction including dimensions, the properties of all materials used, applicable ASTM, ANSI, AWWA or other recognized Standard Specifications, and the manufacturer's catalogue, serial, or other reference numbers for all equipment to be furnished.
- 3. If the Engineer finds that the drawings submitted by the Contractor are in accord with acceptable practice and that they appear to meet the requirements of the Specifications, the Engineer will return a pdf set of said drawings so noted within ten (10) calendar days after their receipt. Otherwise, one set of electronic drawings will be returned to the Contractor within said ten (10) calendar day period with a statement of

D-9

the points wherein they have been found unsatisfactory, and the Contractor shall proceed at once to revise said drawings until they shall be found satisfactory by the Engineer.

Revisions.

- Revisions shown on said shop assembly or layout drawings, equipment drawings or catalogue data necessary to meet the requirements of the Specifications shall not be the basis of claims for extra charges or an extension of time. The Contractor shall accept such revisions or submit other for the Engineer to review.
- 2. When delay is caused by the resubmission of details, the Contractor shall not be entitled to any damages or extensions of time on account of such delay. The required corrections noted by the Engineer shall be made on the tracings as soon as practicable and new prints submitted. As soon as practicable after acceptance by the Engineer of any shop, assembly, or layout drawing, one clear legible transparent print on vellum of the tracing of said drawing shall be forwarded to the Engineer.
- No fabrication or other work shall be performed in advance of the receipt of the final accepted drawings. The Contractor shall not deviate in any way from the design, details, or dimensions shown on said final drawings, without written consent of the Engineer.

Instruction Manuals

- 1. **General**. Prior to delivery of mechanical and electrical equipment, the Contractor shall furnish to the Engineer at least three (3) complete sets of installation, maintenance and operation data for all electrical and mechanical equipment furnished under this contract.
- 2. Extent of Data. Each set of data shall include, but shall not necessarily be limited to, descriptive brochures, installation, operation and maintenance manuals, standard operation manuals, special instructions, and parts lists. Each manual, brochure, etc., shall relate directly and specifically to the applicable equipment and shall not be presentations of a general nature that will make it difficult to ascertain applicability of the data presented.
- 3. **Equipment Covered**. Mechanical and electrical equipment for which such data is to be furnished shall include, but is not necessarily limited to: Valves, meters, air compressor, electrical switchboard, and controls, etc.

D-33 MATERIALS FURNISHED BY THE CONTRACTOR

All materials and articles used for permanent installation in the Work shall be new and shall conform to the respective specifications or brands hereinafter designated and in the Specifications. The materials or articles shall conform to the best standard construction practice, as determined by the Engineer.

All material and articles furnished shall be subject to rigid inspection and no materials or articles shall be used in the Work until it has been inspected by the Engineer. The Contractor shall, if required, furnish satisfactory evidence as to the kind and quality of materials, including the furnishing of written manufacturers' certifications of compliance with other applicable designated governing specifications.

D-34 INSPECTION AND TESTS OF MATERIALS

Readiness for Inspection

The Contractor shall furnish the District full information as to the progress of the work in its various parts and shall give the District timely notice of the Contractor's readiness for inspection. When practicable, inspection will be made during the manufacture of articles. The Contractor shall furnish, without additional charge, all reasonable facilities and assistance for the safe and convenient inspection and tests required by the District.

Final Inspection and Acceptance

Final inspections and acceptance of the articles or materials may be made after delivery at the work site at the District's expense. If any material at the work site is rejected on account of failure to pass the inspection or test, the Contractor shall replace same promptly. Final inspection will be made as promptly as practicable but may not in all cases be made prior to erection or final assembly.

Right to Reject Articles and/or Materials.

- The District shall have the right at all times and places to reject articles and/or materials
 to be furnished hereunder which in any respect fail to meet the requirements of the
 Specifications, regardless of whether the defects in such articles or materials are
 detected at the point of manufacture or after completion of the Work at the site.
- 2. If the inspector, through an oversight or otherwise, has accepted material or work which is defective, or which is contrary to the Specifications, such materials, no matter in what state or condition of manufacture, delivery, or erection, may be rejected by the District.
- 3. Compliance with the Specifications is distinctly a duty of the Contractor and shall not be avoided by act or omission on the part of the District's inspector.

D-35 TRADE NAMES OR APPROVED EQUALS

Where specified, certain equipment, materials or other items are designated for procurement by trade name or the name of a manufacturer and the manufacturer's catalog information or approved equal. The use of alternate items of equal quality will be allowed only when approved and authorized in writing by the Engineer. The burden of proof as to comparative quality and suitability of proposed alternates shall be upon the Contractor, and Contractor shall furnish at his own expense all necessary information required by the Engineer. Where a given specified design application utilizing a trade name product is considered to be unique or novel, no alternate item of equipment will be allowed. The Engineer will be the sole judge as to the acceptability of proposed alternates and Engineer's decision will be final.

D-36 FIELD VERIFICATION OF EXISTING DIMENSIONS, APPURTENANT LOCATIONS AND GROUND PROFILES

General - In lieu of the survey information specified under Paragraph C-15 of these Specifications, the horizontal and vertical control information used by the District for design purposes is included in the Drawings, respectively. Based upon the above-specified information, the Contractor shall develop and make all other detailed surveys as required for Contract construction. At all times, the Contractor shall be responsible for the preservation or resetting of all existing

survey monuments. No separate payment will be made for survey work and the cost of all such work shall be borne by the Contractor.

D-37 QUALITY CONTROL

All items specified under these Specifications and the Proposal Bidding Schedule shall be of the sizes, shapes and materials as specified herein. All materials shall be new, free from defects impairing strength, durability, and appearance, shall be of the best commercial quality for the purposes specified and made with structural properties to withstand all stresses and strains to which they normally will be subjected. Items furnished, unless otherwise specified, shall be standard, approved products of recognized manufacturers and fabricated in accordance with the best shop methods. All incidental items and accessories not specified herein, but which are required to fully carry out the specified intent of the Work, shall be furnished without additional cost.

At all times, the manufacturer shall provide and maintain adequate inspection and quality control procedures for all items or Work, whether manufactured or fabricated in manufacturer's plant or elsewhere. To ensure that all items of Work meet material quality and performance requirements of these Specifications, if so, directed by the Engineer, for those items of Work manufactured or fabricated elsewhere than manufacturer's plant, the manufacturer shall furnish written certification that adequate supervision, inspection, and quality control procedures have been provided by manufacturer.

Welding shall be in accordance with the latest revision of the Standard Code for Arc and Gas Welding in Building Construction as issued by the AWS. All welding shall be performed by certified welders qualified under the standard qualification procedures of the AWS.

D-38 PROGRESS ESTIMATES

In conformance with Paragraph C-27, within the first ten (10) days of each calendar month, the Contractor shall prepare a progress estimate of all the Work performed under the Contract up to and including the twenty-eighth (28th) day of the preceding month. Any statement for material on hand or extra work must be submitted by said twenty-eighth (28th) day if payment is to be included for that month.

D-39 FIRE PROTECTION

The Contractor will use all precautions to prevent fires and shall provide adequate facilities and equipment for extinguishing fires at no cost to the District. Waste disposal by burning will not be allowed at any time.

D-40 GUARANTEE

1. In addition to any other warranties, representations and guarantees stated elsewhere in the Contract and any warranties implied by law, the Contractor guarantees the Work for a period of one (1) year after the date of acceptance of the Work by the District. The Contractor shall repair or remove and replace all such Work, together with any other Work which may be displaced in so doing, that is found to be defective in workmanship and/or materials within said one (1) year period, without expense whatsoever to the District, ordinary wear and tear and unusual abuse or neglect excepted. In the event of a failure to comply with the above-mentioned conditions

within seven (7) days after being notified in writing, the District is hereby authorized to proceed to have the defects remedied and made good at the expense of the Contractor who hereby agrees to pay the cost and charges therefore immediately on demand. Such action by the District will not relieve the Contractor of the guarantees required by this article or elsewhere in the Contract Documents.

- 2. The performance bond and the payment bond shall continue in full force and effect for the duration of the guarantee period.
- 3. If, in the opinion of the District, defective Work creates a dangerous condition or requires immediate correction or attention to prevent further loss to the District or to prevent interruption of operations of the District, the District will attempt to give the notice required by this article. If the Contractor cannot be contacted or does not comply with the District's request for correction within a reasonable time as determined by the District, the District may, notwithstanding the provisions of this article, proceed to make such correction or provide such attention; the costs of such correction or attention shall be charged against the Contractor. Such action by the District will not relieve the Contractor of the guarantees required by this article or elsewhere in the Contract Documents.
- 4. No guarantee, whether provided in this article or elsewhere in the Contract, shall in any way limit the guarantee of any items for which a longer guarantee is specified, or any items for which a manufacturer or supplier gives a guarantee for a longer period. The Contractor agrees to act as co-guarantor with such manufacturer or supplier, and the Contractor shall furnish the District with all appropriate guarantee or warranty certificates upon completion of the project. No guarantee period, whether provided in this provision or elsewhere, shall in any way limit the liability of the Contractor or Contractor's sureties or insurers under the indemnity.
- 5. The District's remedies, whether provided in this part or elsewhere in the Contract, shall be in addition to any other available legal and equitable remedies.

D-41 As-Built Drawings

Within fifteen (15) calendar days after acceptance of the Work by the District, the Contractor shall furnish a marked-up set of hard-copy drawings indicating "As-Built" conditions, which shall reflect all changes made during construction including but not limited to measured distance below finished surface and alignment of subsurface utilities.

Technical Specifications for the TVMWD Miragrand Well Equipping Improvements



PROJECT NO. 58463 PROJECT TECHNICAL SPECIFICATIONS April 2021



Under the Supervision of:

C. SHEM HAWES, P.E.

69578 C.E.

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T-SECTION 01 10 00

SUMMARY OF WORK AND SEQUENCE OF CONSTRUCTION

PART 1 - GENERAL

1.1 Work Covered by Contract Documents

A. Summary of Work, location, Work sequence, closeout, Contractor use of premises, and activities by others at Project site.

The Contractor shall provide and install a new 600 gpm vertical turbine well pump, well house, electrical and civil site improvements, and piping connection to the existing raw water line in the adjacent right of way.

- B. Work includes furnishing products, labor, tools, transportation, and services to:
 - 1. Protect existing facilities in place including existing irrigation lines, power poles, and utilities.
 - 2. Construct new 8" DIP pipelines per plans.
 - 3. Construct, develop, and test new well
 - 4. Furnish and install new MCC and future storage room.
 - 5. Furnish and install new well with 100-hp vertical turbine pump and motor.
 - 6. Construct new masonry building with steel roof, and building appurtenances, ventilation and lighting.
 - 7. Provide instrumentation and telemetry and provide coordination with TVMWD's SCADA integrator (Prime Systems Inc)
 - 8. Provide site improvements including percolation pond, fieldstone fencing, concrete drive ways, and asphalt around the well enclosure building.
 - 9. Pressure test new Work.
 - 10. Disinfect piping and appurtenances to local and AWWA standards.
- C. Furnish and install complete operating engineered systems, including appurtenant structural, mechanical and/or electrical mountings fittings or connections required for
 - 1. Compliance with Manufacturer's installation requirements.
 - 2. Compliance with applicable building, fire, plumbing, mechanical, electrical, and energy codes and standards, and
 - 3. As needed to permit systems to perform functions required by Contract Documents and described in Manufacturer's printed literature.
- D. Contractor's submission of bid shall constitute acknowledgment that, if awarded contract, they have relied upon and are relying upon their own examination of:
 - 1. Contract Documents
 - 2. Available geotechnical information.
 - 3. Work site
 - 4. Access to Work site
 - 5. Electrical service available at Work site.
 - 6. Conditions under which Work is to be performed
 - 7. Existing facilities on and near Work site.
 - 8. Data and matters requisite to completion of Work

1.2 Work Covered by Contract Documents (Wells)

- A. Intent of Contract Documents is to construct a complete and fully operational municipal supply well at the Miragrand site.
 - 1. Well design capacity is 600 gallons per minute (gpm).
- B. Work includes furnishing products, labor, tools, transportation, and services to construct, develop and test proposed well.

- C. Contractor's submission bid shall constitute acknowledgment that, if awarded the contract, they have relied upon and are relying upon their own examination of
 - 1. Contract Documents
 - 2. Available geotechnical information
 - 3. Work site
 - 4. Access to Work site
 - 5. Electrical service available at Work site.
 - 6. Conditions under which Work is to be performed
 - 7. Existing facilities on and near Work site.
 - 8. Data and matters requisite to completion of Work

1.3 Related Work

- A. Section 01 22 00: Unit Prices
- B. Section 01 32 00: Construction Progress Documentation
- C. Section 26 05 10: Common Work Results for Electrical

1.4 **Project Location and Site Conditions**

- A. Site conditions and required equipment environmental ratings are:
- B. Anticipated handled fluids and their properties are:
- C. Work and equipment shall be designed to satisfactorily operate under above conditions at project site.
 - 1. Incorporate derating and necessary oversizing to meet specified performance criteria into equipment design.
 - 2. Design equipment shall be designed to prevent damage from high or low ambient temperature within specified range, freezing, airborne dust, wind, and wet weather conditions.
 - 3. Outside air containing dust will be circulated to cool equipment.
 - 4. Electrical and mechanical equipment shall be suitably sealed.

1.5 Normal Working Hours

A. Normal working hours shall be as shown in General Provisions Section xxx.

or

- A. Conduct Work within the following Owner-accepted schedule:
 - 1. Normal Work Hours:
 - a. 7:00 am to 4:30 pm as amended by permit or noted on Plans.
 - 2. Noise-Restricted and Emission-Restricted Hours:
 - a. Restrict grinding, paving, sweeping, backup alarms equipment to hours after 8:00 am.
 - b. Idling trucks are acceptable after 7:00 am.
 - 3. Normal Work Hours involving lane closures or blockages within paved public right-of-way:
 - a. 8:00 am to 3:30 pm as amended by permit or noted on Plans.
 - b. Do not close or block streets, lanes, or alleys prior to these hours to allow impacted property owners time in morning to move vehicles before closures.
 - c. Set up of traffic control devices may begin 30 minutes prior to closure provided property owners are free to move vehicles.
 - d. Traffic control devices shall be off street by 3:30 pm and roads shall be open to traffic.
 - 4. Normal Work Days: Monday through Friday, excepting legal holidays.
 - 5. In addition, applicable permit conditions from governing agencies may further restrict working hours.
- B. Exceptions to this Work schedule shall be only as accepted in writing by Owner.
 - No Work shall be done outside of normal work hours and work days, except where necessary for public safety, care and protection of Work already performed, or other emergency
 - a. Provide written notice to Owner's Representative prior to any such emergency Work outside normal working hours.

- b. Provide written request to Owner's Representative 7 Calendar Days prior to Work outside normal working hours not required by emergency.
- Requests to work on Saturdays, Sundays, or legal holidays will be reviewed case-by-case
 and considered for acceptance based on additional costs to Owner, location of Work,
 nature of planned Work, and inconvenience to residents, businesses, community facilities,
 public events and activities associated with the proposed work day.
- 3. Owner reserves right to back-charge Contractor for costs incurred outside of standard work hours and days stated above.
- 4. Night work may be established as regular procedure by Contractor if they first obtain written acceptance from Owner.
 - Such notice may be revoked by Owner if Contractor fails to maintain adequate nighttime force and equipment for reasonable prosecution and to justify inspection of Work.

1.6 Reference Standards

A. Refer to Section 01 00 01 for listing of reference standards used.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION

3.1 Work Sequence

- A. The following staged sequence of construction shall apply, except as otherwise accepted in writing by Owner.
- B. The following Work sequence is provided for Contractor's convenience.
 - 1. It is not intended to dictate means and methods or cover every specific item of Work necessary
 - 2. It shall not relieve Contractor from their responsibility to coordinate and perform Work in accordance with Plans and Specifications.
 - 3. Elements under each stage are not necessarily sequential and may be subject to change by Owner.
 - 4. Prepare project schedule and as specified in Section 01 32 00.
 - 5. Changes to construction stages identified herein shall be proposed by Contractor and accepted in writing by Owner before implementation as described in Section 01 32 00.
 - 6. Complete Work not itemized in construction sequencing stages below in accordance with Contract documents and Contractor's proposed, Owner-accepted schedule.
- C. Notify Owner of conflicts of staging process within 30 calendar days of Notice of Award.
- D. General sequence of Work shall be:

E. Stage 1 Preparation

- 1. Before beginning Work, complete the following:
 - a. Coordinate with Servicing Electrical Utility regarding electric service to site, no existing electric service is available and Contractor shall provide for electrical power service/generators as needed to perform the work.
 - b. Obtain required permits, licenses and construction easements.
 - c. Call **Underground Service Alert** and utilities to obtain staking and marking of buried utilities.
 - d. Submit proposed schedule of Work, insurance and bonds.
 - e. Pothole as needed to supplement staking and marking.
 - f. Take preconstruction photographs.
 - g. Verify utility locations, field dimensions, pipe types and voltage and phase of on-site electrical services.
 - h. If discrepancies or conflicts are found, bring these to attention of Owner's Representative.

- i. Submit Shop Drawings and other submittals.
- j. Complete additional preliminary matters required by Contract Documents.
- 2. Begin manufacturing and shipping materials and equipment after receiving accepted submittals.

F. Stage 2 Mobilization

- 3. Provide traffic control facilities.
- 4. Construct temporary security fencing and appurtenances.
- 5. Construct new scaffolding, access facilities, and platforms required to perform Work
- 6. Construct sound attenuation devices as necessary.
- 7. Mobilize construction equipment.
- 8. Provide BMP's for SWPPP compliance.

G. Stage 5 Construction

- 9. Construct underground infrastructure, utilities, buried piping, and appurtenances.
- 10. Construct above-ground piping and well house facilities
- 11. Construct electrical and mechanical well house appurtenances.
- 12. Construct site civil improvements

H. Stage 7 – Mechanical Equipment Upgrades

- 1. Perform system disinfection
- 2. Startup and testing

I. Stage 9 Closeout

- 13. Remove temporary fencing, paving and construction equipment.
- 14. Provide operator training, including O&M manuals containing engineering Product Data and Shop Drawings on equipment.
- 15. Provide record drawings.
- 16. Clean up and restore construction areas.
- 17. Provide warranty as specified.

3.2 New Electrical Service

A. Refer to Section 26 05 10 for coordination requirements with servicing electrical utility.

3.3 Cooperation with Other Contractors

- A. Owner may have additional work performed in this area by other Contractors.
 - 1. Contract requires cooperation with those contractors in the area.
 - 2. Differences or conflicts which arise between Contractor and other contractors will be adjusted and determined by Owner.
 - 3. Contractor shall conduct their operations to minimize interference with work being done by other contractors.
 - a. Make good, promptly, injuries or damages to other contractors' work caused at Contractor's hands.

3.4 Contractor Use of Premises

- A. The following facilities shall remain operational throughout construction of Work:
 - 1. Water service.
 - 2. Do not shut off pipelines or power, or take action which might adversely affect Owner's use or operation of their facilities or premises without prior written authorization from Owner.
 - 3. Construct accepted signs, barricades and lights necessary to ensure public safety and safety of Owner's operators and personnel.
 - a. Provide steel plates across ditches to facilitate safe access of Owner's personnel to facilities.
- B. Contractor shall restrict their area of operations to avoid damage of trees and shrubs and shall not remove trees unless specifically directed by Owner.
- C. Contractor shall legally dispose of material removed.

D. Fences, walls, shrubs, sprinkler systems, substructures or other improvements removed or disturbed by Contractor during construction shall promptly be replaced and/or repaired at Contractor's sole expense to Owner's satisfaction.

3.5 Responsibility for Job Site Conditions

- A. Contractor shall assume sole and complete responsibility for jobsite conditions during course of construction of Work, including safety and health of persons and property; that this requirement shall apply continuously and not be limited to normal working hours
- B. Contractor shall defend, indemnify and hold Owner and design consultant harmless from any and all liability except that arising from sole negligence of Owner or design consultant.
- C. Refer to Section 01 35 26 for jobsite safety requirements.

3.6 Occupancy

A. Successful completion of pre-startup checkout and functional testing shall precede Owner's use or acceptance of completed Work.

END OF SECTION

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T-SECTION 01 21 00 BID OPTIONS

PART 1 - GENERAL

1.1 Work Included

- A. Administrative and procedural requirements governing Bid Options.
 - 1. All Bid Options are at the discretion of TVMWD to utilize and exercise or to omit from the project work.

1.2 Related Work

- A. Section 01 22 00: Unit Prices
- B. Section 01 33 00: Submittal Procedures

1.3 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - 1. SSPWC Standard Specifications for Public Works Construction §3-3 Extra Work

1.4 Unit Prices

A. Payment for Work under Bid Options shall be as specified in Section 01 22 00.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION

3.1 Preparation

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure each allowance item is integrated and interfaced with related Work.

3.2 Contract Closeout

A. At contact closeout, unused allowance amounts remaining shall be credited to Owner by Change Order.

END OF SECTION

4-19-dp 01 21 00 - Allowances - 1 of 2

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4-19-dp 01 21 00 - Allowances - 2 of 2

T-SECTION 01 22 00 UNIT PRICES

PART 1 - GENERAL

1.01 Description

- A. Measurement and payment for Bid Items listed in proposal shall be based upon use of lump sum or unit price method.
 - 1. Extra Work or changes in Work shall be accomplished as provided in Special Provisions.
- B. Refer to Special Provisions §1D-38 Progress Estimates" for additional requirements for preparing progress pay estimates.
- C. Payment for Work in each Section of these Contract Documents shall be included as part of lump sum or unit price bid amount for which such Work is appurtenant.
 - 1. No additional payment will be made for Work described in any Section for which no express bid item is provided.

1.02 Related Work

- A. Bid Proposal Form
- B. General Conditions
- C. Section 01 10 00: Summary of Work and Sequence of Construction
- D. Section 01 21 00: Bid Options
- E. Section 01 29 73: Schedule of Values

1.03 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Partial Payment	Submit monthly typewritten Payment Requests in 8½"x11" paper AIA format	
Requests	accepted by District	
Monthly Progress	Submit upon request supporting documents required for preparation of	
Estimate Backup	monthly progress estimates, including, but not limited to:	
Information	Invoices and receipts for equipment and materials	
	2. Updated schedules	
	3. Updated as-built drawings	
	4. Labor compliance records	
	5. Grant or loan funding required documents	
Final Payment Request	Submit typewritten Payment Requests in 8½"x11" paper AIA format accepted by District	
	Submit upon request supporting documents required for preparation of final	
	payment, including, but not limited to:	
	Invoices and receipts for equipment and materials	
	2. Updated as-built drawings	
	3. Labor compliance records	
	4. Grant or loan funding required documents	
	5. Lien waivers from all preliminary liens received by District	
	6. Release of Stop Notice(s)	

PART 2 - MATERIALS

2.01 General (Measurement)

A. Measurement for unit price quantities will be based upon appropriate Bid Item in proposal. Actual quantity of measurement shall be as constructed by Contractor in place in conformance with Plans and Specifications.

2.02 Linear Measurements

A. Pressure pipe, fencing, curbs, gutters, and other horizontal Work will be measured in horizontal plane along centerline of Work, through tees, bends, fittings, fence gates, driveways, meters, and valves, within limits of Work shown in Contract Documents.

2.03 Area Measurements

- A. Measurement for Bid Items involving area units will be based on horizontal-plane or verticalplane surface areas measured in units shown in bid schedule.
- B. In event of dispute, areas will be computed based on theoretical areas obtained from digital models, Autocad or Cogo prepared using best field surveys and record drawings available.
- C. For convenience, District may use "approximate areas" for payment based on 1 of the following procedures:
 - 1. Planimeter measurements using record drawings.
 - 2. Accepted mathematical formulas for circle or polygon areas.
- D. Measurements of paving or flatwork areas will measure area enclosed by exterior perimeter of measured surface. Areas of vaults, pads, maintenance hole covers, valve box covers, drainage features, hatches, pipe penetrations, bollards, and vents will be included within area measured for payment when surrounded by measured surface on 3 or more sides or at least 270° of arc measured from centers of circles.
- E. Measurements of wall, floor, and roof areas will measure area enclosed by exterior perimeter of measured surface. Areas of doors, gates, windows, hatches, duct penetrations, pipe penetrations, and vents will be included within area being measured for payment when surrounded by measured surface on 3 or more sides or at least 270° of arc measured from centers of circles.
- F. In absence of District-prepared survey and digital model, Contractor may, at their expense, retain licensed surveyor to prepare surveys and sealed calculations of theoretical areas obtained from digital models. In such case, Contractor's surveyor's computed volumes shall govern over "approximate areas" but shall not supersede similar surveys and digital models prepared at District's expense by licensed surveyor.

2.04 Volume Measurements

- A. Measurement for Bid Items involving volume units will be based upon volume measured in units shown in bid schedule.
 - 1. Gallons shall be US gallons.
- B. In event of dispute, payment volumes will be computed based on theoretical volumes obtained from digital terrain models prepared using best field surveys and record drawings available.
- C. For convenience, District may use "approximate volumes" for payment based on 1 of following procedures:
 - 1. Average end area volumes computed as product of average area of vertical or horizontal sections and intervening horizontal or vertical dimension.
 - 2. Accepted mathematical formulas for cylinder, cone, sphere, polyhedron or prism volumes.
 - 3. Analog volumes based on measured weights of delivered materials divided by densities shown in submittals or, in absence of submittal densities, values commonly accepted.
- D. In absence of District-prepared survey and digital terrain model, Contractor may, at their expense, retain licensed surveyor to prepare surveys and sealed calculations of theoretical volumes obtained from digital terrain models. In such case, Contractor's surveyor's computed volumes shall govern over "approximate volumes" but shall not supersede similar surveys and digital terrain models prepared at District's expense by licensed surveyor.

2.05 Weight Measurements

- A. Measurement for Bid Items involving weight units will be based upon weight measured in units shown in bid schedule.
 - 1. Pounds shall be avoirdupois pounds.
 - 2. Tons shall be 2000 lbs avoirdupois.
 - 3. Where Contract Documents require galvanizing, metal weights for payment shall include weight of zinc coating using table of zinc coating weights in ASTM A153.
 - 4. Weights of paint or other shop coatings shall be excluded from payment weights.
 - 5. Weights of temporary erection bolts, boxes, packing containers, and supports used during transportation shall be excluded from payment weights.
 - 6. Except as modified below for connecting bolts, weights of cap screws, anchor bolts, bolts, nuts, washers, and anchor pipe sleeves remaining in finished structure shall be computed based on nominal weights and dimensions shown in Shop Drawings.
- B. Scale weights for payment will be based on load certificates from state-certified platform scales delivered to District's Representative.
 - 1. Scale weights for metal shall be actual weight of members as determined by accurate platform scales.
 - 2. Where carload or truck weights are used, submit record to District's Representative containing itemized statement of dunnage and members included in each lot.
 - 3. Where protective coatings are applied, reduce scale weights as follows:
 - a. 0.25% for each coat of oil.
 - b. 0.5% for each shop coat of paint
 - c. 3.5% for hot-dip galvanizing when not required by Contract Documents
 - 4. Scale weights of members will not be required when quantities of structural steel are designated in Contract Documents in final quantities:
- C. Computed weights for metal shall be obtained using the following rules and assumptions.
 - 1. Density of structural steel and cast steel shall be assumed to be 0.2833 lbm/in³.
 - 2. Density of cast iron shall be assumed to be 0.2604 lbm/in³.
 - 3. Weights of rolled shapes and structural bars and plates shall be computed based on nominal weights and dimensions shown on Shop Drawings, deducting for copes, cuts, and open holes exclusive of bolt holes.
 - 4. Since no deduction to computed weights of structural steel members is made for bolt holes, weights of constructed members will be computed by adding weights of shop-driven and field-driven fasteners and weights of fillet welds.
 - 5. Weights of castings and fillets will be computed from Shop Drawing dimensions, deducting for openings or cuts in finished casting.
 - 6. Weights of pins and rollers will be computed from Shop Drawing dimensions, deducting for holes, openings, pockets, and metal removed by machine finishing.
 - 7. Pilot nuts and driving nuts for each size pin shall be furnished for erection Work, and weights of said nuts shall not be included in payment weights for pins and rollers.
 - 8. When members contain both alloy and carbon steel, computed weights shall be used to determine pay quantities.
 - 9. Weight of structural steel to be paid for shall not exceed computed weight by >1½%.
 - 10. If scale weight of any member is <97½% of computed weight of that member, member will be rejected and will not be included in pay quantities.
 - 11. If computed weights are used, weight to be paid for will be calculated weight as established by District's Representative, and no allowance will be made for weight in excess thereof.
 - 12. When estimated metal quantities required for Work are shown in Contract Documents, said estimated quantities shall payment quantities unless dimensions of Work shown on Plans is revised by District's Representative.
 - a. If Plan dimensions are revised, payment quantities will be adjusted accordingly

2.06 Contractor-Furnished Surveys

A. No payment will be made to Contractor for Contractor-furnished surveys other than such additional payment Contractor may be entitled to due to corrected payment quantities based on Contractor-furnished surveys.

2.07 <u>Unit Measurements</u>

A. Measurement for Bid Items involving units of item will be based upon quantity of units counted as indicated in Bid Item.

2.08 Payment of Unit Price Items

A. Payment for unit price Bid Items will be based upon amount shown in bid schedule multiplied by total installed quantity measurement of item.

2.09 Lump Sum Measurement

- A. Measurement for lump sum Bid Items will be considered as complete project or portion of project constituting a unit.
 - 1. Items to be included in lump sum Bid Items shall be as specified in proposal Bid Item and/or Standard or Special Provisions and as indicated on accepted Schedule of Values.

2.10 Payment Procedures

- A. District's Representative will prepare monthly progress estimate and submit progress estimate on 15th day of each month.
- B. Payment will be made within 30 days after receipt of satisfactory progress estimates.
- C. Payment will be based on amounts shown in bid schedule with percent completion based on:
 - 1. Measured quantities of Work installed for unit price items.
 - 2. Percent completed computed based on District-accepted schedule of values for lump sum items.
- D. Schedule of Completed Values shall be tabular listing of Work Items from District-accepted Schedule of Values.
 - 1. Schedule of Completed Values shall show for each Item of Work the Item Number; Description; Item Value; % and Value Complete for previous period; % and Value complete for current period; Value of Stored Materials (if any); and Total Billing Value.
 - 2. List each issued Field Order and Change Order on Schedule of Completed Values as a separate Item.
 - 3. Attach Schedule(s) of Completed Values to each Invoice presented for payment.

E. Present pay request in tabular format showing:

LUM	P SUM BID	ITEMS				_						
ITEM ORI		ORIGINA	ORIGINAL CONTRACT AMOUNT			TOTAL PREVIOUS BILLING		CURRENT BILLING		TOTAL BILLED TO DATE		% COMPLETE
Bid Item No.	Item Description			Valu	ie	Value		Value		%		
UNIT	PRICE BID	ITEMS										
ITEM		ORIGINAL CONTRACT AMOUNT		TOTAL PREVIOUS BILLING		CURRENT BILLING		TOTAL BILLED TO DATE		% COMPLETE		
Bid Item No.	Work Item Description	Quantity	Unit	Unit Price	Bid Amount	Quantity	Value	Quantity	Value	Quantity	Value	%
TOTA	AL CONTRA	CT	•	•	•	•		•	•			•
ORIGINAL CONTRACT AMOUNT			TOT. PREVI BILLI	OUS	CURF BILL		TOTAL TO D		% COMPLETE			

Total Contract Amount	Value	Value	Value	%
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- F. Payment shall be full compensation for furnishing supervision, lab or and services, operations, transportation, materials, equipment, tools, supplies, incidentals and appurtenances required for construction of Work item, complete, functional, tested, and in place in accordance with Contract Documents, including costs of permits and cost of compliance with regulations of public agencies having jurisdiction.
- G. No payment will be made for materials wasted or disposed of in manner not called for under Contract.
 - 1. This includes rejected material not unloaded from vehicles, material rejected after placement, and material placed outside Work limits shown.
 - 2. No compensation will be allowed for disposing of rejected or excess material.
- H. Whenever Work is performed by District at Contractor's request, cost thereof will be charged against Contractor, and may be deducted from amounts due or becoming due from District.
- I. If immediate action is required to prevent injury, death, or property damage, and precautions which are Contractor's responsibility have not been taken and are not reasonably expected to be taken, District may, after reasonable attempt to notify Contractor, cause such precautions to be taken and will backcharge cost thereof against Contractor, or may deduct such cost from amounts due or becoming due from District.
 - 1. District action or inaction under such circumstances shall not be construed as relieving Contractor or their Surety from liability.
- J. Payment shall not relieve Contractor from their obligations under Contract, nor shall such payment be construed as acceptance of Work.
 - 1. Payment shall not be construed as transfer of ownership of equipment or material to District.
 - Responsibility of ownership shall remain with Contractor who shall be obligated to store fully or partially completed Work for which payment has been made, or replace materials or equipment required to be provided under Contract which may be damaged, lost, stolen or degraded prior to acceptance of Work.
- K. Warrantee or quarantee periods shall not be affected by time of payment.
- L. If, within time fixed by law, a properly executed notice to stop payment is filed with District, due to Contractor's failure to pay for labor or materials used in Work, money due for such labor or materials will be withheld from payment to Contractor in accordance with applicable laws.
- M. Partial payments made after Contract completion date will reflect amounts withheld for Liquidated Damages.
 - 1. Such partial payments made to Contractor, or their Sureties, will not constitute waiver of District's Liquidated Damages.
- N. Partial payments may be made for materials and equipment delivered to jobsite or District's yard or warehouse, inventoried upon delivery, suitably and safely stored within secure storage area at Work site.
 - 1. Requests for payment of materials and equipment delivered to jobsite or District's yard or warehouse shall be accompanied by copies of invoices, bills of lading, delivery receipts, or other suitable documentation showing proof of delivery and cost.
 - 2. If requested by District's Representative, provide additional data as may be reasonably required to support submitted Invoice.
- O. Unless District has agreed in writing to partial payment for material and equipment, Contractor shall pay storage, financing, and other costs associated with ordering, receiving, and storing materials and equipment until materials and equipment can be incorporated into Work.

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- P. If Work on Saturdays, Sundays, legal holidays, or outside of specified work hours is requested by Contractor and approved by District's Representative, Contractor shall pay to District additional costs borne by District beyond those costs typically required for Work within District-accepted work schedule.
 - 1. Such costs may include, but not be limited to overtime and additional inspection costs.
 - 2. Exceptions to this requirement include special work schedules described in Contract Documents at time of bidding, negotiated change orders, work schedules required by permits or regulatory agencies, and schedule changes for District's convenience.

2.11 Work Not Listed in Bid Schedule

A. Include costs for related Work and appurtenances required and/or implied by Permits and Contract Documents but not listed as a separate Bid Item under appropriate Bid Item or items within Bid Schedule.

2.12 **Protecting Existing Utilities**

- A. No Bid Item is provided for Work described in Section 31 05 50 protecting existing utilities.
- B. Payment for locating, potholing, exposing, and protecting existing utilities will be included in price bid for Work items for which such Work is appurtenant.
- C. Payment for abandoning or removing existing utilities will be included in price bid for Work items for which such Work is appurtenant.
- D. <u>Utility Protection or Relocation by Contractor as Shown in Contract Documents</u>: When work on a utility is shown within Contract Documents to be done by Contractor, but is not included as a separate bid item, Contractor shall make arrangements and coordinate with utility District regarding schedule for performance of Work.
 - 1. Include costs for such Work in unit prices or lump sum amounts bid for various Contract items.
 - 2. Submit proposed method of relocation or protecting utility for review.
 - 3. Review by District will not relieve Contractor of any responsibility.
- E. <u>Utility Relocation by Contractor for Contractor's Convenience:</u> Temporary relocation or alteration of any utility, desired by Contractor solely for their convenience in performance of Work, to a position or condition other than that provided for on Contract Documents shall be Contractor's own responsibility.
 - Make arrangements with utility or property owners regarding such Work. Repair, replacement or relocation of buried utilities shall be completed at Contractor's expense by either Utility's forces, or by contractor accepted by Utility in writing and properly licensed to perform Work.
 - 2. Costs of such Work for Contractor's convenience shall be absorbed in unit prices or lump sum amounts bid for various Contract items at no additional cost to District.
- F. <u>Utility Relocations by District</u>: When Contract Documents indicate a utility is to be relocated, altered, or reconstructed by forces other than Contractor, District will conduct negotiations in respect to such work and work will be done at no cost to Contractor.
 - 1. No additional compensation will be given for delays or inconvenience by others to finish their Work on schedule due to unforeseen difficulties.
- G. <u>Unknown Utility Installation by Others During Contract Work</u>: If utility is disclosed or installed subsequent to award of Contract, and utility is not shown on Contract Documents, with reasonable accuracy, and said utility is found to occupy space required to be occupied by Work, District's Representative will determine whether utility requires location, relocation, removal, repair of damages, alteration, support or protection.
 - 1. District will determine method and manner of accomplishing such Work and may order Contractor to do so pursuant to Change Order issued by District.

- 2. Perform Work in accordance with Contract Documents provided or accepted by District and in accordance with the following:
 - a. Where undisclosed utilities are discovered and located by Contractor when performing this Contract, immediately notify District in writing.
 - b. When said utility is found to occupy space required to be occupied by part of permanent Works to be constructed under Contract or parallel to permanent works and within vertical planes on each side at distance away equal to maximum allowable trench width measured in plane 12" above top of pipe, exclusive of branches or other facilities, as specified in Contract Documents, or to be within specified excavation pay lines (when such are specified in Contract Documents); District shall arrange for relocation or alteration of said utility or require Contractor to do same.
 - c. Utilities found to cross excavation, but not intercepting permanent Work to be constructed or interfering with construction shall be maintained in place at Contractor's expense.
 - d. Utilities which interfere with construction technique in use shall be protected or relocated.
 - e. When said utility is more or less parallel with, and any portion of it does not lie within vertical planes specified herein above, or does not lie within excavation pay lines (when such are specified or shown on Contract Documents), advise District thereof, and in cooperation with utility owner, provide and place necessary support for proper protection to guarantee continuous and safe operation of utility.
 - f. Maintain continuous sanitary sewer service.
 - g. Should existing sanitary sewer or maintenance hole extend within proposed excavation, submit method of construction or support for acceptance by District, and assume all responsibilities therefor.
 - h. Costs for such Work shall be borne by Contractor.
 - i. If Work is done by others, provide time and working space for protection and relocation as required.
 - j. District will compensate Contractor for their direct costs of locating, relocating, removal, repair, support or protecting undisclosed utilities, together with cost of equipment used for Work necessarily idled during such Work.
 - k. Contractor will be granted extension of time for completion of Contract equal to time determined by District, to be reasonably necessary to perform the Extra Work, and District will not assess liquidated damages against Contractor for delay in completing Work when such delay was caused by District's failure of District to provide for removal or relocation of such utility facilities.
 - I. Contractor will not be entitled to extra compensation or extension of time when Extra Work is required to repair damage to undisclosed utilities caused by failure of Contractor to exercise reasonable care.
 - m. Contractor will not be entitled to compensation for indirect or consequential costs or damages incurred as a result of Extra Work required.
 - n. When directed or accepted by District, changes in line or grade of structure being built may be made to avoid utilities.
 - o. Additional costs because of such changes will be paid for by Change Order as Extra Work.

2.13 Payment for Testing

- A. Party responsible for payment for testing is identified in individual sections of Contract Documents under tests required.
 - 1. Where Specifications are silent regarding responsible party paying for tests, costs of first tests will be paid by District.

- B. If testing or inspection indicates failure of material or procedure to meet Contract Document requirements, District will back-charge Contractor for retesting and re-inspection costs incurred by testing or inspection agency of District's choice.
 - 1. Such charges will be deducted from progress payments due Contractor.
- C. Additional tests and inspections not specified herein but requested by District will be paid for by District, unless result of such tests and inspections are found to not comply with Contract Documents, in which case District will pay costs for initial testing as well as retesting and re-inspection and back-charge Contractor for retesting and re-inspection.
- D. Costs for additional tests or inspections required because of change in materials being provided or change of source or supply shall be paid by Contractor direct to testing laboratory.
- E. Cost of testing which is required solely for convenience of Contractor in his scheduling and performance of Work shall be borne by Contractor.
- F. Contractor shall pay costs for correcting deficiencies.

2.14 Changes in Quantities Initiated by District

A. Refer to General Conditions §10.7 "Allowable Quantity Variations" for additional requirements for payment where Work quantities differ from Bid quantities.

or

- B. District may change Contract Documents or character and quantity of Work provided total arithmetic dollar value of all changes, both additive and deductive, does not exceed 25% of Contract Price.
 - 1. Changes in Bid Option Items with stipulated prices will not be considered to contribute toward this total.
- C. Should it become necessary to exceed this limitation, change shall be documented by written Supplemental Agreement between Contractor and District unless both parties agree to proceed under Change Order.
- D. Changes ordered in Work items which do not substantially change character of Work from that shown in Contract Documents, will be accompanied by proportional adjustment in payment to reflect quantity changes using unit prices bid, provided Bid quantity does not change by >25%.
- E. Where Bid quantities under a Bid Item are limited to 2 or 3 integral units (eg. 2 valves) the 25% figure above shall be revised upward (to 50% or 34% respectively) to permit addition or deletion 1 integral unit without changing Bid price.
- F. Payment for quantities in >125% of quantities (or appropriate percentage for 2- or 3-unit Bid Items) will be made at mutually agreed rate lower than Bid amount since Contractor's fixed costs shall be deemed to have been recovered through payment for Bid quantity at Contract unit price.
- G. Payment for quantities <75% (or appropriate percentage for 2- or 3-unit Bid Items) will only be adjusted by mutual agreement if Contractor requests so in writing.
 - 1. In no case will payment be less than Contractor is entitled to under original Bid prices nor more than payment due for 75% (or appropriate percentage for 2- or 3-unit Bid Items) of Bid quantity at Contract Unit Price.
- H. If mutual agreement cannot be reached, District may direct Contractor to proceed on basis of Extra Work as covered in General Provisions.
- I. Should a Bid Item be eliminated in its entirety, payment will be made to Contractor for actual out-of-pocket costs incurred in connection with eliminated item prior to written notification from District of deletion of Bid Item.

- 1. Where applicable, Contractor will also be reimbursed for out-of-pocket shipping costs and Manufacturer's restocking fees.
- J. If materials have been ordered prior to date of written notification of deletion of Bid Item and order cannot be cancelled, Contractor will be paid for actual cost of ordered item and ordered material shall become District's property.
- K. In no case shall expenses such as bonding costs expressly covered under other Bid Items be double-charged to District.

PART 3 - EXECUTION

3.01 **Scope**

A. This section defines Bid Items listed in Bid schedule and describes measurement and payment provisions for each item.

3.02 Specification Sections with No Bid Item

- A. Where specification sections are included but no pay item(s) are expressly set forth for Work within those sections, include costs of Work described within those sections under bid items for Work for which the Work within those specification sections is appurtenant.
- B. Specification sections for which no pay item is set forth include but are not limited to:
 - 1. Section 01 10 00: Reports, Standard Drawings, Standard Specifications, and Accepted Materials List
 - 2. Section 01 10 01: Summary of Work and Sequence of Construction
 - 3. Section 01 10 02: Sequence of Operation
 - 4. Section 01 10 03: Coordination
 - 5. Section 01 10 04: Maintenance of Plant Operation
 - 6. Section 01 11 11: Green Building Standards Code Compliance
 - 7. Section 01 21 00: Bid Options
 - 8. Section 01 22 00: Unit Prices
 - 9. Section 01 24 00: Cost Reduction Incentive Proposals
 - 10. Section 01 29 73: Schedule of Values
 - 11. Section 01 31 19: Project Meetings
 - 12. Section 01 32 00: Construction Progress Documentation
 - 13. Section 01 32 23: Construction Survey Staking
 - 14. Section 01 32 33: Construction Photographic and Video Documentation
 - 15. Section 01 33 00: Submittal Procedures
 - 16. Section 01 35 13: Special Project Procedures
 - 17. Section 01 35 26: Governmental Safety Requirements
 - 18. Section 01 35 43: Environmental Procedures
 - 19. Section 01 35 44: Environmental Procedures for Hazardous Materials
 - 20. Section 01 40 00: Quality Requirements
 - 21. Section 01 41 26: Permit Requirements
 - 22. Section 01 42 13: Abbreviations and Acronyms
 - 23. Section 01 45 30: Chemical Resistance (Pickle Jar) Test
 - 24. Section 01 45 31: Infiltration Capacity Test
 - 25. Section 01 45 32: Handheld Viscometer Test
 - 26. Section 01 50 00: Temporary Facilities and Controls
 - 27. Section 01 57 23: Temporary Storm Water Pollution Control, BMP Implementation and Erosion Control/Compliance with SWPPP Requirements
 - 28. Section 01 61 00: Common Product Requirements
 - 29. Section 01 63 00: Product Substitution Procedures
 - 30. Section 01 65 00: Project Delivery Requirements
 - 31. Section 01 66 00: Project Storage and Handling Requirements
 - 32. Section 01 73 00: Execution
 - 33. Section 01 73 24: Seismic Restraint
 - 34. Section 01 73 33: Mechanical Identification
 - 35. Section 01 74 00: Cleaning and Waste Management
 - 36. Section 01 77 00: Closeout Procedures

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37. Section 03 08 50: Leakage Testing of Hydraulic Structures
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- 38. Section 03 10 00: Concrete Forming
- 39. Section 03 15 00: Concrete Accessories
- 40. Section 03 20 00: Concrete Reinforcing
- 41. Section 03 22 00: Fabric and Grid Reinforcing
- 42. Section 03 23 00: Stressed Tendon Reinforcing
- 43. Section 03 23 10: Stressed Tendon Reinforcing for Post-Tensioned Anchors
- 44. Section 03 23 13: Stressed Tendon Reinforcing for Prestressed Concrete Tanks
- 45. Section 03 24 00: Fibrous Reinforcing
- 46. Section 03 25 50: Tank Wall Base and Top Joint
- 47. Section 03 27 17: Externally-Bonded Fiber-Reinforced-Polymer (FRP) Strengthening System
- 48. Section 03 32 10: Cement Mortar
- 49. Section 03 35 00: Concrete Finishing
- 50. Section 03 35 19: Colored Concrete finishing
- 51. Section 03 35 33: Stamped Concrete Finishing
- 52. Section 03 39 00: Concrete Curing
- 53. Section 03 60 00: Grouting
- 54. Section 03 64 23: Epoxy-Injection Grouting
- 55. Section 04 05 00: Masonry Mortaring and Grouting
- 56. Section 05 05 19: Post-Installed Concrete Anchors
- 57. Section 05 05 23: Metal Fastenings and Welds
- 58. Section 05 40 00: Cold-Formed Metal Framing
- 59. Section 09 90 00: Painting and Coating
- 60. Section 09 92 00: Galvanizing
- 61. Section 09 96 56: Epoxy Linings and Coatings
- 62. Section 10 14 00: Signage
- 63. Section 10 73 17: Fabric Canopies
- 64. Section 31 05 50: Protecting Existing Utilities
- 65. Section 31 23 00: Excavation and Fill
- 66. Section 31 23 13: Subgrade Preparation
- 67. Section 31 23 33: Trenching and Backfilling
- 68. Section 32 11 00: Untreated Base Courses
- 69. Section 32 12 23: Tack Coats
- 70. Section 32 13 73: Concrete Paving Joint Sealants
- 71. Section 32 91 19: Topsoil Placement and Grading
- 72. Section 33 01 13: Pipeline Dewatering, Ventilation, and Support Services
- 73. Section 33 01 40: Service Lateral Connection Sealing
- 74. Section 33 05 26: Utility Identification
- 75. Section 33 05 31: Pipeline Joint Materials
- 76. Section 33 05 32: Flange Insulating Kits and Threaded Insulated Bushings
- 77. Section 33 05 33: Couplings, Tie Rods, Flange Connectors, and Unions
- 78. Section 33 05 34: Grooved and Shouldered (Victaulic Style) Couplings
- 79. Section 33 05 37: Wall Pipes, Seep Rings, and Penetrations
- 80. Section 33 05 38: Hangers and Supports
- 81. Section 33 05 39: Manual Valve Operators
- 82. Section 33 08 11: Pressure Testing and Flushing of Water Utilities
- 83. Section 33 08 31: Leakage and Infiltration Testing of Gravity Sewer Pipelines
- 84. Section 33 11 18: Cement-Mortar lining and Coating of Steel Pipe
- 85. Section 33 11 19: Mastic and Tape-Wrap Systems for Metal Pipe
- 86. Section 33 11 20: Polyethylene Encasement for Iron Pipe, Fittings, Couplings, and Valves
- 87. Section 33 11 21: Brass and Copper Pipe
- 88. Section 33 12 22: Bronze Valves 3-inches and Smaller
- 89. Section 33 12 23: Stainless Steel Valves 3-inches and Smaller
- 90. Section 33 12 24: Plastic Valves
- 91. Section 33 13 00: Disinfecting Water Utility Pipelines
- C. Payment for obtaining and complying with permits during construction, including NPDES permits, building permits, encroachment permits, excavation permits, drilling permits, disposal permits, temporary easements, licenses, inspection fees, and Federal, State and local taxes will be included in prices bid for Work for which such costs are appurtenant.

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- D. Payment for shoring and bracing will be included in price bid in bid item for shoring and bracing.
- E. Payment for confined space entry procedures and safety provisions shall be included in lump-sum bid item for Confined Space Entry and other safety requirements.
- F. If environmental procedures require Contractor to stop Work for more than 8 hours, Contractor will be reimbursed under Change Order for standby or remobilization costs.
- G. Include costs of temporary facilities and controls under Bid Items for Work for which temporary facilities and controls is required.
- H. Payment for water furnished by Contractor for construction use will be included in price bid for items to which it is appurtenant.
 - 1. Payment under these items will include full compensation for furnishing labor, products, tools and equipment and doing work necessary to develop sufficient water supply and furnishing necessary equipment for applying water as specified.
- Payment for sanitary facilities will be included in price bid for "Mobilization/Demobilization" / major Work items for which mobilization and demobilization are required.
- J. Payment for power furnished by Contractor for construction use will be included in price bid for items to which it is appurtenant.
 - 1. Payment under these items will include full compensation for furnishing labor, products, tools, and equipment and doing work necessary to obtain and distribute power for construction purposes.
- K. Payment for other temporary utilities furnished by Contractor for construction use will be included in price bid for items to which it is appurtenant.
 - Payment under these items will include full compensation for furnishing labor, products, tools, and equipment and doing work necessary to obtain and distribute power for construction purposes.
- L. Payment for providing construction aids to be furnished by Contractor in support of construction activities will be included in price bid for items to which it is appurtenant.
 - 1. Payment under these items will include full compensation for furnishing labor, products, tools, and equipment and doing work necessary to obtain, distribute, and use temporary utilities for construction purposes.
- M. Payment for dust control, including dust palliatives and water supply and application will be included in price bid for Work items for which dust control during construction is required.
- N. Payment for costs arising from fire or prevention of fire will be included in price bid for items of work for which fire protection during construction is needed.
- O. Payment for noise control facilities will be included in price bid for items of Work where noise control facilities are required during construction.
- P. Payment for providing site security will be included in price bid for items to which it is appurtenant.
 - 1. Payment under these items will include full compensation for furnishing labor, products, tools, and equipment and doing work necessary to comply with site security requirements.

3.03 Bid Item 01 – Mobilization/Demobilization, Bonds, and Permits

- A. Amount bid for Mobilization/Demobilization shall not exceed 5.0% of Contractor's Bid total.
 - 1. Amounts bid in excess of stipulated 5.0% cap will not be paid until project completion.
- B. Work to be paid for under mobilization shall include:
 - 1. Providing bonds and insurance.
 - 2. Obtaining temporary easements.

- 3. Arranging for and establishing storage yard and staging area.
- 4. Possessing OSHA required notices and establishing safety programs.
- 5. Obtaining required permits.
- 6. Submitting initial submittals and project schedule.
- 7. Initiating contact with servicing electrical utility to coordinate installation of electrical service.
- 8. Locating existing utilities.
- 9. Providing preconstruction photos and videos.
- 10. Performing required surveys.
- 11. Performing required testing.
- 12. Moving operations onto site.
- 13. Providing project signs.
- 14. Providing temporary utilities.
- 15. Providing temporary facilities.
- 16. Providing temporary security fencing and monitoring.
- 17. Providing site maintenance and cleanup.
- 18. Providing noise attenuation.
- 19. Providing field offices.
- 20. Conforming to General Provisions and Special and Supplementary Conditions.
- C. Work to be paid for under demobilization shall include:
 - 1. Regrading ground surfaces to restore preconstruction grades.
 - 2. Reconstructing berms, fences, walls, structures and improvements.
 - 3. Repairing damage to pavement, flatwor4k, landscaping and irrigation.
 - 4. Removing splatter, grease, stains, fingerprints, dust, labels and other laitance from finished Work.
 - 5. Repairing improvements damaged by Contractor's operations.
 - 6. Cleaning slabs, paving and ground surfaces.
 - 7. Restoring damaged finishes and nameplates.
 - 8. Removing temporary facilities, utilities, and structures.
 - 9. Legally disposing of waste.
- D. Work to be paid for under this item shall also include protecting existing survey monuments in place and, if Contractor's operations disturb such monuments, hiring registered land surveyor to reestablish and reset disturbed monuments.
- E. Work to be paid for under this item shall also include installing, maintenance and removal of necessary BMPs for SWPPP purposes required by Regional Water Quality Control Board, including establishment of erosion control plan and reporting procedures, placement of erosion control measures, monitoring, reporting, payment of fines due to Contractor's negligence and appurtenant Work required by Contract Documents.
- F. Work to be paid for under this item shall include temporary bypass facilities, including connections to existing buried or above-ground piping, piping, valves, concrete coring, pumping facilities, electrical Work, fencing, protecting and securing temporary equipment and appurtenant Work to maintain District's facilities in operation throughout construction.
- G. Work to be paid for under this item shall also include payment for demobilization, removal of temporary facilities, cleanup of construction site, providing record drawings, well completion report, operation and maintenance manuals, and warranties, complete in place.
- H. Payment for verification of field dimensions and utility locations will be included in price bid for items of Work which may require relocation or refitting if field dimensions differ from those shown on plans.
- I. Payment for Bid Item No. 1 Mobilization shall be made according to the following schedule upon acceptance from District:

- 1. Upon completion of mobilization, 50% of amount bid for this item (or 50% of stipulated 5.0% cap, whichever is less, will be made to Contractor with first progress payment.
- 2. Once total amount of progress payments earned to date exceeds 50% of original contract amount, payment to 75% of amount bid for this item (or 75% of stipulated 5.0% cap, whichever is less, will be paid to Contractor as part of next monthly partial payment estimate of total amount earned to date.
- 3. Remainder will be paid as part of final contract payment upon project completion.
- J. Cost for preparing SWPPP, complying with SWPPP requirements, and complying with storm water pollution prevention best management practices when no SWPPP is available, shall be included in the various bid items set forth in these documents and no additional compensation will be granted.

3.04 Bid Item 02 — Traffic Control

A. Lump sum Bid Item for Contractor costs for equipment, training and personnel to maintain traffic control in areas impacted by the work. Costs include permitting costs, traffic control equipment required by permitting, labor and materials.

3.05 Bid Item 03 - Well House Building w/Fieldstone Cladding

- A. Lump sum Bid Item for Contractor costs to construct all building structural elements including:
 - 1. Reinforced concrete slab
 - Masonry walls and fieldstone cladding
 - 3. Roofing and access hatch
 - 4. Doors and exterior appurtenances
 - 5. Interior walls, ceiling
 - 6. Painting and coatings
- B. Submittal for the roof trusses is required from the Contractor within 45 calendar days of the NTP.

3.06 Bid Item 04 – HVAC (AC and Ventilation)

A. Lump sump Bid Item for Contractor costs for providing and installing ventilation and air cooling systems per the project drawings. Costs include duct work, thermostat controls, sound attenuating building intake louvers, and equipment.

3.07 Bid Item 05 – Asphalt Drive and Paving

A. Lump sum Bid Item for Contractor costs for providing asphalt drive and paving as shown in the project drawings.

3.08 Bid Item 06 – Fieldstone Storm Swales

A. Lump sum Bid Item for Contractor costs for providing and installing fieldstone lined storm swales per the project drawings.

3.09 Bid Item 07 - Wrought Iron Fencing

A. Lump sum Bid Item for Contractor costs for providing and installing wrought iron fencing and fieldstone clad pilasters per the project drawings. Costs include fencing, masonry pilasters and fieldstone cladding, gates, locking mechanisms, painting, electronic gates, and lighting.

3.10 Bid Item 08 – Export Native Soil Materials – Percolation Pond Construction

A. Lump sum Bid Item for Contractor costs for excavation, transport, and legal disposal of export native soil from the project site from construction of the percolation pond and other site improvements. Costs include any permitting or testing requirements for disposal.

3.11 Bid Item 09 - Concrete Access Drives, Pads, and Curbing, and Misc

A. Lump sump Bid Item for Contractor costs to provide and install concrete drives, equipment pads, curbing, and miscellaneous concrete work and grouting where shown in the project drawings.

3.12 Bid Item 10 – Well Header Piping and Appurtenances

- A. Lump sum Bid Item for Contractor costs for 6 and 8 inch welded steel piping for the well header discharge and well to well lines and appurtenances.
- B. Items include but not limited to.
 - 1. Motorized gate valves, 6 inch and 8 inch
 - 2. Swing check valve
 - 3. Air release valve assembly
 - 4. Magnetic flow meter
 - 5. Pipe supports
 - 6. Sampling taps
 - 7. Coatings and linings
 - 8. Other header appurtenances as shown in the plans

3.13 Bid Item 11 - Yard Piping an Pond Outlet Structure

A. Lump sum Bid Item for Contractor costs for 6 and 8 inch welded steel piping for the well discharge and well to waste piping in the site yard. Costs include the outlet structure and outlet valve assembly as shown in the project plans.

3.14 Bid Item 12 – Provide and Install Vertical Turbine Pump and Motor

- A. Lump sum Bid Item for Contractor costs to provide and install a vertical turbine pump at the site's predeveloped well down-hole.
- B. Coordinate with the pump supplier on installation requirements to ensure the installation meets requirements for equipment warrantees from the supplier.
- C. Work to be paid for under this item shall include purchase and installation of the pump, connection to discharge header and providing a functional system.
- D. Submittal for the pump is required from the Contractor within 15 calendar days of the NTP.

3.15 Bid Item 13 - Electrical: MCC & Switchboard, Portable Generator Connection, etc

- A. Lump sum Bid Item for Contractor costs to provide and install the new MCC, switchboard, portable generator hookup, and all well building electrical.
- B. <u>Submittal for the MCC equipment is required from the Contractor within 45 calendar days</u> of the NTP.

3.16 Bid Item 14 – SCADA and Telemetry

A. Lump sum Bid Item for Contractor costs to provide and install SCADA telemetry communications equipment, hardware and software, electrical, and integration of new well process data points to the existing TVMWD SCADA system. Contractor shall coordinate the MCC installation and equipment with TVMWD 's SCADA integrator's design and provided PLC.

3.17 <u>Bid Item 15 – Yard, Electrical and Security, Future Conduits</u>

A. Lump sum Bid Item for Contractor costs to provide and install electrical features in the site yard including building and site power, security, motorized gates, lighting, and future conduits.

3.18 Bid Item 16 – Miscellaneous Electrical Improvements

A. Lump sum Bid Item for Contractor costs to provide and install miscellaneous electrical required to provide full function to all instruments and features shown in the plans. Electrical power, communications, wiring and conduits shall be provided to enable full function of all systems in the project design documents.

3.19 Bid Item 17 - Pressure Testing and Disinfection of Piping and Equipment

A. Lump sum Bid Item for Contractor costs to provide all materials and perform pressure testing and disinfection of piping and equipment installed as part of the project work.

3.20 Bid Item 18 – Startup and Testing and Training

- A. Lump sum Bid Item for Contractor costs to provide all materials, pump and other equipment supplier representatives onsite and remote assistance, to perform startup and testing of the project new equipment and pumping systems. The startup shall include the new pump, its motor control center, remote SCADA connections, instrumentation calibrations, and provide equipment adjustments modifications or additions as needed.
- B. Work to be paid for under this item shall include the development and the review process for the new pump system and equipment operations and maintenance manuals to be developed and provided by the Contractor.
- C. Work to paid under this item includes the training of the TVMWD staff on the new project installed systems and review with staff the Contractor provided O&M manuals. testing for asbestos and other hazardous materials before demolition, removal, handling, and legal disposal of asbestos or other hazardous materials, including remediation, encapsulation, transportation, and applicable landfill and disposal fees.
- D. Work to be paid under this item includes providing a written statement from the pump supplier that the pump installation, and startup and testing results meet the supplier's requirements for warranty enforcement as witnessed by their onsite representative.

3.21 Bid Option Item O-1 – Option for Field Orders

- A. Bid Option 1 has been set aside for procurement and installation of noise abatement materials as shown in the plans.
- B. This Bid Option may be omitted at the discretion of the District.

END OF SECTION

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T-SECTION 01 29 73 SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 Work Included

- A. This section describes preparation of Schedule of Values providing breakdown of labor, materials, tools, equipment and other costs for measurement and payment purposes.
 - 1. Schedule shall show division of Work between Contractor and each Subcontractor.
 - 2. Break Schedule of Values down according to each Specification Division within each project area or structure on site.
 - 3. Include item in Schedule for County and State taxes plus cost items for bond, insurance, temporary facilities and mobilization.
 - 4. Schedule shall itemize items for purchase/delivery, costs for each item and material for which Contractor will request payment prior to installation.
 - 5. Each item shall include overhead and profit directly proportional to direct cost of that item over total Contract cost.
- B. Refer to General Provisions §C-29 "Payments to Contractor" for additional requirements for schedule of values.
- C. Refer to Special Provisions §D-6 "Breakdown of Contract Price" for additional requirements for schedule of values.
- D. Provide Schedule of Values breakdown:
 - 1. On lump sum Bid Items >\$25,000.
 - 2. On smaller lump sum Bid Items where Contractor desires to break down Work items for their convenience or to facilitate payment.
- E. Assign prices to Bid Items which aggregate to Contract Price.
 - 1. Base prices on costs associated with scheduled activities for each Bid Item.
- F. Finalized Schedule of Values will not be accepted until Contractor has responded to Owner's review comments.
 - 1. Provide supporting data, including certified payrolls, as requested by Owner's Representative for Schedule items.
- G. Prepare Schedule of Materials and Equipment Costs providing information necessary for Owner to document asset valuations for Owner's Asset Management program.

1.2 Related Work

- A. Section 01 21 00: Allowances
- B. Section 01 22 00: Unit Prices
- C. Section 01 32 00: Construction Progress Documentation

1.3 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for schedule of values.

PART 2 – MATERIALS (not used)

PART 3 – EXECUTION

3.1 Submittals

A. Submit Schedule of Values and Schedule of Equipment and Materials Costs deliverables as described herein and in accordance with the following timeline:

DELIVERABLE	SUBMITTAL TIME
Preliminary Schedule of Values (Categories Only)	Within 10 Calendar Days from Notice of Award

Schedule of Values	Within 21 Calendar Days from Notice of Award
Schedule of Values; review and resubmittal	Within 28 Calendar Days from Notice of Award
Schedule of Equipment and Materials Costs	Coincident with first submittal of O&M manuals / record
	drawings

B. Upon request, support prices with data which will substantiate their correctness.

3.2 Schedule of Values

- A. Submit Schedule of Values listing each Bid Item identified in Bid Schedule and breaking down large Bid Items for major subcomponents of Work.
- B. Schedule of Values shall contain itemized list of Bid Items and also include detailed breakdown of lump sum or unit price Bid Items >\$25,000 (before extension) to facilitate payment and Owner's asset management.
- C. Schedule of Values may contain additional breakdown where desired to substantiate requests for partial payment as Work progresses.
- D. Separate Work under bid items as follows:
 - 1. Where Work occurs at multiple sites, itemize value of Work at each site.
 - 2. Where Work occurs within multiple structures, itemize value of Work within each structure.
 - 3. Where Work is divided between Work within structures, in yard, and/or offsite Work, separate value of Work by structure, yard, and off-site Work.
 - 4. Where Work supports multiple large (and different) equipment items, separate value of Work by equipment category supported.
 - 5. Where Work supports multiple utilities separate Work by utility type.
- E. Itemize proposed values for the following major Work components.
 - 1. Total value of Division 1 Overhead and General Requirements Work.
 - a. Separate by milestones for mobilization, ongoing expenses, and startup-commissioning.
 - 2. Total value of Division 2 demolition Work
 - 3. Total value of Division 3-6 structural Work.
 - a. Itemize value of earthwork, subgrade preparation, concrete foundation, concrete slabs, concrete columns, concrete roofs, concrete stairs, masonry walls, metal framing, metal roofing, wood framing, and wood roofing as appropriate.
 - b. Minor structures valued at < \$25,000 may be listed as 1 item.
 - 4. Total value of Division 7-14 architectural Work.
 - a. Itemize value of thermal and moisture protection, openings, finishes, and other Work as appropriate.
 - b. Itemize fieldstone cladding of the building exterior
 - 5. Total value of Division 21-23 mechanical Work.
 - a. Itemize value of fire suppression, plumbing, and HVAC Work as appropriate.
 - 6. Total value of Division 25-28 electrical Work
 - a. Separate electrical yard facility work by duct bank designation and substations.
 - b. Itemize value of conduit-raceways, cable-wire installation, switchgear, equipment installation, communications, electronic safety-security, terminations, and lighting as appropriate.
 - c. Itemize MCC installation work
 - d. Itemize VFD controls systems.
 - e. Itemize SCADA related work.
 - 7. Total value of Division 31 and 32 civil site Work.
 - a. Itemize value for clearing and grubbing, earthwork, import or export, finish grading, base courses, asphalt paving, concrete paving, fencing and site improvements, irrigation, and planting as appropriate.
 - 8. Total value of Division 33 utilities Work

- a. Itemize breakdown by each utility category (water, recycled water, wastewater, stormwater, fuel or natural gas, hydronic or steam, electrical, and communications as appropriate.
- b. Itemize value of each pipeline.
- 9. Total value of Division 40-48 process Work.
 - a. Provide itemized breakdowns for each major improvement.
 - b. Provide itemized breakdowns for site preparation, piping systems, major equipment items, instrumentation, and telemetry-control,
- F. Contractor and Owner's Representative shall meet and jointly review preliminary Schedule of Values and make adjustments in value allocations if, in Owner's opinion, these are necessary to establish fair and reasonable allocation of values for major Work components.
 - 1. Front end loading will not be permitted.
 - 2. Owner may require reallocation of major Work components from items in above listing if in opinion of Owner's Representative such reallocation is necessary.
- G. Owner shall be sole judge of acceptable numbers, details and description of values established.
 - 1. If, in Owner's Representative's opinion, more Schedule of Values items are necessary than proposed, add additional items and provide greater detail as requested.
 - 2. Make adjustments deemed necessary to value allocation or level of detail and submit revised detailed Schedule of Values to Owner for record.

3.3 Changes to Schedule of Values

- A. Changes to CPM Schedule to add activities not included in original schedule but included in original work (schedule omissions) shall have values assigned as accepted by Owner's Representative.
 - 1. Reduce other activity values to provide equal value adjustment increases for added activities as approved by Owner.
- B. If Contractor and Owner agree to adjust original Schedule of Values because of inequities discovered in original accepted detailed Schedule of Values, increases and equal decreases to values for activities may be made.

3.4 Schedule of Materials and Equipment Costs

- A. Submit Schedule of Materials and Equipment Costs for items as described herein and shown in example below to establish baseline value for Owner's Asset Management system.
- B. The following does not represent complete list of materials and equipment required for this project.

EXAMPLESCHEDULE OF EQUIPMENT AND MATERIALS COSTS

EQUIPMENT / MATERIALS / FUNCTION / DESCRIPTION	SIZE / CAPACITY	DESCRIPTION / MFG / MODEL NUMBER	LOCATION	MATERIALS COST (UNIT PRICE)	ESTIMATED INSTALLED COST (UNIT PRICE)
Sewer Force Main	6"	DIP, Class 350, restrained joint, ceramic epoxy lined	Buried	\$54/LF	\$75/LF
Magnetic Flow Meter			Lift Station Discharge Piping	\$3,750	\$5,000
Submersible Sewage Pump	5 hp, 125 gpm	KSB, Model KRT E 80- 200/34XG	Lift Station Wet Well	\$5,250	\$7,500
Swing Check Valve	4"	APCO, 6000 series	Lift Station Discharge Piping	\$775	\$1,100

C. Provide required information for equipment and materials listed in Owner-furnished equipment and materials cost spreadsheet.

END OF SECTION

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T-SECTION 01 78 36 PRODUCT WARRANTIES

PART 1 - GENERAL

1.1 Work Included

- A. Warranties are required for all Work furnished under this contract.
- B. Refer to General Provisions §C-28 "Guarantee" for additional requirements for warranties.
- C. Refer to Special Provisions §D-40 "Guarantee" for additional requirements for warranties.
- D. Manufacturer's warranties shall not relieve Contractor of liability required under Contract Documents.
 - 1. Such warranties only shall supplement Contractor's responsibility.
- E. Where Manufacturer's advertised warranty exceeds minimum warranty requirements stipulated, Manufacturer's advertised warranty shall remain in force for duration of advertised warranty period after Contract-stipulated warranties have expired.

1.2 Related Work

- A. Section 01 22 00: Unit Prices
- B. Section 01 33 00: Submittal Procedures
- C. Section 01 40 00: Quality Requirements
- D. Section 01 75 00: Starting and Adjusting
- E. Section 01 77 00: Closeout Procedures

1.3 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Warranty	For equipment bearing Manufacturer's warranty in excess of one year, furnish copy	
	of warranty to District with District named as beneficiary.	

1.4 <u>One-Year Product Warranties</u>

- A. Warranties shall cover improper assembly or erection, defective workmanship and products, and incorrect or inadequate operation.
- B. Warranties shall contain no disclaimer limiting liability to purchase price of products or materials.
- C. Furnish 1-year warranty for Work and manufactured items unless otherwise stated.
 - 1. Warranty shall cover parts, labor, and prompt service for repair of defects, performance failure or damage due to normal wear and tear or due to any cause other than acts of God, or intentional or active and extreme abuse of product.
 - Warranty period shall extend 1 year beyond Final Acceptance of completed contract by District.
- D. In addition to Manufacturer's standard warranty, furnish services of factory-authorized and factory-trained service technician to promptly provide repair service for equipment for specified warranty period.
 - 1. This service shall be provided at no cost to District and shall include cost of replacement parts and labor required during warranty period.
- E. Correct within 10 Calendar Days following receipt of notice from District of unsatisfactory material or workmanship which may be discovered during warranty period.
- F. Correct unsatisfactory material or workmanship without extra charge, notwithstanding that faulty Work may have been overlooked in prior inspections and accepted by District.

1.5 Inspection of Installation by Manufacturer

- A. Should Manufacturer or supplier of any product have reason to suspect said Manufacturer's product has not been installed in accordance with Manufacturer's warranty requirements, Manufacturer shall have right to send their factory authorized representative to inspect facility prior to Final Acceptance.
- B. Should Manufacturer's factory-authorized representative elect to inspect installation, Manufacturer shall promptly notify District in writing of observed deficiencies in installation procedures which might affect required warranty.
- C. Should Manufacturer elect to forego inspection of installation of their products, Manufacturer shall be precluded from claiming faulty installation by others as relief from honoring furnished warranties.

1.6 Eleven-Month Anniversary Warranty Inspection

- A. Warranty inspection will be conducted during 11th month following completion of Work and prior to release of bonds.
- B. District will establish date for warranty inspection and will notify Contractor at least 30 Calendar Days in advance.
 - 1. If notification of inspection date does not occur within 12 months after final acceptance, first anniversary inspection shall be considered to be waived.
- C. Warranty Inspection Report will be prepared by District's Representative and delivered to Contractor.
 - 1. It will set forth the number and type of failures observed and names of persons making inspection.
- D. Locations found in warranty inspection where paving, coating, or paint has peeled, bubbled, or cracked, and locations where rusting is evident will be considered system failures.
 - 1. Repair defective work identified during warranty inspection by removing deteriorating paving, coating or paint system, cleaning surface, and repaving, recoating, or repainting with same system. Electrically test repaired painted areas.
- E. If area of failure >25% of total paved, coated or painted area on any structure or surface, remove and recoat entire paving, coating or paint system per original specification.
- F. Repair other failed products found in warranty inspection per warranty requirements.

1.7 Three-Year Product Warranties and Other Extended Warranties

- A. 3-year warranty shall be 3-year parts-and-labor non-prorated warranty extending from date of District's final acceptance.
 - 1. Warranty need not exceed 5 years from date of shipping.
- B. Extended warranties shall cover parts, labor and prompt service for repair of defects, performance failure or damage due to normal wear and tear, or due to any cause other than acts of God, District's failure to perform minimum maintenance as set forth in O&M instructions furnished with warranty, or intentional or active and extreme abuse of product.
 - 1. Warranty period shall extend stipulated number of years beyond Final Acceptance of completed contract by District.
 - 2. Extended warranties shall cover District's full cost of restoring non-functional components to their full function as described in Contract Documents and in Manufacturer's published literature.
 - 3. Prorated warranties will not be accepted.
 - 4. Replacement of damaged parts with old or recycled parts will not be accepted.
- C. Should Manufacturer refuse to provide full extended warranty, Contractor may be required to purchase extended warranty or negotiate with District to compensate District with fair value for shorter warranty period.
- D. Repair or replace Work that may prove to be defective in workmanship and/or materials within warranty period, along with Work which may be damaged or displaced during performance of warranty Work, at no additional expense to District.

- E. Where sections of specifications stipulate longer warranty period than stipulated in this section, the longest and most stringent warranty requirement shall apply.
- F. Warranty period shall begin on the earliest of 2 milestones:
 - 1. Date of formal notification of completion or
 - 30 Calendar Days after both substantial completion and District taking over beneficial use of project.
- G. Warranties shall cover:
 - 1. Parts
 - 2. Labor
 - 3. Servicing
 - 4. Removal or Installation Charges
 - 5. Setup and Reconfiguration of System with Replacement Parts
 - 6. Shipping
- H. Replace defective parts with new parts.
- I. Where part is replaced during warranty period, extend warranty for replaced part and shipping to at least1 year following replacement date.
 - 1. Warranty for labor shall be unchanged.
- J. In emergency situations, if warranty service is not immediately available from Manufacturer, District will perform repairs to re-establish proper operation of actuator and valve.
- K. Maintenance or repair work performed by District during warranty period shall not be cause for voiding warranty.
- L. Following notification of Contractor of extended warranty issue, Contractor or their agent shall have 10 Calendar Days to inspect and 30 Calendar Days to remedy defective work.
- M. Failure to perform within this stipulated period will result in damages being assessed against Contractor and responsible parties retroactive to date of discovery.

1.8 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for product warranties.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION (not used)

END OF SECTION

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T- ECTION 01 79 00

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 Work Included

- A. System demonstration and commissioning.
- B. Requirements for equipment Manufacturer's services.
- C. Training of Owner's personnel.
- D. Refer to Section 01 75 00 for requirements for pre-operational checkout of equipment prior to System Demonstration.
- E. Design testing procedures to replicate, as nearly as possible, conditions of operation.
- F. Carefully design testing procedures to ensure equipment is not damaged.
- G. Once testing procedures are accepted by Owner's Representative, provide checkout, alignment, adjustment and calibration sign off forms for each item of equipment.
 - 1. Forms will be used in field by Contractor and Owner's Representative jointly to ensure each item of electrical and mechanical equipment is properly installed and tested.
- H. Complete specified testing and system demonstration prior to startup.
- I. Contractor is advised that failure to observe these procedures may place acceptability of Work into question.

1.2 Related Work

- A. Section 01 22 00: Unit Prices
- B. Section 01 33 00: Submittal Procedures
- C. Section 01 75 00: Starting and Adjusting
- D. Section 01 78 23: Operation and Maintenance Data
- E. Section 01 78 43: Spare Parts

1.3 System Description

- A. Proceed in logical, step-wise sequence to demonstrate equipment has been properly serviced, aligned, balanced, connected, calibrated, and adjusted prior to operation.
- B. Manufacturer's representatives during startup shall be factory-authorized personnel with full authority granted by Manufacturer to perform, supervise, and direct start-up and remedial Work and issue certifications required of Manufacturer.
- C. When specified in individual Specification sections, arrange and pay for material or equipment suppliers or Manufacturers to provide qualified personnel (field service representatives) to perform the following:
 - 1. Observe site conditions, conditions of surfaces and installation, and quality of workmanship.
 - 2. Assist during product (system, subsystem, or component) installation to include observation, guidance, instruction of applicator's or installer's assembly, erection, installation or application procedures.
 - 3. Inspect, check, and adjust as required for product (system, subsystem, or component) to function as warranted by Manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.
 - 4. Revisit site as required to correct problems and until installation and operation are acceptable to Owner's Representative.
 - 5. Resolve assembly or installation problems attributable to, or associated with, respective Manufacturer's products and systems.

- 6. Perform and record results of Manufacturer's standard and recommended inspections, functional and performance testing, inspections and tests specified in these documents, and startup and evaluation of installed Work.
- 7. Supply required test equipment.
- 8. Be responsible for protection of material and equipment and safety of personnel during testing.
- 9. Instruct and supervise field repairs and adjustments.
- 10. Train Owner's personnel in operation and maintenance of respective product as required.
- 11. Perform other services normally provided by field representative's company or specified elsewhere in these Specifications.

1.4 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Manufacturer's	For items requiring warranties exceeding one year, submit daily copies of Manufacturers'	
Inspection Reports and	representatives' field notes, data, and reports of Manufacturer's field activities, actions	
Certificate of Proper	taken, and test results to Owner's Representative within 30 days of completion.	
Installation	If activities are at end of Contract duration, complete actions within Contract Time.	
	For items requiring warranties exceeding one year, submit Manufacturer's Certificate of	
	Proper Installation.	
System Demonstration	Submit prior to receipt of progress payments in excess of 60% of Contractor's total bid	
Plan	amount for Work.	
	Describe each system to be tested, functional test methods, test materials, test	
	instruments and recorders, and results to be recorded.	
	List requirements necessary to demonstrate successful operation.	
	Submit step-by-step description of materials, equipment, and personnel required.	
	Identify duration of testing and startup operations.	
	Include continuous 72-hour demonstration of operation of entire installed system.	
	Shorter demonstration period may be authorized by Owner's Representative if external	
	constraints make 72-hour test impractical.	
	Demonstrate operation of instruments, set points, alarms, telemetry, software, safety	
	interlocks, protective logic functions, and back-up operation modes.	
	Incorporate Manufacturer's start-up and demonstration procedures.	
	Owner may modify proposed procedures as deemed necessary to demonstrate system	
	operation.	
	Operate new equipment through entire no-load to full-load range	
	Submit sample testing signoff forms for equipment and systems to be tested.	
Testing Signoff Forms	Submit blank forms 7 Calendar Days prior to start of System Demonstration.	
System Demonstration	Submit for final operations test period.	
Log		
Training Schedule	List specified equipment and systems requiring training services and show	
	Respective Manufacturer	
	Estimated dates for installation completion	
	3. Scheduled training dates.	
	Update and adjust schedule to ensure training of appropriate personnel deemed	
	necessary by Owner and to allow full participation by Manufacturer's representatives.	
Tradicion Octivi	Adjust schedule for interruptions in operability of equipment.	-
Training Outline	Submit for instruction program for Owner's personnel	
I Di	See requirements below in Part 3.	
Lesson Plan	Submit at least 30 calendar days prior to scheduled training for Owner's personnel.	
	See requirements below in Part 3.	

1.5 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for demonstration and training.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION

3.1 Preparation

- A. Notify Owner's Representative of time and place of system demonstrations at least 14 Calendar Days before they begin.
- B. Arrange for representatives of equipment suppliers and subcontractors to be present as required to successfully demonstrate installed system.
- C. Provide gages, meters, recorders and monitors as required to supplement or augment instrumentation system provided under this contract to properly demonstrate equipment fully satisfies requirements of Contract Documents.
 - Specifically select devices employed for purpose of measuring performance of facility's equipment and systems to provide level of uncertainty consistent with variables to be monitored.
 - 2. Instruments shall be recently calibrated.
 - 3. Be prepared at all times to demonstrate, through re-calibration, uncertainty of instruments employed for testing purposes.
 - 4. Perform calibration procedures in accordance with applicable standards of ASTM, ISA and IEEE.
 - 5. Adequacy of gages, meters, recorders and monitors shall be subject to review of Owner's Representative.
- D. Furnish and install temporary valves, fittings, bulkheads, taps or other items necessary for system demonstration.
- E. Unless otherwise specified, provide at no expense to Owner, power, fuel, water, power, utilities, supplies, lubricants, chemicals, materials, replacement parts, testing equipment, testing media, labor and necessary items and Work required to complete specified tests, inspection, and system demonstration.
 - 1. Provide at no expense to Owner temporary heating, ventilating and air conditioning for areas requiring it where permanent facilities are not complete and operable at time of installed tests.
 - 2. Maintain temporary facilities until permanent systems are in service.
- F. Before system demonstration complete the following:
 - 1. Identify and label equipment with nameplates.
 - 2. Remove shipping blocks.
 - 3. Clean equipment.
 - 4. Repair damaged or scratched finishes.
 - 5. Inspect for broken and missing parts
 - 6. Review and collect Manufacturer's Installation Instructions and Shop Drawings for delivery to Owner's Representative.
- G. Prior to system demonstration, provide test runs described in Section 01 75 00 to verify parts and subsystems are in place and in working order.
 - Owner's costs for delays during system demonstration due to Contractor's failure to pretest system and verify products are in place and functional will be back-charged to Contractor.
- H. Provide signoff forms for installed and operational testing to be accomplished under this contract.
 - 1. Provide sign off forms containing provisions for recording relevant performance data for original testing and at least 3 re-tests for each item of mechanical, electrical and instrumentation equipment provided or installed under this contract.
 - 2. Provide separate sections to record values for pre-operation checkout, initials of representatives of equipment manufacturers, Contractor and Owner's Representative.

- 3. Sign off forms shall include motor and driven device on same form and provide at least the following information:
 - a. Equipment name
 - b. Manufacturer
 - c. Model
 - d. Serial Number
 - e. Equipment tag number
 - f. Diagram showing bearing locations
 - g. Operating parameters
 - h. Test equipment
 - i. Witness signatures
 - j. Date
- I. Maintain master file of equipment sign off sheets, which shall be available for inspection by Owner's Representative.
 - 1. Upon completion of testing, furnish Owner's Representative with original and two copies of sign off sheet for each equipment item.
- J. Following system demonstration, start-up shall only be attempted as function of normal plant operation in which plan process flows and levels are routine and equipment operates automatically in response to flow and level parameters shall be considered only upon receipt of written request by Contractor.

3.2 System Demonstration

- A. System demonstration shall conform to Owner-accepted System Demonstration Plan submittal.
- B. Perform systems demonstration in presence of Owner's Representative who will record results on sign-off forms submitted.
 - 1. Start up and operate individual subsystems, pieces of equipment, instruments, and other Work.
- C. Proceed with testing on step-by-step basis in accordance with Contractor's submitted and accepted System Demonstration Plan.
 - 1. Each individual step in procedures shall be witnessed by Owner's Representative.
- D. Contractor's testing Work shall be accomplished by skilled team of specialists under direction of coordinator whose sole responsibility shall be orderly, systematic testing of equipment, systems, structures and complete facility as a unit.
 - 1. Operate equipment and systems during plant operational testing period, to greatest extent practicable, at conditions which represent full range of operating parameters as defined by Contract Documents.
- E. Disassemble, inspect, and replace defective components of equipment exhibiting unusual or unacceptable operating characteristics.
- F. Failure to meet specified requirements shall be cause for retesting at Contractor's expense until requirements are met.
 - 1. Interruption of continuous operation test due to equipment malfunction shall be cause to restart test after repairs.

3.3 Field Quality Control

A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Finished	Installation &	Visual inspection of finished installation	1 inspection	Owner	Owner
Installation	Leakage				
	Motor	Before energizing machines, visually	All motors	Contractor	Contractor
	Installation	inspect for serviceability.			

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
		Check Manufacturer's Installation Instructions for correct lubrication and ventilation. Align motors with driven equipment. Check nameplate for electrical power requirements.			
	Motor Insulation	Test motor insulation winding to winding with ohmmeter or micro-ohmmeter and record results	All motors	Contractor	Contractor
	Motor Test Run	Test run motors uncoupled or unloaded before placing into operation. Check motor for rotation, speed, current, and temperature rise under normal load and record results.	All motors	Contractor	Contractor
		Maintain proper color codes for phase identifications. This may require lead swaps at motor for proper rotation. Use motor phase rotation meter prior to lead connection at motor to minimize alter-swaps	All motors	Contractor	Contractor
	System Demonstration	Demonstrate compliance to Contract Documents and Manufacturer's printed literature using accepted system demonstration plan described above	One 72-hour demonstration without interruption. (If test is interrupted, clock restarts at zero for 72-hour demonstration)	Contractor (Owner will pay for test water)	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

- B. Provide qualified technicians and calibrated test instruments as needed to perform tests.
 - 1. Provide certifications for test instruments.
 - 2. Since coordination with other crafts and Contractors will often be required, workers assigned to checkout shall be available outside normal working hours when necessary.
- C. In addition, furnish Contractor's personnel, as needed, to make adjustments or alterations recommended by equipment Manufacturer's representatives.
- D. Promptly correct defects and malfunctions disclosed during System Demonstration, including malfunctions of equipment or control systems, leakage, excessive vibration and excessive noise.
 - 1. Work failing to perform its intended function, and which cannot be repaired, shall be replaced with new equipment.
- E. Following testing, remove bulkheads and temporary equipment.
- F. Dispose of test water according to local regulations and NPDES requirements.
- G. Inspect for loose connections, leaking fluids, and any irregularities.
- H. Check field-aligned equipment for required alignment and realign if necessary.

3.4 Training of Owner's Personnel

A. Training shall take place on-site or in Owner's offices.

- B. Do not commence training of Owner personnel prior to substantial completion of Work, unless accepted in writing by Owner.
- C. After functional testing is complete, conduct training and instruction program on system operation for Owner-designated personnel.
- D. Furnish services of qualified factory-trained and authorized instructors from applicable equipment Manufacturers, subject to acceptance by Owner.
 - 1. Factory-trained instructors shall be familiar with Owner's facility operation requirements in addition to being familiar with their products.
 - 2. Factory-trained instructors shall be fluent in written and spoken English.
 - No substitute instructors will be accepted unless prior written acceptance is obtained from Owner.
- E. Include instruction covering:
 - 1. Overview of system,
 - 2. Basic operation theory,
 - 3. Preventative maintenance,
 - 4. Routine maintenance and repair,
 - 5. Safety procedures,
 - 6. "Hands-on" operation of equipment.
- F. If not otherwise specified, base duration of program on complexity of equipment involved.
 - 1. Obtain Owner's acceptance of instruction adequacy before terminating program.
- G. Consult Owner to schedule instruction.
- H. Provide accepted Operation and Maintenance Manual for specific pieces of equipment or system at least 10 Working Days prior to training session for that piece of equipment or system.
- I. Provide combination of classroom and field/machine shop training.
 - 1. Conduct classroom training at Owner's specified location.
- J. Provide "hands-on" demonstrations of common troubleshooting and corrective maintenance repairs as described in Contractor's proposed Lesson Plan.
 - 1. Provide tools and equipment to conduct demonstrations.
 - 2. Submit requests for supplemental assistance and facilities with proposed Lesson Plan.
- K. As part of training, provide attendees with names, contact persons, telephone numbers and addresses of authorized service centers within 100-mile radius of jobsite for equipment on which training is taking place.
- L. System demonstration testing, final operation testing, and instruction of Owner's personnel may be performed simultaneously, subject to prior approval of extent of consolidation.
- M. The following training is required:

		CLASSROOM	FIELD	APPROXIMATE
ITEM	LOCATION	TRAINING DURATION	TRAINING DURATION	NUMBER OF ATTTENDEES
System Overview	On-site	2 hours	2 hours	3-12 people
Pilot-Operated Control Valves	On-site	2 hours	2 hours	3-12 people

3.5 Lesson Plan

- A. Include in Contractor's proposed Lesson Plan, as a minimum, elements presented in Outline of Lesson Plan below.
 - 1. Identify specific components and procedures in proposed Lesson Plan, and tailor it to Owner's needs.
- B. Submit resumes of instructors providing training.
- C. Detail specific instruction topics in Contractor's proposed Lesson Plan.

- D. Reference training aids to be used in instruction and attach where applicable to proposed Lesson Plan.
 - 1. Describe "Hands-On" demonstrations planned for instruction.
- E. Use submitted Operation and Maintenance Manuals as basis for instruction.
- F. Submit schedule of dates and estimated duration of each segment of training Lesson Plan.
- G. Allow for multiple sessions when several groups or shifts are involved.
- H. Lesson Plan Outline
 - 1. General Information
 - a. Identify course title and objectives.
 - b. Identify recommended types of attendees (e.g. managers, engineers, operators, maintenance.)
 - c. Identify suggestions for audiovisual equipment to be provided by Owner.
 - d. Provide brief course description and course content.
 - e. Describe format of classroom training (lecture, demonstration) and field training (demonstration, or hands-on)
 - f. Identify handout materials.
 - g. Identify supplementary self-study materials
 - 2. Equipment Operation
 - a. Describe equipment's operating (process) function.
 - b. Describe equipment's fundamental operating principals and dynamics.
 - c. Identify equipment's mechanical, electrical and electronic components and features.
 - d. Identify support equipment associated with operation of subject equipment (i.e., air intake filters, valve actuators, motors).
 - e. Provide standard operating procedures to cover start-up, routine monitoring and shut-down of equipment.
 - f. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each equipment item.
 - g. For equipment or systems requiring seasonal operation or maintenance, perform demonstration of required O&M procedures for all seasons.
 - h. Describe emergency procedures, interlocks, and safety items and procedures, such as lock-out/tag-out.
 - i. Prepare and insert additional data in Operations and Maintenance Manuals when need for additional material becomes evident during instruction.
 - 3. Detailed Component Description
 - a. Identify and describe in detail each component's function.
 - b. Where applicable, group related components into subsystems.
 - c. Describe subsystem functions and their interaction with other subsystems.
 - d. Identify and describe in detail equipment safeties and control interlocks.
 - 4. Describe Preventive Maintenance (PM)
 - a. Describe PM inspection procedures required to:
 - b. Perform inspection of equipment in operation.
 - c. Spot potential trouble symptoms (anticipate breakdowns).
 - d. Forecast maintenance requirements (predictive maintenance).
 - e. Define recommended PM intervals for each component.
 - f. Provide lubricant and replacement part recommendations and limitations.
 - g. Describe appropriate cleaning practices and recommended intervals.
 - 5. Equipment Troubleshooting
 - a. Define recommended systematic troubleshooting procedures.
 - b. Provide component specific troubleshooting checklist.
 - c. Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.
 - 6. Equipment Corrective Maintenance
 - a. Describe recommended equipment preparation requirements.
 - b. Identify and describe use of any special tools required for maintenance of equipment.

- c. Describe component removal/installation and disassembly/assembly procedures.
- d. Perform at least 2 "hands-on" demonstrations of common corrective maintenance repairs.
- e. Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
- f. Define recommended torqueing, mounting, calibration and/or alignment procedures and settings, as appropriate.
- g. Describe recommended procedures to check/test equipment following corrective repair.

3.6 Training Aids

- A. Incorporate training aids as appropriate to assist in instruction.
 - 1. At minimum, include text and figure handouts with training aids.
 - 2. Other appropriate training aids are:
 - a. Audio-visual aids (e.g., films, slides, videotapes, overhead transparencies, posters, blueprints, diagrams, catalogue sheets).
 - b. Equipment Cutaways and Samples (e.g. spare parts, damaged equipment).
 - c. Tools (e.g. repair tools, customized tools, measuring and calibrating instruments).
- B. Furnish complete training materials to include Operation and Maintenance data to be retained by each trainee.
- C. Contractor's instructor shall use descriptive class handouts during instruction.
 - 1. Provide quality reproductions of photocopied class handouts.
 - 2. Provide class handouts during instruction with frequent references made to them.
 - 3. Customized handouts developed especially for instruction are encouraged.
 - 4. Attach handouts planned for instruction with Contractor's proposed Lesson Plan.

END OF SECTION

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SECTION 01 00 00 – GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. The General Conditions apply to all divisions and sections of this Engineering Specification, which shall be used to perform work as shown on the plans and as specified, and shall be properly coordinated with work as described in the related Specifications.
- B. The Drawings and these Specifications are complementary to each other; what is called for by one shall be as binding as if called for by both. If there is any conflict between what is shown on the drawings and what is written in the Specifications, the details described on the drawings shall take precedence and the CONTRACTOR shall communicate the conflicts to the ENGINEER in a timely manner.

C. Safety

1. The CONTRACTOR shall be familiar with, and shall at all times conform to the regulations of the "OSHA General Industry Occupational Safety and Health Standards," "OSHA Safety and Health Regulations for Construction," and other applicable state and municipal standards and regulations.

1.02 REFERENCED SECTIONS – NONE

1.03 CITED STANDARDS

- A. Standards listed as "Reference Standards" in the various sections of these contract documents are hereby incorporated into these Specifications by reference.
- B. Referenced documents shall include all revisions, amendments, supplements, or addenda issued on or before the date of advertising for bids.
- C. All specification sections included shall conform to the requirements of the following standard specifications, of the latest revisions, as applicable:
 - 1. State Standard Specifications, Issued by: Department of Transportation, 2009.
 - 2. NSF 60 Drinking Water Treatment Chemicals Health Effects
 - 3. NSF 61 Drinking water system components Health effects, Editorial revision to NSF/ANSI 61 2002

1.04 NOTED RESTRICTIONS – NONE

1.05 QUALITY CONTROL

- A. Best Management Practices (BMPs)
 - 1. Best Management Practices (BMPs) related to the work of this project are found in the following sections and their sub-sections:
 - a. SECTION 01 40 00 QUALITY REQUIREMENTS

- b. SECTION 01 60 00 PRODUCT REQUIREMENTS
- 2. Additional BMPs may also be included throughout specific sections of each Division of these specifications in order for the CONTRACTOR to conduct work in an environmentally responsible manner.
- B. The ENGINEER shall be responsible for obtaining necessary permits for groundwater treatment work.
- C. The ENGINEER shall be responsible for submitting Notice of Intent (NOI) to State Water Resources Control Board for coverage under the most recent Construction General Permit for the discharge of storm water.
- D. Storm Water Pollution Prevention Plan
 - 1. The ENGINEER will be responsible for preparing the Storm Water Pollution Prevention Plan (SWPPP).
 - 2. The CONTRACTOR shall be responsible for implementation of the SWPPP.
- E. Water Quality Management Plan
 - 1. This project is subject to the requirements of the City's Storm Water and Urban Runoff Control Regulation Ordinance which implements the requirements of the Regional Water Quality Control Board's Water Quality Management Plan (WQMP) Prior to the issuance of any demolition, grading or construction permits for the project the Owner must receive approval of the WQMP. A WQMP has been submitted to the Department of Public Works. The Contractor shall coordinate its efforts in compliance with the substantial requirements of the WQMP. The substantial requirements of the WQMP have been incorporated into the drawings and such documentation is available to the Contractor prior to bidding upon request.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 01 01 - CEQA MITIGATION MEASURES AND REQUIREMENTS

PART 1 - GENERAL

The follow excerpt from the project CEQA study and contains requirements the Contractor shall adhere to all times. The full document is available upon request.

5 MITIGATION MONITORING AND REPORTING PROGRAM

This Mitigation Monitoring and Reporting Program (MMRP) has been prepared to comply with Section 21081.6 of the California Environmental Quality Act (CEQA). Section 21081.6 requires that public agencies adopt a monitoring program for measures that are required to mitigate or avoid significant effects to the environment from the project.

As the lead agency, the Three Valleys Municipal Water District (TVMWD) will be responsible for monitoring compliance with all mitigation measures.

The MMRP serves three functions:

- 1. Assures completion of mitigation measures during project implementation.
- 2. Provides feedback to designated agencies and decision makers regarding the effectiveness of the mitigation measures.
- 3. Identifies the need for enforcement action before irreversible environmental damage occurs.

The MMRP includes a list of the mitigation measures to be implemented during construction and operation of the project; indicates the timeframe for completion of the measure and identifies who is responsible for carrying out the measure and who is responsible for monitoring that the measure is carried out.

TVMWD may modify the means by which a mitigation measure will be implemented or substitute a mitigation measure, as long as a modified or alternative measure successfully mitigate the impact to a less than significant level.

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Mitigation Measures	Method of Verification	Timing of Verification	Responsible Party
Air Quality			
 AQ-1 Construction contractors shall adhere to applicable measures set forth in SCAQMD Rule 403 including, but not limited to: All clearing, grading, earth-moving, or excavation activities shall cease when winds exceed 25 mph per SCAQMD guidelines in order to limit fugitive dust emissions. The contractor shall ensure that all disturbed unpaved roads and disturbed areas within the project site are watered at least three (3) times daily during dry weather. Watering, with complete coverage of disturbed areas, shall occur at least three times a day, preferably in the midmorning, afternoon, and after work is done for the day. The contractor shall ensure that traffic speeds at the project site areas are limited to 15 miles per hour or less. 	Provide notes on all construction plans Construction general contractor shall be responsible for enforcing compliance by subcontractors through reporting to TVMWD Project Manager	On-going during construction	TVMWD Project Manager
Cultural Resources and Tribal Cultural Resources			
CUL-1 Prior to commencement of project ground disturbing activities (e.g., clearing and grubbing, tree removal, potholing or augering, boring, grading, excavation, drilling and trenching) TVMWD shall retain a qualified archaeological monitor approved by the Gabrieleño Band of Mission Indians-Kizh Nation and is listed under the NAHC's Tribal Contact list for the area of the project location. At the end of monitoring activities, the monitor shall submit a monitoring report that describes construction activities, location, soils, and othe	Provide notes on all construction plans Construction general contractor shall be responsible for enforcing compliance by subcontractors and in notifying the TVMWD Project Manager if resources are uncovered	On-going during earth moving and trenching activities	TVMWD Project Manager

Mitigation	Measures	Method of Verification	Timing of Verification	Responsible Party
excavation activities are monitor concludes that timpacting Tribal Cultura CUL-2 In the event that cultural reproject activities, all work if find (within a 60-foot buffer archaeologist meeting Secrebe hired to assess the find. project outside of the buffer assessment period. Addition	en the project site grading and completed, or when the he site has a low potential for l Resources. Esources are discovered during n the immediate vicinity of the r) shall cease and a qualified etary of Interior standards shall Work on the other portions of the red area may continue during this onally, the Gabrieleño Band of	TVMWD Project Manager will be responsible for notifying tribal representatives		
Mission Indians-Kizh Nat Mission Indians Cultural Re shall be contacted, regarding provided information after initial assessment of the nat Tribal input with regards to be implemented in tandem CUL-3 If significant pre-contact cut CEQA (as amended, 2015), cannot be ensured, the arch Monitoring and Treatment	cion and the San Manuel Band of esources Department (SMBMI) ing any pre-contact finds and be the archaeologist makes his/her ture of the find, so as to provide o significance and treatment. (To with mitigation measure TCR-1) altural resources, as defined by are discovered and avoidance			
within TCR-1. The archaeol of the project and impleme CUL-4 If human remains or funeraduring any activities associ immediate vicinity (within				

Mitigation Measures	Method of Verification	Timing of Verification	Responsible Party
State Health and Safety Code Section 7050.5 and that code enforced for the duration of the project. If the coroner recognizes the human remains to be those of a Native American or has reason to believe that they are those of a Native American, he or she shall contact, by telephone within 24 hours, the Native American Heritage Commission (NAHC) and PRC 5097.98 shall be followed. Tribal Cultural Resources Because the analyses of Cultural Resources and Tribal Cultural Resources are interconnected, mitigation measures specific to the issue of Tribal Cultural Resources are included here. TCR-1 The Gabrieleño Band of Mission Indians-Kizh Nation and San Manuel Band of Mission Indians Cultural Resources Department (SMBMI) shall be contacted, as detailed in CUL-1, of any pre-contact cultural resources discovered during project implementation, and be provided information regarding the nature of the find, so as to provide Tribal input with regards to significance and treatment. Should the find be deemed significant, as defined by CEQA, a Cultural Resources Monitoring and Treatment Plan CRMTP) shall be created by the archaeologist, in coordination with SMBMI, representatives of each tribe, and all subsequent finds shall be subject to this CRMTP. The CRMTP shall include a continuation of the monitoring activities as outlined in mitigation measure CUL-1, allow for a monitor to be present that represents SMBMI for the remainder of the project, should SMBMI elect to place a monitor on site.	Verification	Verification	
TCR-2 Any and all archaeological/cultural documents created as a part of the project (isolate records, site records, survey			

	Method of	Timing of	Responsible
Mitigation Measures	Verification	Verification	Party
	Vermeation	vermeation	I al ty
reports, testing reports, etc.) shall be supplied to TVMWD the			
applicant and Lead Agency for dissemination to Gabrieleño			
Band of Mission Indians-Kizh Nation and SMBMI. The			
Lead Agency and/or applicant shall, in good faith, consult			
with each of the Tribal representatives SMBMI throughout			
the life of the project.			
the fire of the project.			
Geology/ Soils/Paleo Resources			
Geology/Soils	Geology/Soils		
GEO-1 Prior to commencement of construction, the construction contractor shall prepare Stormwater Pollution Prevention Plan (SWPPP) for review by TVMWD; and submit a Notice of Intent (NOI) to the State Water Resources Control Board (SWRCB) who will issue a Waste Discharge Identification Number (WDID) for the project. A copy of the SWPPP must be available for review at the construction site and modified (if necessary) to address on-site issues, such as heavy storm events that may require additional measures should they arise.	Construction contractor to prepare the SWPPP for review by TVMWD Project Manager and submittal of a Notice of Intent to the SWRCB	Prior to commencement of construction activities	TVMWD Project Manager
Paleontological Resources GEO-2 During well drilling, or excavation/trenching associated with other construction activities at the project site or as part of trenching for the new pipeline, should paleontological resources be uncovered, all work within a 50-foot radius shall cease and a qualified paleontologist shall be consulted to determine the significance of the find and if necessary, develop a plan to retrieve and curate the resources at an accredited museum.	Paleo Resources Construction general contractor shall be responsible for enforcing compliance by subcontractors and in notifying the TVMWD Project Manager if resources are uncovered	On-going during earthmoving/trenching activities	TVMWD Project Manager

Mitigation Measures	Method of Verification	Timing of Verification	Responsible Party
	TVMWD Project Manager will be responsible for notifying tribal representatives		
Hazards and Hazardous Materials			
Regarding the potential to impair implementation of or physically interfere with an adopted emergency response/ evacuation plan, the Project Description includes the preparation of a traffic control plan (TCP) to be implemented during construction. Therefore, no mitigation is required.			
Hydrology and Water Quality			
Regarding water quality standards, mitigation measure GEO-1 in Section 3.7, Geology and Soils, requires the development and implementation - during all phases of construction - of Stormwater Pollution Prevention Plan (SWPPP) for review by TVMWD and submittal to the State Water Resources Control Board (SWRCB) who will issue a Waste Discharge Identification Number (WDID) for the project. A copy of the SWPPP must be kept on the project site during all construction activities.	Construction contractor to prepare the TCP for review by TVMWD Project Manager and submittal of a Notice of Intent to the SWRCB	Prior to commencement of construction activities	TVMWD Project Manager
Noise			
Construction NOI-1 Construction activities must follow the City's General Plan and the Noise Ordinance, which states that construction, repair or excavation work performed must occur within the	All measures shall appear on all construction plans	On-going during all phases of construction	TVMWD Project Manager

END OF SECTION

SECTION 01 01 02 - SITE GEOTECHNICAL REPORT

PART 1 - GENERAL

The following section contains the geotechnical soils report for the site.

GEOTECHNICAL EXPLORATION PROPOSED MIRAGRAND PRODUCTION WELL 675 EAST MIRAMAR AVENUE CLAREMONT, LOS ANGELES COUNTY, CALIFORNIA

Prepared for:

THREE VALLEYS MUNICIPAL WATER DISTRICT

1021 East Miramar Avenue Claremont, California 91711

Project No. 12773.001

JULY 2, 2020





July 2, 2020

Project No. 12773.001

Three Valleys Municipal Water District 1021 East Miramar Avenue Claremont, California 91711

Attention: Mr. Ben Peralta Jr., PE

Subject: Geotechnical Exploration

Proposed Miragrand Production Well

675 East Miramar Avenue

Claremont, Los Angeles County, California

In accordance with our April 22, 2020 proposal, we have performed geotechnical exploration at the site of the proposed production well at the approximately 1.05-acre "Miragrand" site located at 675 East Miramar Avenue in Claremont, California. The purpose of this study has been to evaluate the geologic and geotechnical conditions of the site and to provide geotechnical recommendations for design and construction of the proposed production well improvements.

Based upon our geotechnical exploration, the proposed improvements are feasible from a geotechnical viewpoint, provided our recommendations are incorporated into the design and construction of the project. The most significant geotechnical issues at the site are those related to the potential for strong seismic shaking and the presence of potentially compressible soils. This report presents our findings, conclusions, and geotechnical recommendations for the project.

No. 2706

We appreciate the opportunity to be of continued service to Three Valleys Municipal Water District. If you have any questions or if we can be of further service, please contact us at your convenience at (909) 527-8771 or (866) *LEIGHTON*, specifically at the phone extensions and/or e-mail addresses listed below.

Respectfully submitted,

LEIGHTON CONSULTING, INC.

Steven G. Okubo, CEG 2706

Project Geologist

Extension 8773, sokubo@leightongroup.com

Jason D. Hertzberg, GE 2711

Principal Engineer

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ECB/SGO/JDH/rsm

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1.0 INTRODUCTION

1.1 **Project Description**

- 1.1.1 <u>Site Location</u>: Three Valleys Municipal Water District's "Miragrand" site is located at the northwest corner of Miramar and Grand Avenues in Claremont, Los Angeles County, California. The site location and immediate vicinity are shown on Figure 1, Site Location Map. The site is an approximately 1.05-acre rectangular parcel (APN 8671-009-900) and is currently vacant and is located in a suburban residential area of northern Claremont. The site is situated on the proximal setting of an alluvial fan fronting the San Gabriel Mountains where immature, very coarse-grained sediment have been deposited. This is a relatively flat site, with drainage gently towards the southwest.
- development within the site consists of a new production wellhouse in the northern portion of the parcel, a new 12-inch-diameter ductile iron pipeline from the new well to an existing pipeline near the intersection of Miramar and Grand Avenues, a 4-inch-diameter PVC line for irrigation, and a proposed onsite retention basin. It is our understanding that the basin will be less than 5 feet in depth. Aesthetic requirements for this project include rock drainage swales, decomposed granite paths and other associated development requirements consistent with the City of Claremont. The wellhouse is required to have a "fieldstone" façade, consistent with historical wellhouses in this area.

1.2 Purpose and Scope of Exploration

The purpose of this geotechnical exploration has been to explore subsurface conditions and geotechnical engineering characteristics of earth materials at this wellhouse site, and to provide geotechnical recommendations for design and construction of the proposed wellhouse and associated improvements. Our geotechnical exploration included the following tasks:

 Field Exploration: Prior to excavation, we located and marked our test pit locations for coordination with Underground Service Alert (USA). Once public utilities had been cleared relative to our test pit locations, we excavated, logged, and sampled the three test pits with a



subcontracted backhoe and operator to depths extending down to approximately 4 to 5 feet below existing grade. Each test pit was logged by a member of our technical staff and digitally photographed. Larger cobbles and/or boulders were tape measured. Representative bulk soil-samples of gravel-size and smaller-diameter soils was collected at shallow depths from our exploratory test pits for visual classification and further geotechnical laboratory testing. All recovered soil samples were transported to our in-house geotechnical laboratory for testing. Within two of the test pits, which were excavated in the area of the proposed basin, we conducted open-pit infiltration tests in general accordance with Los Angeles County guidelines. Test pits were then backfilled with excavated soils and tamped. A description of our field exploration and boring logs are presented in Appendix A, *Field Exploration*.

- Geotechnical Laboratory Tests: Geotechnical laboratory tests were performed at our in-house geotechnical laboratory, on selected soil samples collected during our subsurface exploration. This laboratory testing program was designed to evaluate general physical and engineering characteristics of sampled earth materials. This testing included modified Proctor (ASTM D1557) laboratory maximum dry density and optimum moisture content, grain size distribution (≤3-inch gravel), and a soil corrosivity suite of tests including pH, minimum electrical resistivity, water-soluble sulfate and chloride. Results of laboratory tests are provided in Appendix B, Geotechnical Laboratory Testing.
- Engineering Analysis: Data obtained from our background review, field exploration, and geotechnical laboratory testing program was evaluated and analyzed to develop geotechnical conclusions and recommendations for the proposed improvements.
- Report Preparation: Results of this evaluation have been summarized in this report, presenting our findings, conclusions and geotechnical recommendations for this proposed improvements.

This report does not address the potential for encountering hazardous materials at this site. Important information about limitations of geotechnical reports, in general, is presented in Appendix D, GBA *Important Information About Your Geotechnical Report*.



2.0 FINDINGS

A summary of our findings from research, three test pits, infiltration testing, geotechnical laboratory testing and engineering analysis, is discussed in the following sections.

2.1 Site Geotechnical Setting

As regionally mapped on Figure 3, *Regional Geology Map*, this WVMWD site is situated on the proximal setting of an alluvial fan fronting the San Gabriel Mountains where immature, very coarse-grained sediment have been deposited. The site is located in the Los Angeles Basin in the northern portion of the Peninsular Range geomorphic province of California. This is an area of complex geology as the relatively northwestward migrating Peninsular Range Province interacts with the Transverse Range Province (San Gabriel Mountains) to the north. Several active or potentially active faults have been mapped in the region, which accommodate or have accommodated compression associated with this crustal interaction. The site is underlain by a thick accumulation of alluvial soil consisting of sand and gravel with cobbles and boulders, silt, and clay eroded from the San Gabriel Mountains, then transported and deposited at the site.

The surficial geologic unit mapped onsite is young alluvial fan with boulders (CGS, 2000a). During periods of sheet flooding, migrating channels along the alluvial fan transported and deposited sand, cobbles, and boulders that currently compose the subgrade soils on the site. California Geologic Survey (CGS, 2000) has indicated that for this area, the upper part of the alluvial fan (north of Holt Avenue) is dominated by gravel-, cobble-, and boulder-rich deposits, interbeds of sand, silt, and clay.

This is a relatively flat site, sloping down gently to the southwest. This site is not within a California Geological Survey (CGS) liquefaction hazard zone.

2.2 <u>Encountered Subsurface Conditions</u>

In each of our test pits, we encountered alluvial fan deposits consisting primarily of poorly graded sand with silt and gravel (SP-SM). Testing of the alluvium indicated 3.7 to 7.4 percent fines (silt and clay). Due to the cohesionless and granular nature of these soils, compacted fill from these materials are expected to possess a very low expansion potential (EI<21). Tested onsite near-surface soil was found to have negligible sulfate content and mildly corrosive minimum resistivities.



2.3 Groundwater

Groundwater was not encountered in any of our test pits, which extended to a maximum depth of 5.3 feet below existing ground surface, on May 26, 2020. Historic ground water data from CGS (2000a) indicated that the historically highest ground water levels in the site vicinity were on the order of 75 to 100 feet below the ground surface. A well maintained by the Six Basins Watermaster located approximately 0.5 mile southeast of the site indicated a highest groundwater level of approximately 127 feet below the ground surface based on measurements taken from October 2011 through October 2019.

2.4 Infiltration Testing

Two constant head, open pit percolation tests were conducted within test pits TP-1 and TP-2 in the portion of the site of the proposed basin to estimate the infiltration characteristics of native soils at those locations and depths. Well permeameter tests were conducted at depths of approximately 3.5 to 4.5 feet below the existing ground surface, within granular soils.

Conducting open pit percolation tests at the bottom of larger test pits are useful for field measurements of soil infiltration rates. It should be noted that this is a clean-water, small-scale test, and that correction factors need to be applied. Relatively large test pits were excavated approximately to the depth of the test and a smaller pit for the percolation testing was excavated at the bottom. A layer of gravel was placed in the pit bottom to support a temporary perforated standpipe and a float valve within the percolation pit. In addition, gravel was poured around the outside of the standpipe within the test zone to prevent the sides of the pit from caving/collapsing or eroding when water was added. The float valve, lowered into the standpipe, controlled the flow of water into the percolation pit as the water infiltrated into the soil, while maintaining a relatively constant water head within the percolation pit. Incremental infiltration rates were then measured. The test was conducted based on the USBR 7300-89 test method.

The raw infiltration rate was approximately 3.5 inches per hour (no factor of safety or correction factors applied) at the depths tested. See Section 3.10 for recommendations for infiltration rates.



2.5 Faulting and Seismicity

Based on review of published geologic hazard maps, this proposed "Miragrand" Production Well is not located within a currently designated Alquist-Priolo Earthquake Fault Zone. The principal seismic hazard that could affect the site also includes ground shaking resulting from an earthquake occurring along several major active or potentially active faults in southern California. The known regional active and potentially active faults that could produce the most significant ground shaking at the site include the Chino-Central Avenue, San Jose, Sierra Madre, Cucamonga, Whittier, Elysian Park Thrust, Elsinore-Glen lvy, Clamshell-Sawpit, and Raymond faults (USGS, 2020). Site-specific seismic design coefficients are presented in Section 3.3 of this report.

2.6 <u>Secondary Seismic Hazards</u>

2.6.1 <u>Liquefaction Potential</u>: Liquefaction is the loss of soil shear strength due to a buildup of pore-water pressure during severe and sustained ground shaking. Liquefaction is associated primarily with loose (low density), saturated, fine-to-medium grained, cohesionless soils. As shaking action of an earthquake progresses, soil grains are rearranged and densify within a short period of time. Rapid densification of soil results in a buildup of porewater pressure within saturated soils. When the pore-water pressure approaches the total overburden pressure, then soil shear strength reduces greatly, and this soil temporarily behaves similarly to a fluid. Effects of liquefaction can include sand boils, settlement, and bearing capacity failures below structural foundations.

The site has not been mapped in an area considered to have a potential for liquefaction on the Seismic Hazard Zones Map for the Mount Baldy Quadrangle (CGS, 2000). Groundwater levels, as we understand them, are expected to be greater than 50 feet in the region. The underlying alluvial soil is typically dense, and would not be considered susceptible to liquefaction.

2.6.2 <u>Seismically Induced Settlement</u>: During a strong seismic event, seismically induced settlement can occur within loose to moderately dense, dry or saturated granular soil. Settlement caused by ground shaking is often non-uniformly distributed, which can result in differential settlement.



We anticipate that seismically induced settlement would be relatively minor and within generally tolerable limits. Underlying alluvium is coarse and dense; and is not considered susceptible to significant seismic settlement.

- 2.6.3 <u>Seismically Induced Landslides</u>: The site is not mapped in an area considered to have a potential for earthquake-induced landslides on the Seismic Hazard Zones Map for the Mount Baldy Quadrangle (CGS, 2000). In addition, significant slopes are not located on or adjacent to the site. Therefore, the potential for seismically induced landslides that will affect the site is considered low.
- 2.6.4 <u>Lateral Spreading Potential</u>: Lateral spreading is a phenomenon in which large blocks of intact, non-liquefied soil move down slope on a liquefied soil layer. For lateral spreading to occur, the liquefiable soil zone must be laterally continuous, unconstrained laterally and free to move along sloping ground. This possibility does not exist on this site in alluvium due to the lack of liquefiable layers.

3.0 CONCLUSIONS AND RECOMMENDATIONS

3.1 Conclusions and Recommendations Summary

Based on this geotechnical review, development of the site appears feasible from a geotechnical standpoint. No severe geologic or soils related issues were identified that would preclude development of the site. The most significant geotechnical issues at the site are those related to the potential for loose surficial soils and strong seismic shaking. Good planning and design can limit the impact of these constraints.

3.2 <u>Earthwork Considerations</u>

3.2.1 Remedial Grading: We recommend that this proposed wellhouse footprint be excavated to a depth of 3 feet below existing surface grade, to expose dense, undisturbed native coarse alluvium (sands and gravel) or 1 foot below the bottom of proposed footings, whichever is deeper. Overexcavation should extend 3 feet horizontally beyond the wellhouse outside perimeter of the proposed foundation exterior perimeter. Exposed subgrade in this overexcavation should then be scarified to a depth of at least 6 inches, moisture conditioned to above optimum moisture content and compacted to at least 90 percent of the ASTM D 1557 (modified Proctor) laboratory maximum density. This overexcavation should then be backfilled with site sands free of organics,



- at or slightly above optimum moisture content, compacted to at least 90 percent of the ASTM D 1557 (modified Proctor) laboratory maximum density.
- 3.2.2 Compacted Fill/Backfill: Fill soils should be free of organic and other deleterious materials (glass, wood, plaster, plastic, steel, pipe materials, agricultural waste, etc.). Specifically, fill soils should not contain more than 2 percent organic content measured by dry weight (ASTM D 2974). Cobbles greater than 3 inches but less than 12 inches in largest dimension may be used in compacted fill if mixed with at least 80 percent soils and not allowed to nest or create voids in the fill. In general, onsite soils are suitable for use as compacted fill for building subgrade preparation or trench backfill above the pipe zone, if cleared of oversized material over 12 inches in diameter. Fill soils should be placed near or slightly above optimum moisture content and compacted to a minimum of 90 percent of the maximum dry density (based on ASTM Test Method D 1557) at near optimum moisture content. Optimum lift thickness to produce a uniformly compacted fill will depend on the type and size of compaction equipment used. However, fill should be placed in uniform lifts not exceeding 8 inches in loose thickness.
- 3.2.3 Oversized Material: Oversized material (rock or rock fragments greater than 12 inches in dimension) were observed during our investigation, but is expected to make up less than 3 percent of onsite soils. Oversize rock should be placed in deeper fills (deeper than 4 feet below finish grade) or removed from structural fill areas.
- **3.2.4** Trench Backfill: Utility trenches should be backfilled with compacted fill in accordance with Sections 306-12.2 (narrow trench) and 306-12.3 (mechanical compaction) of the *Standard Specifications for Public Works Construction*, ("Greenbook").
 - Pipe Zone: The pipe bedding zone can be backfilled with Controlled Low Strength Material (CLSM) consisting of at least one sack of Portland cement per cubic-yard of sand, conforming to Section 201-6 of the 2015 Edition of the Greenbook. If CLSM is not used, then, prior to backfilling trenches, pipes should be bedded in and covered with a uniform, granular material that has a Sand Equivalent (SE) of 30 or greater, and a gradation meeting requirements of the pipe manufacturer. Bedding should be placed to 1 foot (0.3 m) over the top of the conduit, and densified by jetting in areas of granular soils, if allowed by the permitting agency. Jetting of



the bedding around the conduits should be observed by Leighton. CLSM should not be jetted and need not be observed by Leighton.

- Over Pipe Zone: Above the pipe zone, trenches can be backfilled with excavated on-site soils free of debris, organic and oversized material greater than 6 inches in largest dimension. Oversized rock (cobbles and/or boulders) should either be removed from any backfill, or pulverized for use in backfill only above the pipe zone. Gravel larger than ¾ inch in diameter should be mixed with at least 80 percent soil by weight passing the No. 4 sieve. Native soil backfill over the pipe bedding zone should be placed in thin lifts, moisture conditioned, as necessary, and mechanically compacted using a minimum standard of 90 percent relative compaction, relative to the ASTM D 1557 laboratory maximum dry density. Backfill above the pipe zone (bedding) should be observed and tested by Leighton.
- 3.2.5 <u>Surface Drainage</u>: Positive surface gradients should be provided adjacent to the wellhouse to direct surface water away from foundations and slabs-on-grade towards suitable discharge facilities. Ponding of surface water should not be allowed on or adjacent to the backwash waste vessel (tank), slabs-on-grade and/or pavements. Roof runoff should be directed away from foundations and slabs-on-grade in conduits discharging at least 5 feet horizontally away from building/structure perimeters.
- 3.2.6 <u>Construction Observation</u>: Leighton should observe and test all grading and earthwork, to check that overexcavations expose competent native soils, selected fill materials are satisfactory, and placement and compaction of engineered fill has been performed in accordance with our recommendations and project specifications. Sufficient notification to the geotechnical team prior to earthwork is essential. Project plans and specifications should incorporate our recommendations contained in this report.

Variations in site conditions are possible and may be encountered during construction. To confirm correlation between geotechnical data obtained during our field and laboratory explorations, relative to actual subsurface conditions encountered during construction, and to observe conformance with the plans and specifications, it is essential that Leighton be retained to perform continuous or intermittent review during earthwork, excavation and foundation construction phases.



3.3 Seismic Design Parameters

The principal seismic hazard to the site is ground shaking resulting from an earthquake occurring along any of several major active and potentially active faults in southern California. The intensity of ground shaking at a given location depends primarily upon the earthquake magnitude, the distance from the seismic source, and the site response characteristics. The site should be expected to experience strong ground shaking after the proposed project is developed resulting from an earthquake occurring along one or more of the major active faults in the region. Accordingly, the project should be designed in accordance with all applicable current codes and standards utilizing the appropriate seismic design parameters to reduce seismic risk as defined by California Geological Survey (CGS) Chapter 2 of Special Publication 117a (CGS, 2008). Through compliance with these regulatory requirements and the utilization of appropriate seismic design parameters selected by the design professionals, potential effects relating to seismic shaking can be reduced.



The following parameters should be considered for design under the 2019 CBC:

2019 CBC Seismic Design Parameters

2019 CBC Parameters (CBC or ASCE 7-16 reference)	Value 2019 CBC
Site Latitude and Longitude: 34.129283, -117.7031	75
Site Class Definition (1613A.2.2, ASCE 7-16 Ch 20)	D
Mapped Spectral Response Acceleration at 0.2s Period (1613A.2.1), S _s	1.761 g
Mapped Spectral Response Acceleration at 1s Period (1613A.2.1), S_1	0.668 g
Short Period Site Coefficient at 0.2s Period (T1613A.2.3(1)), Fa	1.0
Long Period Site Coefficient at 1s Period (T1613A.2.3(2)), F _v	1.7*
Adjusted Spectral Response Acceleration at 0.2s Period (1613A.2.3), S_{MS}	1.761 g
Adjusted Spectral Response Acceleration at 1s Period (1613A.2.3), S_{M1}	1.136* g
Design Spectral Response Acceleration at 0.2s Period (1613A.2.4), S_{DS}	1.174 g
Design Spectral Response Acceleration at 1s Period (1613A.2.4), S_{D1}	0.757* g
Mapped MCE _G peak ground acceleration (11.8.3.2, Fig 22-9 to 13), PGA	0.753 g
Site Coefficient for Mapped MCE _G PGA (11.8.3.2), F _{PGA}	1.1
Peak Ground Acceleration (1803A.5.12; 11.8.3.2), PGA _M	0.829 g

^{*} Per Table 11.4-2 of Supplement 1 of ASCE 7-16, this value of F_v may only be used to calculate Ts [that note is not included in Table 1613A.2.3(2)]; note that S_{D1} and S_{M1} are functions of F_v . In addition, per Exception 2 of 11.4.8 of ASCE 7-16, special equations for C_s are required. This is in lieu of a site-specific ground motion hazard analysis per ASCE 7-16 Chapter 21.2.

Based on the 2019 CBC Table 1613A.2.3(2) footnote c., F_v should be determined in accordance with Section 11.4.8 of ASCE 7-16, since the mapped spectral response acceleration at 1 second is greater than 0.2g for Site Class D; in accordance with Section 11.4.8 of ASCE 7-16, a site-specific seismic analysis is required. However, the values provided in the table above may be utilized if design is performed in accordance with Exception (2) in Section 11.4.8 of ASCE 7-16, with special requirements for the seismic response coefficient (Cs), and F_v is only used for calculation of T_s . This exception does not apply (and the values in the table above would not be applicable) for proposed structures with seismic isolation or seismic damping systems, which is not anticipated for this project.



^{**} Site Class D, and all of the resulting parameters in this table, may only be used for structures without seismic isolation or seismic damping systems.

The project structural engineer should review the seismic parameters. A sitespecific seismic ground motion analysis can be performed upon request.

3.4 Shallow Foundation Recommendations

Overexcavation and recompaction of the footing subgrade soil should be performed as detailed in Section 3.2. The following recommendations are based on the onsite soil conditions and soils with a very low expansion potential. Additional testing of the onsite soils should be conducted at the completion of grading to confirm the expansion index of the soil present in the upper portion of pad grade.

Minimum Embedment and Width: Based on our investigation, footings should have a minimum embedment per code requirements, but no less than 12 inches below the lowest adjacent grade, with a minimum width of 15 and 24 inches for square and continuous footings, respectively.

Allowable Bearing: An allowable bearing pressure of 2,000 pounds-per-square-foot (psf) may be used for footings, based on the minimum embedment depth and width above. This allowable bearing value may be increased by 250 psf per foot increase in depth or width to a maximum allowable bearing pressure of 5,000 psf. If higher bearing pressures are required, this should be reviewed on a case-by-case basis and may include additional overexcavation and/or soil reinforcement. These allowable bearing pressures are for total dead load and sustained live loads.

Footing reinforcement should be designed by the structural engineer. However, as a minimum, footing reinforcement should consist of one No. 4 rebar at the top and at the bottom of continuous footings and No. 4 rebar spaced at 18 inches on center in each direction for isolated footings.

Lateral Load Resistance: Soil resistance available to withstand lateral loads on a shallow foundation is a function of the frictional resistance along the base of the footing and the passive resistance that may develop as the face of the structure tends to move into the soil. The frictional resistance between the base of the foundation and the subgrade soil may be computed using a coefficient of friction of 0.35. The passive resistance may be computed using an allowable equivalent fluid pressure of 250 pounds per cubic foot (pcf), assuming there is constant contact between the footing and undisturbed soil. The coefficient of friction and passive resistance may be combined without further reduction.



Increase Bearing and Friction – Short Duration Loads: For the case of short term loading (such as those imposed by seismic and wind loading), the allowable bearing pressure and coefficient of friction values may be increased by one-third.

Settlement: The recommended allowable bearing pressure for shallow footings is generally based on a post-construction static settlement of 1 inch. Post-construction static differential settlement is estimated to be on the order of ½ inch over a horizontal distance of 30 feet for shallow footings. Since settlement is a function of footing size and contact bearing pressure, differential settlement can be expected between adjacent columns or walls where a large differential loading condition exists.

3.5 Slab-on-Grade Recommendations

Concrete slabs-on-grade should be designed by the structural engineer in accordance with the current CBC for soil with a very low expansion potential. Where conventional light floor loading conditions exist, the following minimum recommendations should be used. More stringent requirements may be required by local agencies, the structural engineer, the architect, or the CBC. Laboratory testing should be conducted at finish grade to evaluate the expansion index of near-surface subgrade soils. In addition, slabs-on-grade should have the following minimum recommended components:

Subgrade Moisture Conditioning: The subgrade soil should be moisture conditioned to at least 2 percentage points above optimum moisture content to a minimum depth of 12 inches prior to placing the moisture vapor retarder, steel or concrete.

Moisture Retarder: A minimum of a 10-mil vapor retarder should be placed below slabs where moisture-sensitive floor coverings or equipment is planned. A Stego 15-mil vapor barrier would provide additional protection. Since moisture will otherwise be transmitted up from the soil through the concrete, it is important that an intact vapor retarder be installed. We recommend that the vapor retarder meet the requirements of ASTM E 1745 and be installed per ASTM E 1643. The structural engineer should specify pertinent concrete design parameters and moisture migration prevention measures, such as whether a sand blotter layer should be placed over the vapor retarder. Gravel or other protruding objects that could puncture the moisture retarder should be removed from the subgrade prior to placing the vapor retarder, or a stronger vapor retarder intended for the specific conditions present can be used.



Concrete and Structural Design Thickness: Slabs-on-grade should be designed by the structural engineer, but should be at least 4 inches thick (this is referring to the actual minimum thickness, not the nominal thickness). Reinforcing steel should be designed by the structural engineer, but as a minimum (for conventionally reinforced slabs) should be No. 3 rebar placed at 18 inches on center, each direction, mid-depth in the slab.

Minor cracking of the concrete as it cures, due to drying and shrinkage is normal and should be expected. However, cracking is often aggravated by a high water/cement ratio, high concrete temperature at the time of placement, small nominal aggregate size, aggregate that is not sufficiently clean, and rapid moisture loss due to hot, dry, and/or windy weather conditions during placement and curing. Cracking due to temperature and moisture fluctuations can also be expected. Low slump concrete can reduce the potential for shrinkage cracking. Additionally, our experience indicates that reinforcement in slabs and foundations can generally reduce the potential for shrinkage cracking. The structural engineer should consider these and other pertinent concrete design and construction considerations in slab design and specifications.

Moisture retarders can reduce, but not eliminate moisture vapor rise from the underlying soils up through the slab. Leighton does not practice in the field of moisture vapor transmission evaluation, since this is not specifically a geotechnical issue. Therefore, we recommend that a qualified person, such as the flooring subcontractor and/or structural engineer, be consulted with to evaluate the general and specific moisture vapor transmission paths and any impact on the proposed construction. That person should provide recommendations for mitigation of potential adverse impact of moisture vapor transmission on various components of the structures as deemed appropriate. The recommendations in this report and our services in general are not intended to address mold prevention, since we, along with geotechnical consultants in general, do not practice in the area of mold prevention. If specific recommendations are desired, a professional mold prevention consultant should be contacted.



3.6 **Lateral Earth Pressures / Retaining Walls**

3.6.1 <u>Design Earth Pressures</u>: Design lateral earth pressures tabulated below are provided for design of permanent retaining walls no more than 15 feet high. Earth pressures provided are ultimate values and a safety factor should be applied as appropriate.

Table 1. Static Lateral Earth Pressures (Drained and Level Backfill)

Conditions ¹	Static Equivalent Fluid Weight (pcf)
Active (cantilever)	35
At-Rest (braced)	45
Passive ²	350

- 1. For level backfill, not including surcharges or added seismic loads
- 2. Passive equivalent fluid pressure may be doubled for isolated soldier piles spaced at least 2½ diameters on-center. Passive resistance should not exceed 5,000 poundsper-square-foot (psf)

Determination of appropriate design conditions (active or at-rest) depends on retaining wall type. If a rotation of more than 0.001 radian (0.06 degrees) is allowed, active pressure conditions apply; otherwise, at-rest condition governs.

3.6.2 Retaining Wall Surcharges: In addition to the above lateral forces due to retained earth, surcharge due to above grade loads on the wall backfill, such as traffic, should be considered in design of retaining walls and vaults. Vertical surcharge loads behind the retaining wall on or in the backfill within a 1:1 (horizontal:vertical) plane projection up and out from the retaining wall toe, should be considered as lateral and vertical surcharge. Unrestrained (cantilever) retaining walls should be designed to resist one-third of these surcharge loads applied as a uniform horizontal pressure on the wall. Braced walls should also be designed to resist an additional uniform horizontal-pressure equivalent to one-half of uniform vertical surcharge-loads.

In areas where autos and pickup trucks will drive, we suggest assuming a uniform vertical surcharge of 300 psf, which would result in active and at-rest horizontal surcharges of 100 psf and 150 psf, respectively. This should be doubled in areas of heavy construction traffic (such as concrete trucks, heavy equipment delivery-trucks, etc.). If crane outrigger loads or other point load



sources are applied as wall surcharge, this will require additional analyses based on load source and location relative to the wall.

3.6.3 <u>Incremental Seismic Loads on Retaining Walls</u>: Seismic incremental loads need not be added to retaining walls with stem heights on the order of (≤) 6 feet or less, with adjacent level backfill. However, at the discretion of the project Structural Engineer (SE), incremental seismic earth pressures (equivalent fluid pressure) of 34 pounds-per-cubic-foot (pcf) may be applied for design in addition to static active earth and surcharge pressures presented above.\

3.7 **Soil Corrosivity Evaluation**

3.7.1 <u>Ferrous Corrosivity:</u> Many factors can affect the corrosion potential of soil including soil moisture content, resistivity, permeability and pH, as well as chloride and sulfate concentration. In general, soil resistivity, which is a measure of how easily electrical current flows through soils, is the most influential factor. Based on the findings of studies presented in ASTM STP 1013 titled "Effects of Soil Characteristics on Corrosion" (February, 1989), the approximate relationship between soil resistivity and soil corrosiveness was developed as listed below:

Soil Resistivity (ohm-cm)	Classification of Soil Corrosiveness
0 to 900	Very Severely Corrosive
900 to 2,300	Severely Corrosive
2,300 to 5,000	Moderately Corrosive
5,000 to 10,000	Mildly Corrosive
10,000 to >100,000	Very Mildly Corrosive

Table 2. Soil Resistivity and Corrosivity Relationship

Acidity is an important factor of soil corrosivity. The lower the pH (the more acidic the environment), the higher the soil corrosivity will be with respect to buried metallic structures and utilities. As soil pH increases above 7 (the neutral value), the soil is increasingly more alkaline and less corrosive to buried steel structures, due to protective surface films that form on steel in high pH environments. A pH between 5 and 8.5 is generally considered relatively passive from a corrosion standpoint. Chloride and sulfate ion concentrations, and pH appear to play secondary roles in affecting corrosion



- potential. High chloride levels tend to reduce soil resistivity and break down otherwise protective surface deposits, which can result in corrosion of buried steel or reinforced concrete structures.
- 3.7.2 <u>Sulfate Attack:</u> Sulfate ions in the soil can lower the soil resistivity and can be highly aggressive to Portland cement concrete by combining chemically with certain constituents of the concrete, principally tricalcium aluminate. This reaction is accompanied by expansion and eventual disruption of the concrete matrix. A potentially high sulfate content could also cause corrosion of the reinforcing steel in concrete. Generally accepted sulfate exposure classifications are tabulated below:

Water-Soluble Sulfate (SO₄) Sulfate In Water in soil (percentage by **Sulfate Exposure** (parts-per-million) weight) 0-150 0.00 - 0.10Negligible 0.10 - 0.20150-1,500 Moderate 1,500-10,000 0.20 - 2.00Severe Very Severe >10,000 Over 2.00

Table 3. Sulfate Concentration and Exposure Relationship

3.7.3 <u>Corrosivity Test Results</u>: To evaluate corrosion potential of site soils, we tested two soil sample from this site, collected during our subsurface exploration for soluble sulfate, chloride content, pH and resistivity testing. Results of these tests are summarized below:

Table 4. Results of Corrosivity Testing

Boring	Sample Depth (feet)	Sulfate Content (%)	Chloride Content (ppm)	рН	Resistivity (ohm-cm)		
TP-1	2.0	0.019	80	7.82	6,595		

Note: mg/kg = milligrams per kilogram, or parts-per-million

Ferrous Metals Corrosivity: As tabulated above, minimum soil resistivities measured in our laboratory was 6,595 ohm-centimeters for a shallow soil sample from this site. Based on generally accepted resistivity correlations, it appears that corrosion potential for onsite soils may be characterized as "mildly corrosive" for ferrous pipe in contact with these soils. Corrosion information presented in this report should be provided to your underground utility subcontractors. Additional testing and evaluation



by a corrosion engineer may be warranted if corrosion protection is considered critical to the project.

Sulfate Attack of Concrete: Based on results of our laboratory testing, soluble sulfate concentration of 190 parts-per-million (ppm) was measured in onsite near-surface soils. Therefore, concrete structures in contact with these on-site soils will have "negligible" exposure to water-soluble sulfates. Type II cement may be used for concrete construction. The concrete should be designed in accordance with Table 4.3.1 of the American Concrete Institute provisions.

3.8 **Preliminary Pavement Design**

Preliminary recommended pavement sections presented below were calculated using the current Caltrans Highway Design Manual and an assumed design R-value of 78 based on laboratory test results of a representative onsite soil sample. Final pavement design should be based on the Traffic Index determined by the project civil engineer and R-value testing provided near the end of grading.

Asphalt Pa	evement Section Thi	ckness, Type I Subg	ırade Soil
Street Designation	Asphaltic Concrete	Class 2 Aggregate	Total Pavement
(Traffic Index)	(AC) Thickness	Base Thickness	Section Thickness
(Trailic index)	(inches)	(inches)	(inches)
5 or less	3	4	7
6	3.5	4	7.5

All pavement construction should be performed in accordance with the Standard Specifications for Public Works Construction or Caltrans Specifications. Field observations and periodic testing, as needed during placement of the base course materials, should be undertaken to ensure that the requirements of the standard specifications are fulfilled.

Prior to placement of aggregate base, the subgrade soil should be processed to a minimum depth of 6 inches, moisture-conditioned, as necessary, and recompacted to a minimum of 95 percent relative compaction. Aggregate base should be moisture conditioned, as necessary, and compacted to a minimum of 95 percent relative compaction.



If the pavement is to be constructed prior to construction of the structures, we recommend that the full depth of the pavement section be placed in order to support heavy construction traffic.

3.9 <u>Infiltration Recommendations</u>

Infiltration Rate: Open pit percolation tests yielded small-scale, clean-water infiltration rate averaging 3.5 inches per hour in the area of the planned infiltration facilities. The subsurface soils encountered suggest infiltration will be feasible. We recommend an unfactored (small-scale) infiltration rate of 3.5 inches per hour be used for preliminary design. Correction factors need to be applied, as discussed below.

We recommend that a correction factor/safety factor be applied to the infiltration rate in conformance with Los Angeles County guidelines, since monitoring of actual facility performance has shown that actual infiltration rates are lower than for small-scale tests. The small-scale infiltration rate should be divided by a correction factor of at least 2 for buried chambers, and at least 3 for open basins or for conditions where retained water will be exposed to the open atmosphere, but the correction/safety factor may be higher based on project-specific aspects.

The infiltration rates described herein are for a clean, unsilted infiltration surface in native, sandy alluvial soil. These values may be reduced over time as silting of the infiltration facility occurs. Furthermore, if the basin or chamber bottom is allowed to be compacted by heavy equipment, this value is expected to be significantly reduced. Infiltration of water through soil is highly dependent on such factors as grain size distribution of the soil particles, particle shape, fines content, clay content, and density. Small changes in soil conditions, including density, can cause large differences in observed infiltration rates. Infiltration is not suitable in compacted fill.

It should be noted that during periods of prolonged precipitation, the underlying soils tend to become saturated to greater and greater depths/extents. Therefore, infiltration rates tend to decrease with prolonged rainfall. It is difficult to extrapolate longer-term, full-scale infiltration rates from small-scale tests, and as such, this is a significant source of uncertainty in infiltration rates.



Additional Review and Evaluation: Infiltration rates are anticipated to vary significantly based on the location and depth. Infiltration concepts should be discussed with Leighton as infiltration plans are being developed. Leighton should review all infiltration plans, including specific locations and depths of proposed facilities. Further testing may be needed based on the design of infiltration facilities, particularly considering their type, depth and location.

General Design Considerations: The periodic flow of water carrying sediments into the infiltration facility, plus the introduction of wind-blown sediments and sediments from erosion of basin side walls, can eventually cause the bottom of the facility to accumulate a layer of silt, which has the potential of significantly reducing the overall infiltration rate of the facility. Therefore, we recommend that significant amounts of silt/sediment not be allowed to flow into the facility within stormwater, especially during construction of the project and prior to achieving a mature landscape on site. We recommend that an easily maintained, robust silt/sediment removal system be installed to pretreat storm water before it enters the infiltration facility.

As infiltrating water can seep within the soil strata nearly horizontally for long distances, it is important to consider the impact that infiltration facilities can have on nearby subterranean structures, such as basement walls or open excavations, whether onsite or offsite, and whether existing or planned. Any such nearby features should be identified and evaluated as to whether infiltrating water can impact these. Such features should be brought to Leighton's attention as they are identified.

Infiltration facilities should not be constructed adjacent to or under buildings. Setbacks should be discussed with Leighton during the planning process, but should be a minimum of 10 feet.

Infiltration facilities should be constructed with spillways or other appropriate means that would cause overfilling to not be a concern to the facility or nearby improvements.

For buried chambers, control/access manhole covers should not contain holes or should be screened to prevent mosquitos from entering the chambers

Additional Design Considerations (Particularly for Open Basins): If open basins are planned, additional observation of the soils exposed at the bottom of



the basin should be conducted, as these soils are critical to the basin's success. Soils at the bottom of buried chambers are also important, but not as critical to their success, provided the infiltration chamber cuts through sufficiently granular soils.

In general, the rate of infiltration reduces as the head of water in the infiltration facility reduces, and it also reduces with prolonged periods of infiltration. As such, water typically infiltrates much faster near the beginning of and/or immediately after storm events than at times well after a storm when the water level in the facility has receded, since the infiltration rate is then slower due to both lower head and longer overall duration of infiltration. In open basins with compacted or silty bottoms, this could be problematic, in that, even if the basin had already infiltrated significant amounts of storm water, the lower several inches or feet of water could remain in the basin for an extended period of time, creating a prolonged open-water safety concern and potential for mosquitos. In a buried/covered infiltration chamber without direct access to the open atmosphere, these conditions would be of less concern.

Parks or play/recreation areas should not be constructed within basin bottoms or below the spillway level.

For open basins and swales, vegetation within the basin bottoms and sides is expected to help reduce erosion and help maintain infiltration rates.

Estimating infiltration rates, especially based on small-scale testing, is inexact and indefinite, and often involves known and unknown soil complexities, potentially resulting in a condition where actual infiltration rates of the completed facility are significantly less than design rates. In open infiltration basins, this could create nuisance water in the basin. As such, enhancements may be needed after completion of the basin if prolonged or frequent standing water is experienced. A potential basin enhancement, if needed, might be to install additional infiltration trenches or infiltration borings in the basin bottom to capture and infiltrate low flows and to help speed infiltration during/after storms; specific recommendations, such as minimum trench/boring depth, would be developed based on conditions observed.

Construction Considerations: We recommend that Leighton evaluate the infiltration facility excavations, to confirm that granular, undisturbed alluvium is



exposed in the bottoms and sides. Additional excavation or evaluation may be required if silty or clayey soils are exposed.

It is critical to infiltration that the basin or chamber bottom not be allowed to be compacted during construction or maintenance; rubber-tired equipment and vehicles should not be allowed to operate on the bottom. We recommend that at least the bottom 3 feet of the basins or chambers be excavated with an excavator or similar.

If fill material is needed to be placed in the basin, such as due to removal of uncontrolled artificial fill, the fill material should be select and free-draining sand, and should be observed and evaluated by Leighton.

Maintenance Considerations: The infiltration facilities should be routinely monitored, especially before and during the rainy season, and corrective measures should be implemented as/when needed. Things to check for include proper upkeep, proper infiltration, absence of accumulated silt, and that de-silting filters/features are clean and functioning. Pretreatment desilting features should be cleaned and maintained per manufacturers' recommendations. Even with measures to prevent silt from flowing into the infiltration facility, accumulated silt may need to be removed occasionally as part of maintenance.

4.0 CONSTRUCTION CONSIDERATIONS

4.1 <u>Temporary Excavations</u>

The contractor is responsible for (1) all temporary slopes and trenches excavated at the site and (2) design and installation of any required temporary shoring. Shoring, bracing and benching should be performed by the contractor in accordance with the current edition of the *California Construction Safety Orders*, see:

http://www.dir.ca.gov/title8/sb4a6.html

During construction, exposed earth material conditions should be regularly evaluated to verify that conditions are as anticipated. The contractor is responsible for providing the "competent person" required by OSHA standards to evaluate soil conditions. Close coordination between the competent person and Leighton Consulting, Inc. should be maintained to facilitate construction while providing safe excavations. Existing shallow soil encountered are OSHA soil



Type C. Therefore, unshored temporary cut slopes should be cut no steeper than 1½:1 (horizontal:vertical), for a height no greater than 20 feet (*California Construction Safety Orders*, Appendix B to Section 1541.1, Table B-1). For steeper temporary construction slopes, deeper excavations and/or where unsuitable soils are encountered during excavation, shoring should be provided by the contractor as necessary to protect the workers in the excavation and adjacent improvements.

4.2 **Temporary Shoring**

Trench excavations may be supported by several methods including cross-braced hydraulic shoring, conventional shields, sheet piles, soldier piles and wood. The choice should be left to the contractor's judgment since economic considerations and/or the individual contractor's construction experience may determine which method is more economical and/or appropriate. The contractor and shoring designer should also perform additional geotechnical studies as necessary to refine the means-and-methods of shoring construction.

These shoring systems adjacent to existing structures should be designed by a California licensed civil or structural engineer. The contractor should forward their plans for the support system to Leighton for pre-construction review. In addition, it should be the contractor's responsibility to undertake a pre-construction survey with benchmarks and photographs of the adjacent improvements (if any). The contractor and shoring designer should perform additional geotechnical studies as necessary to refine the means and methods of shoring construction. As preliminary design guidelines, we present the following geotechnical parameters for shoring design:

- Design Lateral Earth Pressures: Unrestrained (cantilever) shoring above groundwater can be designed to resist an equivalent fluid pressure of 30 pounds-per-cubic-foot (pcf), for shoring no more than approximately 15 feet in height with level backfill. For braced shoring (restrained from movement at the top) a uniform pressure of 20H pounds-per-square-foot (psf), where H is the shoring height in feet, should be used in design for shoring heights greater than 15 feet, not to exceed 25 feet with level backfill.
- Soldier Piles: Soldier piles may be assumed to have a passive resistance below the lowest adjacent excavation (bottom of over-excavation) of 800 pounds-per-square-foot (psf), per foot of embedment of the soldier pile encased in concrete in firm contact with undisturbed native sands. This



passive pressure should not exceed 8,000 psf, and is based on the assumption that soldier piles will be spaced at least three diameters on center. We do **not** have any empirical evidence regarding caving in drilled shafts at this site. Caving of sands is extremely likely. This should be considered by the soldier-pile installation contractor.

Lagging: Lagging with solder piles may be considered as an option. Continuous lagging will be required between the soldier piles. The lagging should be installed as the excavation proceeds. The soldier piles should be designed for the full anticipated lateral pressure. However, pressure on lagging will be less due to arching in the soils. We recommend that the lagging be designed for the recommended earth pressure but limited to a value 400 psf.

Surcharge loads (dead or live) should be added to the indicated lateral earth pressures and should be applied uniformly, if such loads are within a horizontal distance that is less-than the exposed shoring height. The corresponding lateral earth pressure will approximately be 33 percent of the vertical surcharge for active conditions, and 50 percent for at-rest conditions. Surcharge pressures from concentrated loads should be evaluated after geometric constraints and loading conditions are determined on individual basis.

4.3 Additional Geotechnical Services

This report was based in part on data obtained from three test pits. The nature of many sites is such that differing soil or geologic conditions can be present within relatively small distances beyond a boring and under varying climatic conditions. Changes in subsurface conditions can and do occur over time. Therefore, our findings, conclusions and recommendations presented in this report are only valid if Leighton Consulting, Inc. has the opportunity to observe subsurface conditions during construction, to confirm that our preliminary data are representative for this site. Geotechnical observation and testing should be provided by Leighton Consulting, Inc. during foundation excavation and earthwork, and particularly if any unusual subsurface conditions are encountered.

5.0 LIMITATIONS

This report was prepared solely for Three Valleys Municipal Water District and their design team, solely for design of this proposed wellhouse and appurtenances described in this report, in accordance with generally accepted geotechnical engineering practices



at this time in southern California. No warranty is expressed or implied. This report does not address the potential for encountering hazardous materials in soil and/or groundwater.

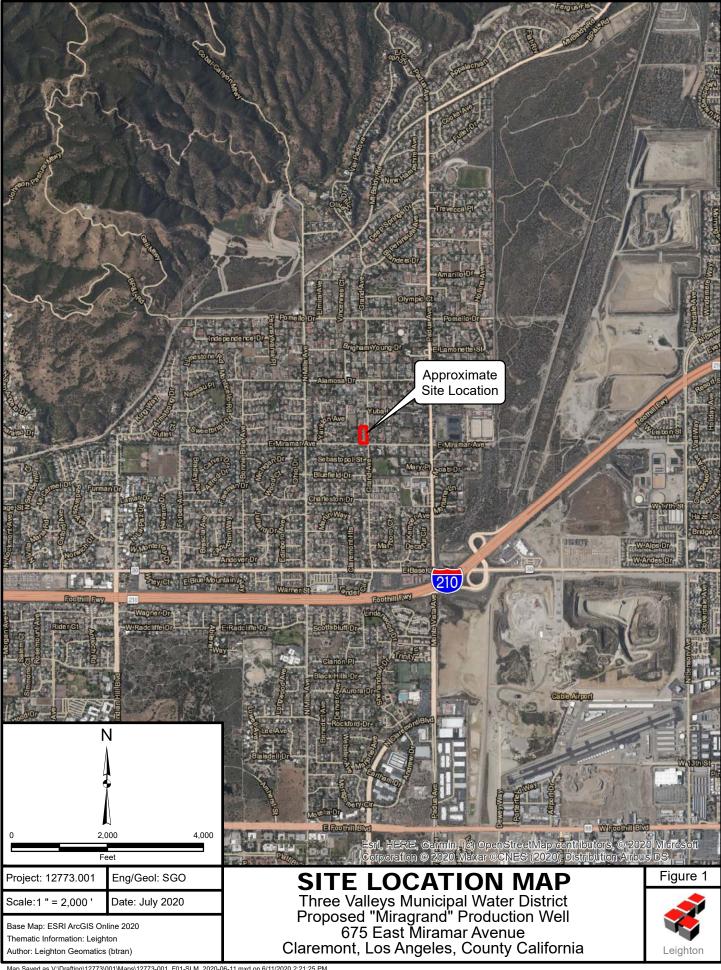
This report is not authorized for use by, and is not to be relied upon by any party except Three Valleys Municipal Water District, with whom Leighton Consulting, Inc. has contracted for the work. Use of or reliance on this report by any other party is at that party's sole risk. Unauthorized use of or reliance on this report constitutes an agreement to defend and indemnify Leighton Consulting, Inc. from and against any liability which may arise as a result of such use or reliance, regardless of any fault, negligence, and/or strict liability of Leighton Consulting, Inc.



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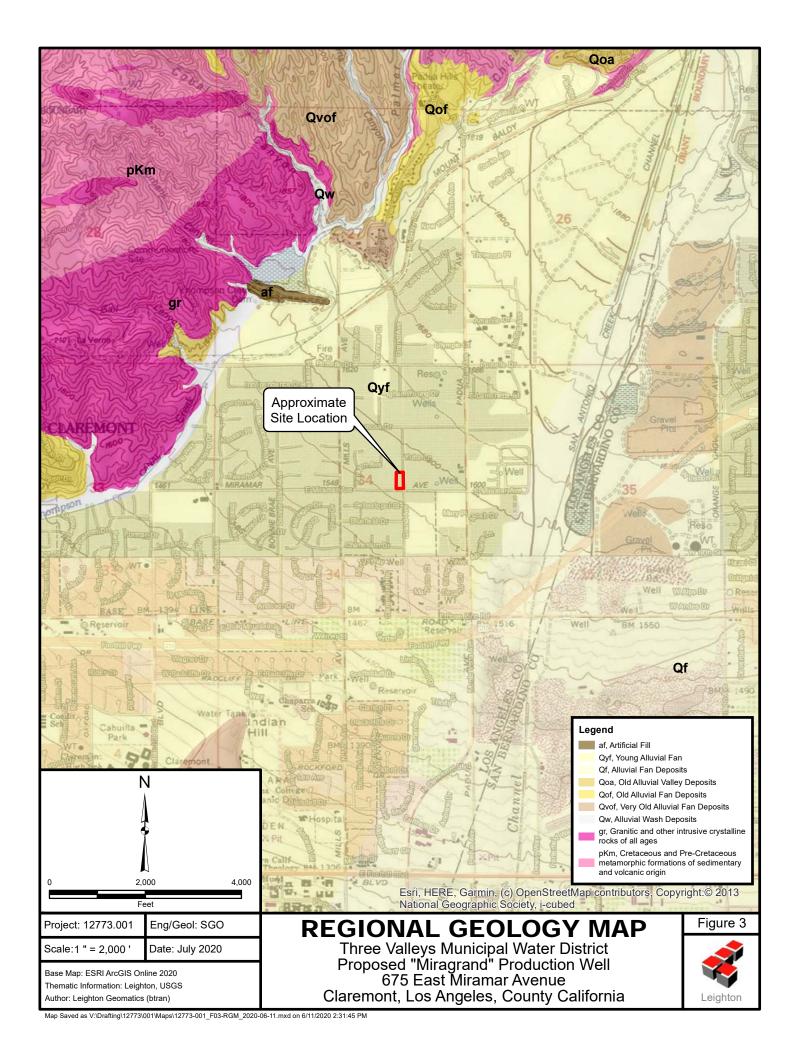




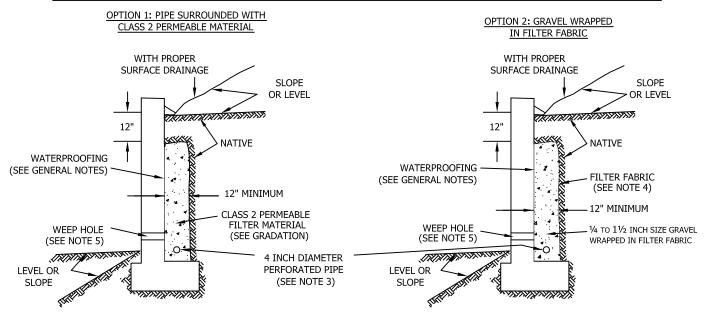


Three Valleys Municipal Water District
Proposed "Miragrand" Production Well
675 East Miramar Avenue, Claremont, Los Angeles, County California

Base Map: ESRI ArcGIS Online 2020 Thematic Information: Leighton Author: Leighton Geomatics (btran)



SUBDRAIN OPTIONS AND BACKFILL WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50



Class 2 Filter Permeable Material Gradation Per Caltrans Specifications

Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25 -4 0
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

GENERAL NOTES:

- * Waterproofing should be provided where moisture nuisance problem through the wall is undesirable.
- * Water proofing of the walls is not under purview of the geotechnical engineer
- * All drains should have a gradient of 1 percent minimum
- *Outlet portion of the subdrain should have a 4-inch diameter solid pipe discharged into a suitable disposal area designed by the project engineer. The subdrain pipe should be accessible for maintenance (rodding)
- *Other subdrain backfill options are subject to the review by the geotechnical engineer and modification of design parameters.

Notes

- 1) Sand should have a sand equivalent of 30 or greater and may be densified by water jetting.
- 2) 1 Cu. ft. per ft. of 1/4- to 1 1/2-inch size gravel wrapped in filter fabric
- 3) Pipe type should be ASTM D1527 Acrylonitrile Butadiene Styrene (ABS) SDR35 or ASTM D1785 Polyvinyl Chloride plastic (PVC), Schedule 40, Armco A2000 PVC, or approved equivalent. Pipe should be installed with perforations down, Perforations should be 3/8 inch in diameter
- placed at the ends of a 120-degree arc in two rows at 3-inch on center (staggered)
- 4) Filter fabric should be Mirafi 140NC or approved equivalent.
- 5) Weephole should be 3-inch minimum diameter and provided at 10-foot maximum intervals. If exposure is permitted, weepholes should be located 12 inches above finished grade. If exposure is not permitted such as for a wall adjacent to a sidewalk/curb, a pipe under the sidewalk to be discharged through the curb face or equivalent should be provided. For a basement-type wall, a proper subdrain outlet system should be provided.
- 6) Retaining wall plans should be reviewed and approved by the geotechnical engineer.
- 7) Walls over six feet in height are subject to a special review by the geotechnical engineer and modifications to the above requirements.

RETAINING WALL BACKFILL AND SUBDRAIN DETAIL FOR WALLS 6 FEET OR LESS IN HEIGHT

WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50



APPENDIX A

FIELD EXPLORATION

Our field exploration consisted of a surface reconnaissance and a subsurface exploration program consisting of drilling three test pits to depths of 3½- to 4½ -feet on May 26, 2020. 2016. Approximate test pit locations are shown on Figure 2, *Test Pit Location Map*. Encountered soils were continuously logged in the field by our representative and described in accordance with the Unified Soil Classification System (ASTM D 2488). Test pit logs are included as part of this appendix.

In addition, disturbed bag (or bulk) samples were also obtained from soil cuttings. Types of samples obtained from each location are shown on boring logs at corresponding depths. After sampling and logging, our test pits were backfilled with soil cuttings generated during excavation. Representative earth-material samples obtained from this subsurface exploration were transported to our in-house geotechnical laboratory for evaluation and appropriate testing.

Subsurface exploration logs and related information in this appendix depict subsurface conditions only at the location indicated and at the particular date designated on the log. Subsurface conditions at other locations may differ from conditions occurring at this location. Passage of time may result in altered subsurface conditions due to environmental changes.



TEST PIT TP-1

TVMWD Well Claremont

Project No. 12773.001 Logged By: **ECB** Date Excavated: 05/26/2020

Elevation: 1572' ECB Sampled By:

Location: (see Figure 2, Geotechnical Exploration Map)

This soil description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth	(feet)	00			La	aboratory T	est Resul	ts
Тор	Bottom	USCS Symbol	Soil Description	Geologic Unit	Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)
			surface: sand, gravel					
0.0	2.0		Alluvium (Qal): SILTY SAND with gravel, cobbles, and boulders (SM): brown,slightly moist, 30% fines (field estimate), fine to medium sand, dense, some rootlets	Qal	B1	2		
2.0	4.5	SW	Alluvium (Qal): SAND with gravel, cobbles, and boulders (SW): light brown, moist, coarse sand, dense	Qal				
			SPOILS: Ten 12-18" soubrounded boulders					

Total Depth = 4.5 feet

No groundwater encountered when excavating Bottoms used as infiltration basin: Area 4' by 2.25'

Test pit back-filled and tamped with spoils on May 26, 2020



This log is a part of a report by Leighton and should not be used as a stand-alone document.

TEST PIT TP-2

TVMWD Well Claremont

Project No. 12773.001 Logged By: **ECB** Date Excavated: 05/26/2020

Elevation: 1573' ECB Sampled By:

Location: (see Figure 2, *Geotechnical Exploration Map*)

This soil description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth	(feet)	00			La	aboratory T	est Resul	ts
Тор	Bottom	USCS Symbol	Soil Description	Geologic Unit	Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)
			surface: sand, gravel					
0.0	1.8	SM	Alluvium (Qal): SILTY SAND with gravel, cobbles, and boulders (SM): brown, moist, 30-40% fines (field estimate), fine to medium sand, moderately dense to dense, some rootlets	Qal				
1.8	3.5	SW	Alluvium (Qal): SAND with gravel, cobbles, and boulders (SW): brown, moist, medium to coarse sand, dense	Qal				
			SPOILS: Eight to ten 12-18" soubrounded boulders					

Total Depth = 3.5 feet

No groundwater encountered when excavating Bottoms used as infiltration basin: Area 3.8' by 2'

Test pit back-filled and tamped with spoils on May 26, 2020



This log is a part of a report by Leighton and should not be used as a stand-alone document.

TEST PIT TP-3

TVMWD Well Claremont

Project No. 12773.001 Date Excavated: 05/26/2020 **ECB** Logged By:

Sampled By: Elevation: 1576' **ECB**

Location: (see Figure 2, Geotechnical Exploration Map)

This soil description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. This soil description (below) is a simplification of actual conditions encountered. Transitions between soil type may be gradual.

Depth	(feet)	0			Laboratory Test Results								
Тор	Bottom	USCS Symbol	Soil Description	Geologic Unit	Sample Number	Depth (feet)	Dry Density (pcf)	Moisture (%)					
			surface: sand, gravel										
0.0	4.0	SM	Alluvium (Qal): SILTY SAND with gravel, cobbles, and boulders (SM): dark brown, moist, 20% fines (field estimate), medium sand, moderately dense to dense, some rootlets	Qal									
4.0	5.3	SW	Alluvium (Qal): SAND with gravel, cobbles, and boulders (SW): yellowish brown, moist, coarse sand, dense	Qal	B1	4.5							
			SPOILS: Eight 12-18" soubrounded boulders, one 2' boulder										

Total Depth = 5.3 feet

No groundwater encountered when excavating

Test pit back-filled and tamped with spoils on May 26, 2020



This log is a part of a report by Leighton and should not be used as a stand-alone document.

Results of Well Permeameter, from USBR 7300-89 Method.

Project: TVMWD Miragrand Exploration #/Location: TP-1 Depth Boring drilled to (ft): IDO Tested by: USCS Soil Type in test zone: Weather (start to finish): Liquid Used/pH: Measured boring diameter: Well Prep:

15 in. Well Radius

<u>Depth to Bot of well</u> (or top of soil over Bentonite) Pilot Tube stickup (+ is above ground)

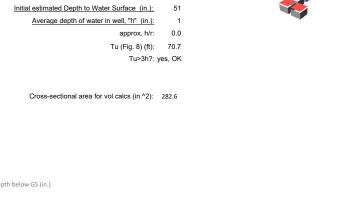
Depth to top of sand outside of casing from top of pilot tube Depth to top of float assembly from top of pilot tube Float Assembly ID

Float assembly Extension length (in.)

Diameter of barrels (in.): No. of Supply barrels

Total Area of barrels (in.^2): 397.4

Total (in.) 52 -12 -12. in. 17. in. 17 29 Depth below GS (in.)



Field Data						Calcul	ations												
Date Start Date	Time Start time:	Water Level in Supply Barrel (in.)	Depth to WL in Boring (measured from top of pilot tube)	Water Temp (deg F)	Comments	Δt (min)	Total Elapsed Time (min.)	Depth to WL in well (in.)	Water in	∆h (in.)	Avg. h		nange (in.^3)	Flow (in^3/ min)	q, Flow (in^3/ hr)	Average Infiltration Surface Area, (in^2)	V (Fig 9)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
5/26/2020	10:00		ft in.									from supply	from ∆h	Iotai					
5/26/20	10:35	27.5	3.24				35	50.9	1.1										
5/26/20	10:48	24	3.2			13	48	50.4	1.6	0.48	1	1391	-136	1255	97	5794	835	0.9	6.40
5/26/20	10:58	22.5	3.27			10	58	51.2	0.8	-0.84	1	596	237	833	83	5001	818	0.9	5.64
5/26/20	11:08	21	3.29			10	68	51.5	0.5	-0.24	1	596	68	664	66	3984	767	0.9	4.79
5/26/20	11:18	20	3.28			10	78	51.4	0.6	0.12	1	397	-34	363	36	2181	761	0.9	2.64
5/26/20	11:28	18.75	3.28			10	88	51.4	0.6	0	1	497	0	497	50	2981	767	0.9	3.58
5/26/20	11:38	17.5	3.28			10	98	51.4	0.6	0	1	497	0	497	50	2981	767	0.9	3.58
5/26/20	11:48	16.25	3.27			10	108	51.2	0.8	0.12	1	497	-34	463	46	2777	772	0.9	3.31
5/26/20	11:58	15	3.27			10	118	51.2	0.8	0	1	497	0	497	50	2981	778	0.9	3.53
5/26/20	12:08	13.75	3.26			10	128	51.1	0.9	0.12	1	497	-34	463	46	2777	784	0.9	3.26
5/26/20	İ			İ								İ							
5/26/20	12:17	29.25	3.31				137	51.7	0.3										
5/26/20	12:30	27.5	3.3			13	150	51.6	0.4	0.12	0	695	-34	662	51	3053	739	0.9	3.81
5/26/20	12:40	26.25	3.31			10	160	51.7	0.3	-0.12	0	497	34	531	53	3184	739	0.9	3.97
5/26/20	12:51	25	3.3			11	171	51.6	0.4	0.12	0	497	-34	463	42	2525	739	0.9	3.15
5/26/20	13:14	22	3.28			23	194	51.4	0.6	0.24	1	1192	-68	1124	49	2933	755	0.9	3.58
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Results of Well Permeameter, from USBR 7300-89 Method.

Project: TVMWD Miragrand Initial estimated Depth to Water Surface (in.): Exploration #/Location: TP-2 Depth Boring drilled to (ft): Tested by: USCS Soil Type in test zone: Weather (start to finish): Liquid Used/pH: 18.34 in. Well Radius Measured boring diameter: Well Prep:

39

0.2

Average depth of water in well, "h" (in.):

Cross-sectional area for vol calcs (in.^2): 422.4

approx. h/r:

Tu (Fig. 8) (ft): 71.7

Tu>3h?: yes, OK

<u>Depth to Bot of well</u> (or top of soil over Bentonite) Pilot Tube stickup (+ is above ground)

Depth to top of sand outside of casing from top of pilot tube Depth to top of float assembly from top of pilot tube Float Assembly ID

Float assembly Extension length (in.)

Diameter of barrels (in.): No. of Supply barrels:

Total Area of barrels (in.^2): 397.4

<u>ft</u>	<u>in.</u>	Total (in.)	
3. ft	7. in.	43	
	-2. in.	-2	
	17. in.	17	19 Depth below GS (in.)
	F		
		1	

Field Data						Calcula	ations												
Date	Time	Water Level in Supply Barrel	Depth to WL in Boring (measured from top of	Water Temp (deg F)	Comments	Δt (min)	Total Elapsed Time (min.)	Depth to WL in well (in.)	Water in	Δh (in.)	Avg. h	Vol Ch	nange (i	n.^3)	Flow (in^3/ min)	q, Flow (in^3/ hr)	Average Infiltration Surface Area, (in^2)	V (Fig 9)	Infiltration Rate [flow/surf area] (in./hr)
Start Date	Start time:	(in.)	pilot tube)				,		,			from supply	from Δh	Total			(in^2)		(FS=1)
5/26/2020	10:00		ft in.									117							
5/26/20	10:32	30	3.38				32	42.6	0.4										
5/26/20	10:50	27.25	3.32			18	50	41.8	1.2	0.72	1	1093	-304	789	44	2629	1148	0.9	2.11
5/26/20	11:00	26	3.32			10	60	41.8	1.2	0	1	497	0	497	50	2981	1190	0.9	2.31
5/26/20	11:10	24.5	3.34			10	70	42.1	0.9	-0.24	1	596	101	697	70	4185	1176	0.9	3.28
5/26/20	11:20	23	3.33			10	80	42.0	1.0	0.12	1	596	-51	545	55	3272	1169	0.9	2.58
5/26/20	11:29	21.5	3.32			9	89	41.8	1.2	0.12	1	596	-51	545	61	3636	1183	0.9	2.83
5/26/20	11:39	20	3.32			10	99	41.8	1.2	0	1	596	0	596	60	3577	1190	0.9	2.77
5/26/20	11:49	18.5	3.33			10	109	42.0	1.0	-0.12	1	596	51	647	65	3881	1183	0.9	3.02
5/26/20	11:59	17	3.32			10	119	41.8	1.2	0.12	1	596	-51	545	55	3272	1183	0.9	2.55
5/26/20	12:09	15.5	3.34			10	129	42.1	0.9	-0.24	1	596	101	697	70	4185	1176	0.9	3.28
5/26/20																			
5/26/20	12:18	29	3.29				138	41.5	1.5										
5/26/20	12:31	28.5	3.43			13	151	43.2	-0.2	-1.68	1	199	710	908	70	4193	1134	0.9	3.41
5/26/20	12:42	27.75	3.45			11	162	43.4	-0.4	-0.24	0	298	101	399	36	2179	1024	0.9	1.96
5/26/20	12:52	26.5	3.44			10	172	43.3	-0.3	0.12	0	497	-51	446	45	2676	1017	0.9	2.42
5/26/20	13:08	24.25				16	188	43.3	-0.3	0	0	894	0	894	56	3353	1024	0.9	3.02
5/26/20																			
5/26/20	13:23	16	3				203	38.0	5.0										
5/26/20	13:26	13.5	2.97			3	206	37.6	5.4	0.36	5	994	-152	841	280	16829	1653	0.9	9.38
5/26/20	13:31	9.25	2.93			5	211	37.2	5.8	0.48	6	1689	-203	1486	297	17834	1701	0.9	9.66
5/26/20	13:34	7	2.9			3	214	36.8	6.2	0.36	6	894	-152	742	247	14842	1750	0.9	7.82
5/26/20	13:36	5	2.91			2	216	36.9	6.1	-0.12	6	795	51	846	423	25365	1763	0.9	13.25
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template updated: 6/30/2020

APPENDIX B GEOTECHNICAL LABORATORY TESTING





MODIFIED PROCTOR COMPACTION TEST ASTM D 1557

Project Name: TVMWD Miragrand Geo Inv Tested By: J. Gonzalez Date: 06/03/20
Project No.: 12773.001 Input By: A. Santos Date: 06/05/20

Boring No.: TP-1 Depth (ft.): 2.0

Sample No.: B-1

Soil Identification: Olive poorly-graded sand with silt and gravel (SP-SM)/g

Note: Corrected dry density calculation assumes specific gravity of 2.70 and moisture

content of 1.0% for oversize material

Preparation Method:	X
Compaction	X
Method	

Moist Dry Mechanical Ram

Manual Ram

Scalp Fra	ction (%)
#3/4	28.9
#3/8	
#4	

Rammer Weight (lb.) = 10.0Height of Drop (in.) = 18.0

Mold Volume (ft³) 0.07490

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil -	+ Mold (g)	7131	7445	7476			
Weight of Mold	(g)	2734	2734	2734			
Net Weight of Soil	(g)	4397	4711	4742			
Wet Weight of Soil +	Cont. (g)	771.2	758.3	711.3			
Dry Weight of Soil +	Cont. (g)	745.4	717.0	659.3			
Weight of Container	(g)	88.8	75.8	77.4			
Moisture Content	(%)	3.93	6.44	8.94			
Wet Density	(pcf)	129.4	138.7	139.6			
Dry Density	(pcf)	124.5	130.3	128.1			

Maximum	Dry	Density	(pcf)
Corrected	Dry	Density	(pcf)

130.5 139.6 Optimum Moisture Content (%)
Corrected Moisture Content (%)

7.0 5.3

Procedure A

Soil Passing No. 4 (4.75 mm) Sieve Mold: 4 in. (101.6 mm) diameter Layers: 5 (Five)

Blows per layer: 25 (twenty-five) May be used if +#4 is 20% or less

Procedure B

Soil Passing 3/8 in. (9.5 mm) Sieve Mold: 4 in. (101.6 mm) diameter

Layers: 5 (Five) Blows per layer: 25 (twenty-five)

Use if +#4 is >20% and +3/8 in. is 20% or less

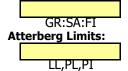
Procedure C

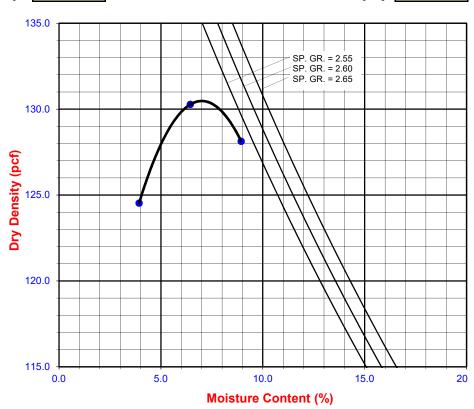
Soil Passing 3/4 in. (19.0 mm) Sieve Mold: 6 in. (152.4 mm) diameter

Layers: 5 (Five) Blows per layer: 56 (fifty-six) Use if +3/8 in. is >20% and +3% in.

is <30%

Particle-Size Distribution:







TESTS for SULFATE CONTENT CHLORIDE CONTENT and pH of SOILS

Project Name: TVMWD Miragrand Geo Inv Tested By: A. Santos Date: 06/02/20
Project No.: 12773.001 Checked By: G. Bathala Date: 06/05/20

Boring No.	TP-1		
Sample No.	B-1		
Sample Depth (ft)	2.0		
Soil Identification:	Olive (SP- SM)/g		
Wet Weight of Soil + Container (g)	153.70		
Dry Weight of Soil + Container (g)	153.37		
Weight of Container (g)	59.20		
Moisture Content (%)	0.35		
Weight of Soaked Soil (g)	100.10		

SULFATE CONTENT, DOT California Test 417, Part II

SOLIAIL CONTENT/ DOT Camorina 1650	+17/1 dit 11	
Beaker No.	95	
Crucible No.	14	
Furnace Temperature (°C)	860	
Time In / Time Out	9:10/9:55	
Duration of Combustion (min)	45	
Wt. of Crucible + Residue (g)	19.6930	
Wt. of Crucible (g)	19.6884	
Wt. of Residue (g) (A)	0.0046	
PPM of Sulfate (A) x 41150	189.29	
PPM of Sulfate, Dry Weight Basis	190	

CHLORIDE CONTENT, DOT California Test 422

ml of Extract For Titration (B)	15		
ml of AgNO3 Soln. Used in Titration (C)	0.6		
PPM of Chloride (C -0.2) * 100 * 30 / B	80		
PPM of Chloride, Dry Wt. Basis	80		

pH TEST, DOT California Test 643

pH Value	7.82		
Temperature °C	19.9		



SOIL RESISTIVITY TEST DOT CA TEST 643

Project Name: TVMWD Miragrand Geo Inv Tested By: Y. Nguyen Date: 06/05/20
Project No.: 12773.001 Checked By: G. Bathala Date: 06/05/20

Boring No.: TP-1 Depth (ft.): 2.0

Sample No.: B-1

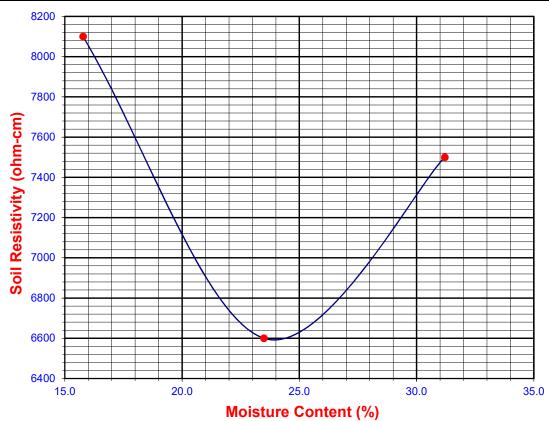
Soil Identification:* Olive (SP-SM)/g

*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	20	15.78	8100	8100
2	30	23.49	6600	6600
3	40	31.20	7500	7500
4				
5				

Moisture Content (%) (MCi)	0.35
Wet Wt. of Soil + Cont. (g)	153.70
Dry Wt. of Soil + Cont. (g)	153.37
Wt. of Container (g)	59.20
Container No.	
Initial Soil Wt. (g) (Wt)	130.10
Box Constant	1.000
MC = (((1+Mci/100)x(Wa/Wt+1))	.))-1)x100

Min. Resistivity	Moisture Content	Sulfate Content	Chloride Content	So	il pH
(ohm-cm)	(%)	(ppm)	(ppm)	pН	Temp. (°C)
DOT CA Test 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA	Test 643
6595	23.9	190	80 7.82		19.9



Boring No.	TP-1	TP-3					
Sample No.	B-1	B-1					
Depth (ft.)	2.0	4.5					
Sample Type	Bulk	Bulk					
Soil Identification	Olive poorly- graded sand with silt and gavel (SP-SM)/g	Olive poorly- graded sand with gavel (SP)/g					
No Moisture Correction; ASTM D	1140 modified	to include sp	litting the sar	nple on the #	4 sieve		
Total Sample Dry Weight Determ	ination			T	1		
Dry Weight of Soil + Container (g)	3719.10	5048.20					
Weight of Container (g)	231.10	231.00					
Dry Weight of Soil (g)	3488.00	4817.20					
Sample Dry Weight Determination	on, Retained or	Sieve #4	_	T			
Dry Weight of Sample + Cont. (g)	1440.80	2281.44					
Weight of Container (g)	231.10	231.00					
Weight of Dry Sample (g)	1209.70	2050.44					
Sample Dry Weight Determination	on, Passing Sie	ve #4					
Dry Weight of Sample + Cont. (g)	736.60	739.80					
Weight of Container (g)	236.70	234.50					
Weight of Dry Sample (g)	499.90	505.30					
After Wash				T	1		
Method (A or B)	Α	Α					
Dry Weight of Sample + Cont. (g)	680.15	707.49					
Weight of Container (g)	236.70	234.50					
Weight of Dry Sample (g)	443.45	472.99					
% Passing No. 4 Sieve	65.3	57.4					
% Retained No. 4 Sieve	34.7	42.6					
% Passing No. 200 Sieve	7.4	3.7					
Leighton		No. 200	PASSING SIEVE D 1140	i	Project Name: Project No.: Client Name:	TVMWD Miragrand Geo Inv 12773.001	



ASTM D 1140

Tested By: ACS/YN Date: 06/02/20



R-VALUE TEST RESULTS

DOT CA Test 301

PROJECT NAME: TVMWD Miragrand Geo Inv PROJECT NUMBER: 12773.001

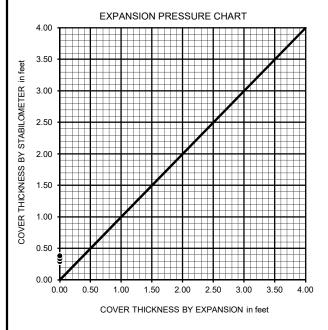
LOCATION: TP-1 DEPTH (FT.): 2

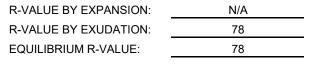
SAMPLE NUMBER: B-1 TECHNICIAN: O.Figueroa

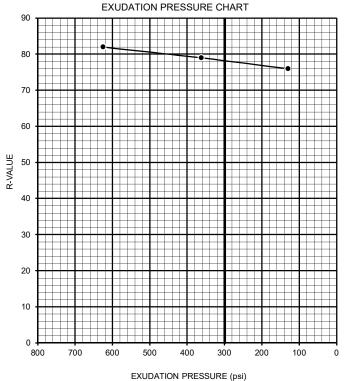
SAMPLE DESCRIPTION: Olive poorly-graded sand with silt and gr. (SP-SM)g DATE COMPLETED: 6/4/2020

TEST SPECIMEN	а	b	С
MOISTURE AT COMPACTION %	7.2	7.6	8.5
HEIGHT OF SAMPLE, Inches	2.52	2.53	2.47
DRY DENSITY, pcf	133.4	128.0	125.6
COMPACTOR PRESSURE, psi	350	300	275
EXUDATION PRESSURE, psi	625	362	130
EXPANSION, Inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	16	18	21
TURNS DISPLACEMENT	4.80	5.20	5.30
R-VALUE UNCORRECTED	82	79	76
R-VALUE CORRECTED	82	79	76

DESIGN CALCULATION DATA	а	b	С
GRAVEL EQUIVALENT FACTOR	1.0	1.0	1.0
TRAFFIC INDEX	5.0	5.0	5.0
STABILOMETER THICKNESS, ft.	0.29	0.34	0.38
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00







APPENDIX C SEISMIC ANALYSIS







Latitude, Longitude: 34.129283, -117.703175



	ap data 32020
Date	7/1/2020, 10:47:54 AM
Design Code Reference Document	ASCE7-16
Risk Category	IV
Site Class	D - Stiff Soil

Туре	Value	Description
S _S	1.761	MCE _R ground motion. (for 0.2 second period)
S ₁	0.668	MCE _R ground motion. (for 1.0s period)
S _{MS}	1.761	Site-modified spectral acceleration value
S _{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S _{DS}	1.174	Numeric seismic design value at 0.2 second SA
S _{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Туре	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
Fa	1	Site amplification factor at 0.2 second
F _v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.753	MCE _G peak ground acceleration
F _{PGA}	1.1	Site amplification factor at PGA
PGA _M	0.829	Site modified peak ground acceleration
TL	8	Long-period transition period in seconds
SsRT	1.761	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.9	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	2.26	Factored deterministic acceleration value. (0.2 second)
S1RT	0.668	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.732	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.766	Factored deterministic acceleration value. (1.0 second)
PGAd	0.927	Factored deterministic acceleration value. (Peak Ground Acceleration)
C _{RS}	0.927	Mapped value of the risk coefficient at short periods
C _{R1}	0.913	Mapped value of the risk coefficient at a period of 1 s

https://seismicmaps.org

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https://seismicmaps.org

APPENDIX D GBA IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL REPORT



Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative - interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. **Active involvement in the Geoprofessional Business** Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civilworks constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared solely for the client. Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full*.

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- · project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be,* and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations only after observing actual subsurface conditions revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnicalengineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, but be certain to note conspicuously that you've included the material for informational purposes only. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, only from the design drawings and specifications. Remind constructors that they may

perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated subsurface environmental problems have led to project failures. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. Geotechnical engineers are not building-envelope or mold specialists.



Telephone: 301/565-2733 e-mail: info@geoprofessional.org www.geoprofessional.org

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END OF SECTION

SECTION 01 04 50 - EXISTING FACILITIES

PART 1 - GENERAL

1.01 DEFINITIONS

- A. This section describes the procedures for locating, protecting, and relocating existing underground utilities, surface improvements, and requirements to connect to existing facilities.
- B. Do not perform work that would affect any oil, gas, sewer, or water pipeline; any telephone, telegraph, or electric transmission line; any fence; or any other structure, prior to providing the owner of the improvement due notice of the beginning of work, and remove, shore, support, or otherwise protect such pipeline, transmission line, ditch, fence, or structure, or replace same.

1.02 RELATED WORK

- A. Standard Drawings
- B. Standard Specifications 01 00 00, 01 04 50, 01 32 16, 01 33 00, 02 41 13.13, 03 30 00, 03 15 16, 09 90 00, 09 96 71, 21 50 10, 23 00 00, 23 26 13, 23 31 19.13, 23 91 10, 23 91 19, 23 92 13, 23 92 17, 23 93 10, 23 93 17, 23 94 05, 23 95 13, 31 23 00, 31 23 19, 32 16 13, 33 02 22

1.03 CONDITION OF EXISTING FACILITIES

A. Neither the TVMWD nor the Design Engineers warrant the condition, size, material, and location of existing facilities.

1.04 EXISTING FACILITY LOCATION

A. The contractor shall be responsible for verifying in advance the location of all existing pipelines and subsurface utilities and structures as marked by (USA) Underground Services Alert as shown on the plans. Discrepancies shall be reported to the project engineer, prior to the fabrication of, or purchase of material and construction affected by the discrepancy.

1.05 EXISTING FACILITY DOCUMENTATION

- A. After the Notice to Proceed issued and before Work at site is started, Contractor and TVMWD shall make thorough examination of pre-existing conditions including existing buildings, structures, pipelines, roadways, and other improvements in vicinity of Work, as applicable, which might be impacted or potentially damaged by construction operations.
- B. Contractor shall take photographs and videotape to document preexisting conditions prior to the start of the work. Include public roads and improvements to adjacent private property as part of preexisting condition documentation. Three sets of dated photographs and three copies of the dated video provided on DVD shall be submitted to the TVMWD prior to the beginning of construction. The TVMWD will review, sign, and return one record copy to Contractor to be kept on file in Contractor's field office as site records.
- C. These photographs and videotapes are intended for use as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of Contractor's operations, and is for protection of Contractor and TVMWD.

D. The Contractor shall notify property owners adjacent to the site and property owners located on streets that will be closed or restricted by the Work. Notification shall be in the form of a letter, reviewed and approved by TVMWD and delivered a minimum of 15 days before construction is scheduled to commence. The Contractor shall be available to attend one community meeting to answer public questions regarding the project if requested to do so. The meeting time, date and location will be provided by TVMWD for inclusion in the notification letter.

1.06 UTILITY VERIFICATION

- A. Existing utilities have been identified and located on the Plans based on available information, including above ground utility evidence, mapping provided by utility agencies. The Contractor shall be responsible for verifying the location of all existing utilities within the entire pipe trench of the new water main. The necessary verification for existing utilities shall commence prior to constructing the new water main.
- B. The Contractor shall contact all utility owners a minimum of 72 hours in advance of any excavations to verify existing utilities and substructures. Utility verification may result in modification of the pipeline alignment or profile to avoid conflict with existing utilities that are found to be in a different location than shown on the Drawings. Minor modifications involving no increase in pipe length, number of fittings, or appurtenances shall be made at no additional cost to the TVMWD.
- C. Delays resulting from discoveries during potholing shall not justify additional time and monetary compensation to the Contractor.
- D. The Contractor shall perform exploratory excavations within the new water main pipe trench to determine the actual location, depth and required listed information in 1.06.E all utilities parallel and crossing the new water main. In the event it is required to deepen the pipe trench to lower the new water main to avoid obstructions, the contractor shall be required to verify for all utilities within the required depth of the revised pipe trench. The Contractor shall conduct exploratory excavations a minimum of two days prior to pipeline installation to provide sufficient lead time to resolve utility conflicts. Utilities that were potholed will be provided to the Contractor. The Contractor may perform additional utility verification at his discretion to ensure safety and progress of the work at no additional cost to the TVMWD.
- E. The Contractor shall provide the Engineer with the following information for the existing utilities or substructures within the pipe trench of the new pipeline:
 - 1. Horizontal location as measured from two existing features shown on the Drawings
 - 2. Depth to the top and bottom of utility from ground surface
 - 3. Size (diameter, width, and depth)
 - 4. Roundness of pipe
 - 5. Circumference
 - 6. Width
 - 7. Material
 - 8. Type of utility
 - 9. Pipeline station where the conflict is located

F. Exploratory excavations shall be backfilled with one sack cement slurry and patched to match existing pavement profile and reopened to traffic as soon as practicable after the data is obtained. If the excavation is located within an area to be resurfaced as part of the pipeline installation, the surface course of the pothole shall be temporarily patched with cold mix AC which shall be removed before the final pavement patch is installed.

1.07 PROTECTION OF EXISTING FACILITIES

- A. The Contractor's attention is directed to the possible existence of pipe and other underground improvements that may or may not be shown on the Approved Plans. Once discovered, the Contractor shall preserve and protect all such improvements whether shown on the Approved Plans or not. The Contractor shall provide and install suitable safeguards, and shall be responsible for the care and protection of all existing utilities and substructures including but not limited to: sewer and water pipe (including laterals and services), electrical and telephone conduits, gas mains and service lines, oil mains culverts, or other above-ground or belowground facilities or structures which may be encountered in or near the area of work. It shall be the responsibility of the Contractor to notify USA and each agency of jurisdiction and utility company and to make arrangements for location of facilities prior to beginning construction. In the event of damage to existing facilities during the progress of the work, such facilities shall be replaced or restored to original condition, as determined by TVMWD, at the Contractor's expense.
- B. The Contractor shall be responsible for determining in advance the location, elevation, alignment and pipe type and size of all existing pipelines to which connections are to be made (reference Section 1.05.F). Potholing to determine location will be allowed only after providing the TVMWD with three (3) day's advance notice. The contractor is required to contact Underground Service Alert (USA) at 1-800-227-2600 or 1-800-422-4133 for mark-out of all utilities in the area of the work.
- C. If the Contractor, either before commencing work or during the course of the work, finds any discrepancy between specifications or drawings and the physical conditions at the site of the work, Contractor shall promptly notify the TVMWD in writing of such discrepancy.
- D. The Contractor is to prepare a support plan for each utility crossing detailing the intended support method. The Contractor is responsible to provide shoring, underpinning, and structural support for existing utility lines and structures that become suspended or otherwise unsupported because of adjacent excavation operations. Contractor must obtain approval from the owner of the utility prior to excavation of the utility.

1.08 PROTECTION OF LANDSCAPING

- A. The Contractor shall be responsible for the protection of all trees, shrubs, fences, and other landscape items adjacent to or within the work area, unless specific removals are indicated on the Approved Plans.
- B. In the event of damage to landscape items, including the thickness of topsoil, the Contractor shall replace the damaged items in kind, in a manner satisfactory to the TVMWD.
- C. When pipelines are proposed within planted or otherwise improved areas in public or private easements, the Contractor shall restore such areas to original condition after completion of the work.

- D. When pipelines are proposed within unimproved areas, the ground surface shall be dressed smooth to the contour of the original ground and left in a neat, presentable condition, free of cleared vegetation, rubbish and other construction wastes. Rocks and clumps that cannot be readily covered by spreading shall be hauled away and disposed of by the Contractor.
- E. Unimproved areas disturbed during construction of the pipeline shall be hydro seeded in accordance with these Standard Specifications.

1.09 PUBLIC UTILITY RELOCATION

- A. In case it should be necessary to relocate or temporarily maintain the property of any public utility or any other property, and it is understood that the cost of such relocation or temporary maintenance is not required to be borne by the owner of the utility or property, the Contractor shall bear all expenses incidental to the removal or temporary maintenance of such property in a manner satisfactory to said owner. It is understood that in such cases, the utility or property owner has the option of doing such work with his or her own forces, or permitting the work to be performed by the Contractor.
- B. The right is reserved to the State, County, TVMWD, and utility owners to enter at any time upon any street, alley, right of way or easement for the purpose of making changes for maintenance or repairs to their property necessitated by the Contractor's work.

1.10 PERMITS

A. All work shall conform to the specifications and requirements of the City of Claremont, California, the County, the TVMWD having jurisdiction, and all other affected agencies involved. The Contractor shall obtain and keep a copy of all the required permits in the job site and comply with all the terms and conditions of said permits. Permits shall also include any related to the abandonment of an existing water or sewer pipe.

1.11 MEASUREMENT AND PAYMENT

A. Measurement and payment for work in this section will be considered as subsiding obligation of the Contractor and the cost thereof shall be in the applicable items listed in the Bid Schedule.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials used in making the connection or removing the facility from service shall conform to the applicable sections of the project.

PART 3 - EXECUTION

3.01 GENERAL CUT IN CONNECTION INFORMATION

A. Unless otherwise indicated on the Approved Plans or specifically directed by the TVMWD Engineer, all connections to existing facilities, cut-in installations, shall be performed by Contractor. All types of connections to existing water facilities shall be performed in strict accordance with the following procedures.

- The contractor shall submit a connection plan developed for all connections (including multiple connections) to the TVMWD's water system. The connection plan is to be prepared with the intent of minimizing service interruptions to TVMWD customers. The connection plan will be reviewed and approved by the TVMWD prior to proceeding with any work.
- 2. The Contractor shall furnish the required fittings, valves, and all other materials per the Approved Plans as called for in the Standard Specifications. The Contractor shall provide all equipment and labor required for the excavation and installation of the connection including but not limited to thrust blocks, thrust restraints, lights, and barricades, backfill and pavement replacement. In addition, the Contractor shall assist the TVMWD in alleviating any hardship incurred during a shutdown for connections. Emergency standby equipment or materials may be required of the Contractor by the TVMWD Engineer.

3.02 FIELD VERIFICATION OF CUT IN CONNECTION

- A. Prior to construction, Contractor shall pothole or excavate the existing pipe at the location of the proposed connection. The TVMWD Engineer shall inspect the pothole/excavation prior to Contractor's repair of trench. Contractor shall record the following information on as-built drawings:
 - 1. Pipe size, outside diameter.
 - 2. Pipe Roundness
 - 3. Pipe type such as ACP, PVC, Ductile-Iron or Steel.
 - 4. Pipe class and/or pressure rating.
 - 5. Elevation, grade, and alignment.
 - 6. Location of collars, pipe bells, fittings or couplings, if found.
 - 7. Potential conflicts with existing utilities.
- B. The recorded information shall be used by the Contractor to verify the materials submitted during the shop drawing submittal phase of the project are of the proper size and application. Contractor is responsible for verifying and demonstrating the approved materials for the connection are adequate and within product manufacturer tolerances and recommendations. This verification will be presented to the TVMWD in form of a new and separate submittal. Should the approved materials be determined inadequate by the TVMWD Engineer the Contractor shall submit new materials for review and approval.

3.03 CONNECTION TO EXISTING FACILITIES

- A. Contractor may proceed with excavation only when the all proceeding procedures (all utility verification, system shutdown and customer notifications) have been completed, materials have been approved and delivered, and a copy of the approved traffic control plan (if not included in the Approved Plans) has been supplied to the TVMWD Engineer.
 - 1. The Contractor shall saw-cut pavement, excavate and provide and install shoring and steel plating, when necessary, one day prior to the cut-in installation.
 - 2. The Contractor shall provide lights, barricades and traffic control devices in accordance with the TVMWD's Representative and as deemed necessary for the excavation by the TVMWD Engineer.

- 3. The Contractor shall de-water existing mains in full compliance with NPDES standards where cut-in installations are required and shall be done in the presence of the Engineer. The Contractor shall be prepared to deal with leaking valves and water from those valves to complete the shutdown. Only TVMWD personnel are authorized to operate existing valves. The Contractor shall be responsible for any and all damage resulting from unauthorized operation of existing TVMWD facilities.
- 4. In areas where cut-ins are to be performed the Contractor shall line the bottom of the trench with 12" to 18" of 3/4" rock and install a 12" to 16" deep sump for dewatering the trench bottom.
- 5. To facilitate the proposed connection and allow for slight adjustments in alignment, the Contractor shall leave a minimum 10' gap between the new pipe installation and the proposed connection point at the existing water main. The Contractor shall leave a gap longer than 10' if conditions warrant, or if directed by the TVMWD Engineer.
- 6. Connections shall be made with as little change as possible in the grade of the new main. If the grade of the existing pipe is below that of the new pipeline, a sufficient length of the new line shall be deepened so as to prevent the creation of any high spot or abrupt changes in grade of the new line. Where the grade of the existing pipe is above that of the new pipeline, the new line shall be laid at specified depth, except for the first joint adjacent to the connection, which shall be deflected within 75% of the allowances of the pipe manufacturer as necessary to meet the grade of the existing pipe. If sufficient change in direction cannot be obtained by the limited deflection of the first joint, a fitting of the proper angle shall be installed. Where the connection creates a high or low spot in the line, a standard air release or blow off assembly shall be installed as directed by the TVMWD Engineer.
- 7. Where connections are made to existing valves, the contractor shall furnish and install all temporary blocking, steel clamps, shackles, and anchors as required by the TVMWD, and he shall replace the valve riser box and cover and adjust the valve cover to the proper grade in accordance with these specifications. The TVMWD will operate all existing valves. All valves, existing or newly installed, shall be readily accessible at all times to the TVMWD for emergency operation.
- 8. After the Contractor has performed the cut-in operations, and the TVMWD Engineer has given approval to proceed, the Contractor shall complete the installation as shown on the Approved Plans in accordance with the Standard Specifications including, but not limited to:
 - a. Disinfecting and installing the pipe section(s) necessary to make the closure to the new system. New pipelines shall not be connected to existing facilities until new pipelines have been successfully tested and disinfected and accepted by the TVMWD.
 - b. Installing and setting the valve gate well(s) in accordance with the Standard Drawings.
 - c. Installing thrust and anchor blocks where shown in the plans in accordance with Section 03 30 00.
 - d. Completing all backfill and compaction of the trench in accordance with **Section** 31 23 00.
 - e. Repairing or replacing pavement as necessary in accordance with agency of jurisdiction requirements.

3.04 UTILITIES CROSSING WATER, RECYCLED WATER OR SEWER FACILITIES

A. Wherever new utilities cross under or over water, recycled water or sewer facilities, the minimum vertical separation shall be 12" unless otherwise approved by the TVMWD Engineer. The new pipeline shall be restrained in accordance with the Approved Plans. All new utilities crossing under or over water, recycled water or sewer facilities shall remain exposed until inspected and approved by the TVMWD's Representative. Wherever new utilities cross under or over water, recycled water or sewer facilities, backfill and compaction within the limits of the water, recycled water, or sewer facility trench width shall be in strict conformance with the backfill and compaction requirements specified herein.

3.05 HORIZONTAL SEPARATION OF UTILITIES PARALLELING WATER, RECYCLED WATER OR SEWER FACILITIES

A. Wherever new utilities parallel water, storm drain, recycled water or sewer facilities, the minimum horizontal separation shall be per the California Department of Health Services separation requirements unless otherwise approved by the TVMWD's Representative.

3.06 REMOVAL FROM SERVICE OF EXISTING MAINS AND APPURTENANCES

- A. Existing mains and appurtenances shall be removed from service at the locations shown on the plans or as directed by the engineer.
- B. Existing pipe and appurtenances removed from the ground will require backfill and repair of surface in accordance with Section 31 23 00.
- C. Removed pipe and appurtenances shall be temporarily stockpiled on the job in a location that will not disrupt traffic or be a safety hazard, disposed of in a proper manner (as determined by the TVMWD Engineer). The contractor shall remove and dispose of all removed pipe at his own expense to a landfill permitted to accept such materials.
- D. Before excavating for installing mains that are to replace existing pipes and/or services, the contractor shall make proper provisions for the maintenance and continuation of service as directed by the TVMWD Engineer unless otherwise specified.
- E. If the meter box is to be removed from an abandoned water service, the service line is to be removed and the corporation stop closed and capped. If there is no corporation stop on the service, the adapter is to be removed and a brass plug is to be installed in the service saddle.
- F. Asbestos Cement Pipe (ACP) shall be cut, removed and disposed of in a proper manner. The contractor shall be responsible for the proper manifesting of any and all ACP at an authorized disposal site.

3.07 CUTTING AND RESTORING STREET SURFACING

- A. In cutting or breaking up street surfacing, the contractor shall not use equipment that will damage adjacent pavement.
- B. All asphalt and/or Portland cement concrete surfaces shall be scored with sawing equipment of a type meeting the approval of the TVMWD; providing however, that any cement concrete base under an asphaltic mix surface will not be required to be scored by sawing. Existing paving

surfaces shall be saw cut back beyond the edges of the trenches to form neat square cuts before repaying is commenced.

- C. The Contractor is required to visit all project locations prior to bid.
- D. The Contractor will be provided additional pavement information once it becomes available.
- E. Pavement, sidewalks, curbs, or gutters removed or destroyed in connection with performance of the work shall be saw cut to the nearest score marks, if any, and shall be replaced with pavement sidewalks, curbs, or gutters of the same kind, or better by the contractor in accordance with the latest specifications, rules, and regulations and subject to the inspection of the agency having jurisdiction over the street or highway.
- F. One sack cement slurry base shall be placed beneath the restored pavement to the thickness required by the agency having to allow the restoration of the pavement.

3.08 MAINTENANCE, REMOVAL, AND RECONSTRUCTION OF UTILITIES AND OTHER FACILITIES

- A. Insofar as practicable during the progress of the work, no pipeline, conduit, sewer, culvert, storm drain, drainage channel, pole line, street lighting system, overhead wires or cables, or underground wires or cables, either main line structures or laterals and services, or any other structure or facility, shall be disturbed, but all shall be supported and protected against injury and maintained by the Contractor in good operating condition. In no case shall any such property be disturbed or removed without the approval of the Engineer as hereinafter provided. The Contractor shall be responsible for and make good all damage due to his/her operations and the provisions of this section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of backfilling.
- B. All affected traffic signal materials or equipment as a result of this improvement shall be restored or replaced by the Contractor at no cost to the TVMWD. This includes pull boxes, inductive loop detectors, detectors, lead-in wire, and interconnect cable, etc.
- C. Where a pipe fitting or portion of the pipe is to be removed near a valve, and the valve is to be left in place as a stop against main pressure, the valve shall be tied back by the Contractor to the satisfaction of the Engineer. Any damage which might result to the TVMWD's property as a result of a main break caused by inadequate restraint of the valve will be charged to the Contractor.

END OF SECTION

SECTION 01 11 00 - SUMMARY OF WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Demolition and Protection in Place of Existing Features

1. The project site is located on an unimproved site with existing oak and fruit trees. Residential neighboring lots have large trees with overhanging branches requiring special care to protect in place. An existing irrigation line in the north of the lot must have service maintained throughout construction.

B. Miramar Well Site Improvements

- 1. The project involves installation of a contractor provided and installed vertical turbine pump sized with a 100 HP VFD rated motor and pump assembly. Contractor shall coordinate with the pump supplier to ensure all installation complies with pump supplier warranty requirements.
- 2. The new well will be housed inside a new well building with fieldstone cladding to match the architectural theme of the neighborhood. The building will include a climate controlled new MCC room. A future chemical disinfection room is provided with conduits for future chemical piping.
- 3. A percolation pond will be constructed for disposal of well water during well start up to dispose of an turbid water in the initial discharge. Haul routes will be strictly enforced and hours of operation of haul limited to 8:00AM to 5:00PM to reduce impacts on local residents.
- 4. Site improvements include wrought iron fencing with fieldstone cladding it's pilasters.
- 5. Site security, yard lighting, fieldstone storm swales, and landscaping are included in the site improvements.

C. Connection to Raw Water Line In Street Right-of-Way

1. TVMWD is has installed a raw water line from their other existing well and discharges to the Miramar WTP located just to the east of the project site. The project connect to the existing piping on Grand Ave and also small section interconnecting at the intersection of Miramar Ave and Grande Ave

D. Early Submittal Requirements:

- 1. The Contractor will be required to provide submittals on key long lead items early in the project in an effort minimize construction schedule. The following equipment and materials shall have the submittals provided early in the project as they are expect to have to longest lead time in procuring:
- 2. Vertical Turbine Pump, Motor and Accessories: Submit to Engineer within 15 calendar days of NTP.
- 3. MCC and VFD Equipment: Submit to Engineer within 45 calendar days of NTP.
- 4. Well Building Steel Trusses: Submit to Engineer withing 45 calendar days of NTP.

SUMMARY OF WORK 01 11 00 - 1

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SUMMARY OF WORK 01 11 00 - 2

SECTION 01 11 13 – WORK COVERED BY CONTRACT DOCUMENTS

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section provides a description of the Work Covered by the Contract Documents.
- 1.02 CITED STANDARDS NONE
- 1.03 NOTED RESTRICTIONS
 - A. For the purposes of this project, all work to be performed shall be as described in Section C Bid Forms of the associated Construction Contract, and will not be included in this section.
- 1.04 QUALITY CONTROL
 - A. Work Covered by the Contract Documents requires purchase, furnishing of all labor, material, and equipment to perform installation of all equipment and materials as necessary to complete the work as shown on the drawings, described in the Specifications, and as specified herein.
 - B. The CONTRACTOR shall be responsible for obtaining, at a minimum, the following permits:
 - 1. Encroachment and Construction Permitting for the City of Claremont
 - C. The CONTRACTOR shall include anticipated costs to obtain the necessary permits for the Work to be performed. The CONTRACTOR shall be notified so if this is the case.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 14 13 – ACCESS TO SITE

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section provides a description of the CONTRACTOR's responsibilities and restrictions related to site access.
- 1.02 CITED STANDARDS NONE
- 1.03 NOTED RESTRICTIONS
 - A. Nothing herein shall be construed to entitle the CONTRACTOR to the exclusive use of any public street, utility right-of-way or the site of the Work during the performance of the Work.
 - B. The CONTRACTOR shall complete all Work within public right-of-ways in accordance with the applicable permit(s) issued by the City of Pasadena and Los Angeles County including, but not limited to, any restrictions on work hours.
 - C. Below include anticipated work hours for reference by the CONTRACTOR. The CONTRACTOR shall confirm "actual" specific work hours with the PWP prior to performing work.
 - 1. City of Claremont
 - a. 7am 7pm
 - b. School Zones: 9am 2:30pm

1.04 HIGHWAY AND STREET LIMITATIONS

- A. The CONTRACTOR shall make its own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits and other limitations affecting transportation and ingress and egress to the site of the Work. It shall be the CONTRACTOR's responsibility to construct and maintain any haul roads required for its construction operations.
- B. Where excavation is being performed in primary streets or highways one (1) lane in each direction shall be kept open to traffic at all times unless otherwise provided or shown. Fire hydrants on or adjacent to the Work shall be kept accessible to fire-fighting equipment at all times. Temporary provisions shall be made by the CONTRACTOR to assure the use of sidewalks, access routes and the proper functioning of all gutters, sewer inlets and other drainage facilities.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

ACCESS TO SITE 01 14 13 - 1

SECTION 01 14 16 - COORDINATION WITH THE OWNER

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section provides a description of how the General Construction CONTRACTOR shall coordinate construction activities with the OWNER.
 - 1. The CONTRACTOR shall develop and implement a plan to minimize the effect of construction activities on surrounding areas affected by this project.
 - 2. The CONTRACTOR shall be responsible for providing prior notice to the owners of all business and residential properties where access to the properties may be restricted.
 - 3. The CONTRACTOR shall restrict access to businesses within the affected area during normal business hours.
 - 4. The CONTRACTOR shall minimize restriction of access to residential properties to the extent practicable.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. The CONTRACTOR shall conduct its operations so as not to interfere unnecessarily with the authorized work of utility companies, other agencies, or the PWP's plant personnel. No street or access shall be closed without first obtaining permission of the proper authority.
- 1.05 QUALITY CONTROL
 - A. The CONTRACTOR shall comply with all applicable federal, state and local standards, codes, permitting and other restrictions in effect for construction activities.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 14 19 – USE OF SITE

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section provides a description of how the CONTRACTOR shall use the designated site area.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE

1.04 NOTED RESTRICTIONS

- A. "Use of the Site" will be in accordance with the access agreements agreed to for each specific site/property owner that the project is worked on.
- B. The CONTRACTOR shall limit work activities to the construction site and shall restrict storage of construction materials, equipment, etc. to a site (or sites) designated by the OWNER.
- C. Holes and/or trenches shall not be left in any locations unguarded. If it is necessary to do so, the CONTRACTOR shall provide suitable protection and warning signs to prevent injury.

1.05 QUALITY CONTROL

- A. The CONTRACTOR shall assume full responsibility for protection and safekeeping of products and other items under this contract.
- B. The CONTRACTOR shall determine if there are underground wires, cables, pipelines, or other apparatus in the work area prior to excavation.
- C. The CONTRACTOR shall be liable for any damage to underground utilities caused by excavation.

1.06 CONTRACTOR'S WORK AND STORAGE AREA

- A. The ENGINEER will designate and arrange for the CONTRACTOR's use a portion of the property adjacent to the Work for its exclusive use during the term of the Contract as an office and storage and shop area for its construction operations relative to this contract.
- B. The CONTRACTOR shall be solely responsible for the security of its tools, supplies and equipment at the site.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

USE OF SITE 01 14 19 - 1

SECTION 01 20 00 - PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes Specifications for measurement and payment as they apply to the work, and includes provisions applicable to lump sum prices.

1.02 REFERENCED SECTIONS

A. See TVMWD Technical Specification T-01 22 00 for details on Bid Items and unit break down requirements.

1.03 LUMP-SUM MEASUREMENT

- A. The CONTRACTOR shall construct the work under a single lump sum fixed price contract. Lump-sum measurements will be for the entire item, unit of work, structure, or any combination of these described, as specified and as indicated in the Bid Schedule of the Bid Form.
- B. If the CONTRACTOR requests progress payments for lump-sum items or amounts in the Bid Schedule, such progress payments will be made in accordance with a well-balanced, detailed program of payment-apportioning, prepared by the CONTRACTOR and submitted to the OWNER for approval. Such payment-apportioning may require modifications during the Contract, as determined by the ENGINEER.
- C. Such a program for each applicable lump-sum item shall show fixed definable and measurable quantities where possible and unit prices therefore as developed and assigned by the CONTRACTOR to the different features of the work and major subdivisions thereof. The summation of extensions of quantities and unit prices and related costs shall equal the amount of the lump-sum Contract Price or lump sum bid item indicated in the Bid Schedule.
- D. Following the OWNER's approval, progress payments will be made in accordance with the CONTRACTOR's payment-apportioning program and from the approved progress schedule, reflecting the progress which occurred during the payment period as approved by the OWNER.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 31 19 - PROJECT MEETINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Required to enable orderly review during pre-design and pre-installation conferences and progress of Contracted Work, and to provide for systematic discussion of design and installation problems and other construction problems arisen, the ENGINEER will conduct project meetings throughout the design and construction period. Conform to the Design Scheduling Conference, Pre-Construction Scheduling Conference and Project Schedule Review Meeting.

1.02 AGENDA ITEMS

A. To the maximum extent practicable, advise the ENGINEER'S at least twenty-four (24) hours in advance of project meetings regarding items to be added to the agenda or requesting the cancellation of any Meeting.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 SECTION INCLUDES

A. Except as noted for preconstruction meeting, project meetings will be held weekly. To the maximum extent practicable, meetings will be held in CONTRACTOR'S job office at the Jobsite and/or via video teleconference. Site meetings will be held as necessary to support construction progress.

END OF SECTION

PROJECT MEETINGS 01 31 19 - 1

SECTION 01 32 16 - CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes the scheduling of work requirements to be performed by the Contractor. The development of the schedule, monthly payment requisitions, and project status reporting requirements of the Contract shall employ computerized Critical Path Method scheduling. Prepare the CPM Schedule and all reports with the latest version of "Primavera," or equal software.

1.02 RELATED WORK

- A. Standard Drawings
- B. Standard Specifications

1.03 QUALIFICATIONS

A. Submit to TVWMD's Engineer a statement of computerized CPM qualifications verifying the Contractor's in-house staff or consultant capability to use CPM techniques required herein. Identify the individual who will perform the CPM scheduling and verify qualifications by providing a description of construction projects that the individual has successfully applied computerized CPM. List at least two projects of similar nature, scope, and value, and provide a contact person for each referenced project with current telephone, fax, email address, and mailing address information.

1.04 CPM STANDARDS

- A. CPM, as required herein, shall be interpreted to be generally as outlined in the Association of General Contractors publication, "The Use of CPM in Construction," except that either "i-j" arrow diagrams or precedence diagramming format may be utilized. In the case of conflicts between this specification and the AGC publication, this specification shall govern.
- B. Include with construction schedules a graphic network diagram and computerized construction schedule reports.
- C. The CPM network shall be in a form of a time scaled "i-j" activity-on-arrow or precedence type diagram and may be divided into a number of separate sheets with suitable match lines relating the interface points among the sheets.
- D. Indicate all construction activities and procurement in a time-scaled format using a calendar time line shown along the entire sheet length. Plot each activity arrow or node so that the beginning and completion dates of each activity are accurately represented along the calendar time line. Show all activities using the symbols that clearly distinguish between Critical Path activities, non-critical activities, and free float for each noncritical activity. Identify all activity items by their respective Activity Number, Responsibility Code, Work Duration, and their Dollar Value. All non-critical path activities shall show their total float time in scale form by utilizing a dotted line or some other graphical means.

- E. Compute the duration estimate indicated for each activity in working days and represent the single best estimate considering the scope of the activity work and resources planned for the activity.
- F. Except where otherwise provided herein, float as referenced in these documents is total float. Total float is the period of time measured by the number of working days each non-critical path activity may be delayed before it and its succeeding activities become part of the Critical Path. If a non-critical path activity is delayed beyond its float period, that activity then becomes part of the Critical Path and controls the end date of the Project. Thus, the delay of the non-critical path activity beyond its float period will cause delay to the Project itself.
- G. Duration of a single activity shall not be more than 10 calendar days on the CPM network.

1.05 CPM SCHEDULE SUBMITTALS

- A. Within 10 calendar days after the date of receipt of the Notice to Proceed, submit for review by TVWMD Engineer one hard copy and one compact disc (CD-R format) of the initial CPM Network Schedule and the Computerized Schedule Report tabulation. The CPM Schedule shall be a time-scaled network diagram of the "i-j" activity-on-arrow or precedence type. The network diagram shall describe the activities to be accomplished and their logical relationships, and show the Critical Path.
- B. The computerized schedule report tabulations shall include the following:
 - 1. Report of activities sorted by Activity Number. Correlate Activity Numbers, where practical, to the Contractor's work areas.
 - 2. Report of activities sorted by Early Start date.
 - 3. Report of activities sorted by Total Float.
 - 4. Report of activities sorted by Responsibility Code. Responsibility Codes shall be established for the Contractor, Engineer, Water Authority, subcontractors, suppliers, etc. Codes shall be identified in the Network Diagram.
 - 5. A Successor-Predecessor Report which shall identify the successor and predecessor activities for each activity and ties between schedule activities.
- C. Include sufficient detail for the identification of work components into such activities as mobilization and demobilization; clearing and grubbing; temporary erosion control installation and removal; traffic control; dewatering; shoring and bracing installation and removal; trenching, backfilling and compaction; blasting; tunneling; final grading; restoration and revegetation; pavement repair; pipe fabrication; pipe installation; pipe lining; coating of field joints; installing valves and miscellaneous piping; testing and disinfection; placing reinforcement; forming, placing and curing of concrete; masonry construction; miscellaneous metals fabrication and installation; painting and coating; installation of electrical and instrumentation equipment; and other such work.
- D. Within 5 calendar days after submittal of initial CPM Network Schedule, meet with TVWMD Engineer to review such submittal. TVWMD's Engineer's review will be limited to the submittal's conformance to the Contract requirements, and may include directions to include activities and information missing from the submittal and requests to the Contractor to clarify his schedule.

- E. Revise the initial CPM Network Schedule submittal to address all review comments received from the Engineer and resubmit the Network Diagrams and reports. TVWMD's Engineer will either (1) accept the resubmitted schedule, or (2) advise the Contractor in writing to review any part or parts of the schedule, which either do not meet the Contract requirements or are unsatisfactory for TVWMD Engineer to monitor the project's progress and status. TVWMD Engineer may accept the schedule with conditions that the first monthly CPM Schedule update be revised to correct deficiencies identified. When the CPM Schedule is accepted, it shall be considered as the "Baseline CPM Construction Schedule." The Water Authority reserves the right to require that the Contractor adjust, add to, or clarify any portion of the CPM Schedule, which may later be discovered to be insufficient for the monitoring of the work.
- F. Acceptance of the Baseline CPM Construction Schedule by TVWMD Engineer shall be a CONDITION PRECEDENT to holding the Pre-Construction Conference, mobilizing any labor, equipment and materials at the site of work, and processing any Application for Payment subsequent to the first monthly payment.
- G. By way of the Contractor assigning activity durations and proposing the sequence of the work, the Contractor agrees to utilize sufficient and necessary management and other resources to perform the work in accordance with the CPM Schedule.
- H. Submission of the Baseline CPM Construction Schedule to City Engineer shall not relieve the Contractor of his total responsibility for scheduling, sequencing, and pursuing the work to comply with the requirements of the Contract Documents, including adverse effects such as delays resulting from ill-timed work.
- I. Following the acceptance of the Contractor's Baseline CPM Construction Schedule, monitor the progress of the work and adjust the Schedule each month to reflect actual progress and any changes in planned future activities. Submit each CPM Schedule monthly update to meet all requirements as indicated herein for the original schedule submittal. Show all work activities on each update, including those already completed. Accurately show the "record" information for completed work activities by indicating when the work was actually started and completed.
- J. The CPM Schedule update submittal will be reviewed with the Contractor during monthly construction progress meetings. Subsequent to such meetings, submit on or before the fifth day of each month a revised CPM Network Diagram, revised CPM computerized tabulations, and revised Successor-Predecessor Report. Acceptance of the monthly Schedule Update submittal shall be a condition precedent to processing each monthly application for payment.
- K. Highlight or otherwise identify all changes to the Schedule. Modify any portions of the CPM Schedule, which become infeasible because of activities behind schedule or for any other valid reason.
- L. Neither the submission nor the updating of the Contractor's Schedule submittal, nor TVWMD Engineer's review or acceptance of any such Schedule shall have the effect of modifying the Contract completion date or milestone dates or the Contractor's obligations under this Contract.

1.06 PROGRESS SCHEDULES

A. Progress schedules shall represent a practical plan to complete the Work within the Contract time(s) of completion indicated, and shall convey the CONTRACTOR's intent in the manner of execution and progress of the Work.

- B. The scheduling and execution of construction in accordance with the Contract Documents are the responsibility of the CONTRACTOR. The CONTRACTOR shall involve and coordinate all Subcontractors and material suppliers in the development and updating of progress schedules.
- C. The submittal of progress schedules shall be understood to be the CONTRACTOR's representation that the progress schedule meets the requirements of the Contract Documents and that the Work will be executed in the sequence and duration indicated in the progress schedule.

D. Scheduling Format

- 1. The Project Schedule shall be computer produced by utilizing project scheduling software such as Primavera, Microsoft Project, SureTrak, Timeline or other equivalent software as approved by the ENGINEER. Project schedules shall be prepared in advance of the project pre-construction conference.
- 2. The Project Schedule shall be updated monthly and shall show Contract tasks, the percent complete, progress bars, baseline schedules, milestones, start and finish dates, and other breakdowns as required by the ENGINEER. The schedules shall show clearly the sequence of activities and shall list specifically the following activities:
 - a. Interim milestone completion dates. Phasing and staging of the Work as specified shall be prominently identified.
 - b. Submittals and the OWNER's review of submittals.
 - c. Any long lead time (over 60 days) orders for material and equipment.
 - d. Work to be performed by other contractors or agencies.
- 3. Descriptions of scheduled activities shall include sufficient detail to identify the work that is to be accomplished.
 - a. The schedule shall contain sufficient activities to clearly show the sequence and interdependencies of the Work. The schedule shall be prepared in such a way that an activity or group of activities will correspond directly with the bid item breakdown and/or the breakdown of lump sum bid items. The ENGINEER may request that additional activities be added.
 - b. Activity durations shall be expressed in whole days. Work that is to be performed by Subcontract shall be clearly defined.
 - c. Float suppression techniques, such as preferential sequencing (crew movement, equipment use, and form reuse), extended duration, imposed dates, scheduling of work not required for the Contract, and others, shall not be used to affect or limit float in the schedule. The use of constraint dates should be minimized, and must be approved by the OWNER.
- 4. A schedule showing that Work that is completed in less than the completion time specified may be found to be impractical by the ENGINEER.
- 5. A schedule showing that Work that is completed in less than the completion time specified, that is found to be practical by the ENGINEER, shall be considered to have float. The float shall be the time between the scheduled completion of the Work and the Contract completion date. Float time shall not be for the exclusive benefit of the CONTRACTOR.
- 6. A schedule found to be impractical for the preceding reasons or any other reasons shall be revised by the CONTRACTOR and resubmitted.

7. Two week look ahead schedules prepared in a format suitable to the CONTRACTOR and ENGINEER shall be prepared on a Weekly basis.

1.07 CHANGE ORDERS

- A. Incorporate approved Change Orders in the Schedule Update submittal for the next month following Change Order approval. Utilize a sub-network in the schedule depicting the changed work and its effect on other activities. Tie this sub network to the main network with the appropriate logic so that a true analysis of the Critical Path can be made.
- B. Each Change Order requiring a time impact analysis to be submitted along with the Change Order. Change Order will not be considered unless the Time Impact Analysis is submitted.

1.08 SCHEDULE REPORTS (FORMAT)

- A. Prepare Schedule Reports based on the Construction Schedule, and include the following minimum data for each activity:
 - 1. Activity Numbers and Responsibility Codes.
 - 2. Work Order Number.
 - 3. Estimated Activity Duration.
 - 4. Activity Description.
 - 5. Activity's Percent Completion.
 - 6. Early Start Date (Calendar Dated).
 - 7. Early Finish Date (Calendar Dated).
 - 8. Late Start Date (Calendar Dated).
 - 9. Late Finish Date (Calendar Dated).
 - 10. Status (Whether Critical).
 - 11. Total Float for Each Activity.
 - 12. Free Float for Each Activity.
- B. Preface each Schedule Report with the following summary data:
 - 1. Project Name.
 - 2. Contractor.
 - 3. Type of Tabulation.
 - 4. Project Duration.
 - 5. Contract Completion Date (revised to reflect time extensions).
 - 6. The Commencement Date stated in the Notice to Proceed.
 - 7. The Data Date and Plot Date of the Network Diagram.
 - 8. If an update, cite the new schedule completion date.

1.09 MEASUREMENT AND PAYMENT

A. Measurement and payment for work in this section will be considered as subsiding obligation of the Contractor and the cost thereof shall be in the applicable items listed in the Bid Schedule.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 32 19 - SUBMITTALS SCHEDULE

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section includes information regarding the submittals schedules.
- 1.02 REFERENCED SECTIONS
 - A. Related Sections are listed below:
 - 1. SECTION 01 32 16 CONSTRUCTION PROGRESS SCHEDULE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
- 1.05 QUALITY CONTROL (SUBMITTAL REQUIREMENTS)
 - A. The CONTRACTOR shall submit a completed submittal schedule and list of products for all items requiring the OWNER's review and approval within ten (10) calendar days after the effective date of Notice to Proceed. The following shall be included in the submittal:
 - 1. Submittals, including description of the item and name of manufacturer, trade name and model number.
 - 2. Specification reference.
 - 3. Intended submission/resubmission date(s).
 - 4. Order release date.
 - 5. Lead time to delivery/anticipated delivery date(s).
 - 6. Highlight any items that require expedited review to meet the project schedule.
 - B. Schedules shall be presented in a form acceptable to the OWNER in both electronic and hard copy versions and shall be updated and sent to the OWNER on a monthly basis. The CONTRACTOR shall identify all submittals that are required by the Contract Documents and determine the date on which each submittal will be submitted in conformance with the schedules specified in Section 01 32 16 Construction Progress Schedule.
 - C. Submittals involving Engineering design services, such as shoring and underpinning, excavation support structures, falsework for concrete, and load and design calculations, shall be sealed and signed by a professional ENGINEER, currently registered in the State, for the discipline involved.
 - 1. Other submittals involving Engineering design services, when specified or required by governing codes and regulations, shall be sealed and signed by a professional ENGINEER, currently registered in the State, for the discipline involved.

D. Review Period

- 1. The CONTRACTOR shall prepare submittals sufficiently in advance so that approval may be given before commencement of the related work.
- 2. Fifteen (15) calendar days shall be allowed after receipt by the OWNER for review of each submittal, including re-submittals.
- 3. The CONTRACTOR shall be responsible for determining whether or not certain governmental entities and utility districts require longer review periods. When longer review periods are required, the CONTRACTOR shall schedule the Work accordingly, so that the Work and project progress schedules are not adversely impacted.
- E. The following equipment and materials shall have the submittals provided early in the project as they are expect to have to longest lead time in procuring:
 - 1. Vertical Turbine Pump, Motor and Accessories: Submit to Engineer within 15 calendar days of NTP.
 - 2. MCC and VFD Equipment: Submit to Engineer within 45 calendar days of NTP.
 - 3. Well Building Steel Trusses: Submit to Engineer withing 45 calendar days of NTP.

F. Submittal Delivery

- 1. The CONTRACTOR shall deliver submittals by shipping them prepaid to OWNER, or by delivering them to the OWNER directly by hand.
- G. Transmittal forms shall accompany submittals and include the following information:
 - 1. The CONTRACTOR's name, address, and telephone number;
 - 2. Submittal number and date;
 - 3. Contract title and number;
 - 4. Supplier's, manufacturer's, or Subcontractor's name, address, and telephone number; and
 - 5. Subject identification including Contract Drawing and Specification reference.
- H. Changes in approved submittals will not be allowed unless those approved submittals with changes have been resubmitted and approved, in the same manner as the original submittal.
- I. Supplemental submittals initiated by the CONTRACTOR for consideration of corrective procedures shall contain sufficient data for review. Make supplemental submittals in the same manner as initial submittals.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 33 00 – SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 GENERAL

- A. Wherever submittals are required hereunder, all such submittals by the Contractor shall be submitted to the Engineer. A Submittal is defined as any drawing, calculation, specification, product data, samples, manuals, requests for substitutes, spare parts, photographs, survey data, record drawings, bonds, or similar items required to be submitted to the TVMWD Engineer under the terms of the contract.
- B. Before issuance of Notice to Proceed, the Contractor shall submit the following submittal items to the Engineer for review:
 - 1. A Preliminary Construction Schedule indicating the starting and completion dates of the various stages of the Work. Section 01 32 16 Construction Progress Schedules.
 - 2. A preliminary schedule of Shop Drawings, Samples, and proposed substitutes or "Or Equal" submittals.
 - 3. A list of all permits and licenses the Contractor shall obtain indicating the agency required to grant the permit and the expected date of submittal for the permit and required date for receipt of the permit.
 - 4. A preliminary schedule of values (lump sum price breakdown for all of the Work which will include quantities and prices of items aggregating the Contract Price and will subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such prices shall include an appropriate amount of overhead and profit applicable to each item of work which will be confirmed in writing by the Contractor at the time of submittal.
- C. Submittals: Before the preconstruction meeting, the Contractor shall submit to the Engineer proposed Substitutes or "Or Equal" products for the Engineer's review and approval. All such submittals shall be in conformance with the requirements of Paragraph 1.04, herein.
- D. The Contractor hereby agrees that failure to submit alternative product requests within the stipulated time period shall act as a waiver of any future rights to offer such substitutes, and the Contractor hereby agrees to provide one of the specific products called for in the Contract Documents.

1.02 SECTION INCLUDES

- A. This section specifies the general methods and requirements of submissions applicable to shop drawings, product data and samples, and operations and maintenance manuals. Detailed submittal requirements will be specified in the technical Specifications sections.
- B. The term "submittal" as used herein shall be understood to include working drawings, detail design calculations, shop drawings, fabrication and installation drawings, erection drawings, lists, graphs, operating instructions, catalog sheets, data sheets, samples, and similar items.

1.03 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 01 32 16 CONSTRUCTION PROGRESS SCHEDULE
 - 2. SECTION 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
 - 3. SECTION 01 40 00 QUALITY REQUIRMENTS
 - 4. SECTION 01 77 00 CLOSEOUT PROCEDURES

1.04 RELATED WORK

- A. Standard Drawings
- B. General Conditions
- C. Standard Specifications
- 1.05 CITED STANDARDS NONE

1.06 NOTED RESTRICTIONS

- A. All submittals shall be complete, clearly typed, and legible. Incomplete submittals will be returned without review comments and no time extensions will be granted.
- B. It is the CONTRACTOR's responsibility to review submittals made by his Suppliers and Subcontractors before transmitting them to the ENGINEER to assure proper coordination of the work and to determine that each submittal is in accordance with his desires and that there is sufficient information about materials and equipment for the ENGINEER to determine compliance with the Contract Documents. Incomplete or inadequate submittals will be returned for revisions without review.

1.07 QUALITY CONTROL

A. CONTRACTOR's Responsibilities

- 1. The CONTRACTOR shall have each submittal reviewed, stamped, and signed as reviewed and approved prior to submission, and shall be responsible for the following:
 - a. The correctness of the drawings, for shop fits and field connections, and for the results obtained by the use of such drawings.
 - b. Verification of catalog numbers, and similar data.
 - c. Determination and verification of field measurements and field construction criteria.
 - d. Checking and coordinating information in the submittal with requirements of the Work and of the Contract Documents.
 - e. Determination of accuracy and completeness of dimensions, quantities, and field conditions at the site.
 - f. Safety precautions.
 - g. Errors or omissions on submittals.

- h. Coordination and performance of work of all trades.
- i. Identification and notification to the ENGINEER of deviation(s) from Contract requirements, and Conformance with the Specifications.
- 2. A submittal cover sheet shall accompany each submittal. The submittal cover sheet shall clearly indicate the names of the Project, OWNER, ENGINEER, CONTRACTOR, and Subcontractor or supplier (if appropriate), as well as the date, submittal number and contract number. Each item included in the submittals shall be listed on the cover sheet with a description, applicable project specification section including specification section and paragraph numbers, drawing number (if appropriate), location in the WORK, quantity required, and whether the item is being submitted as a product listed in the Contract Documents or as an equivalent substitution.
- 3. The CONTRACTOR shall coordinate each submittal with the requirements of the Work, placing particular emphasis upon assuring that each submittal of one trade is compatible with other submittals of related work.
- 4. All submittals shall bear the stamp of approval and signature of CONTRACTOR as evidence that CONTRACTOR has reviewed them. CONTRACTOR's stamp shall contain the following minimum information:

PROJECT NAME:	
CONTRACTOR'S NAME:	
Date:	
Submittal No.:	
Approved By:	

- 5. The CONTRACTOR stamp and signature certify the following:
 - a. The dimensional compatibility of the product with the space in which it is intended to be used.
 - b. The review of submittals for compliance with Contract requirements.
- 6. A number shall be assigned to each submittal by the CONTRACTOR starting with No. 1 and thence numbered consecutively. Re-submittals shall be identified by the original submittal number followed by the suffix "A" for the first resubmittal, the suffix "B" for the second resubmittal, etc.
- 7. No portion of the work requiring a shop drawing, sample, or product data shall be started nor shall any materials be fabricated or installed prior to the approval or qualified approval of such item. Fabrication performed, materials purchased or on-site construction accomplished which does not conform to approved shop drawings and data shall be at the CONTRACTOR's risk. The ENGINEER will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.
- 8. Approval of drawings and associated calculations by the ENGINEER shall not relieve the CONTRACTOR from the responsibility for errors or omissions in the drawings and associated calculations, or from deviations from the Contract Documents, unless submittals containing such deviations were submitted to the ENGINEER and the deviations were specifically called to the attention of the ENGINEER in the letter of

- transmittal and within the submittal, and approved specifically by the ENGINEER as a Contract change.
- 9. Approval of the CONTRACTOR's submittal by the ENGINEER shall not relieve the CONTRACTOR of any responsibility, including responsibility for accuracy and agreement of dimensions and details.
- 10. The ENGINEER will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.
- 11. For submittal Quantities, refer to **Section 01 33 23 Shop Drawings, Product Data, and Samples**. After review by the ENGINEER, one marked up reproducible set of drawings, one copy of product data, and one sample will be returned to the CONTRACTOR.
- 12. After review, the CONTRACTOR shall distribute prints or copies of approved submittals, bearing the OWNER's or designated approval authority's stamp and signature, to the CONTRACTOR's field office, the ENGINEER's field office, and any affected and concerned subcontractors, suppliers, fabricators, or members of the CONTRACTOR's workforce.

B. Review by OWNER/ENGINEER

- 1. Submittals will be reviewed for conformance with requirements of the Contract Documents. Review of a separate item will not constitute review of an assembly in which the item functions. Review will not relieve the CONTRACTOR from CONTRACTOR's responsibility for accuracy of submittals, for conformity of submittals to requirements of Contract Documents, for compatibility of described product with other provided products and the rest of the system, or for prosecution and completion of the Contract in accordance with the Contract Documents.
- 2. The review of shop drawings, data, and samples will be general. The review shall not be construed:
 - a. As permitting any departure from the Contract requirements;
 - b. As relieving the CONTRACTOR of responsibility for any errors, including details, dimensions, and materials;
 - c. As approving departures from details furnished by the ENGINEER.
- 3. The ENGINEER will indicate its reviews of submittals and the action taken by means of its review stamp. The review stamp will be affixed by the OWNER, the action block will be marked, and the stamp will be signed and dated.
- 4. The review-stamp action-block marks will have the following meanings:
 - a. The mark REVIEWED (or "NO EXCEPTIONS TAKEN") means that the submittal appears to conform to the respective requirements of the Contract Documents; that fabrication, assembly, manufacture, installation, application, and erection of the illustrated and described product may proceed; and that the submittal need not be resubmitted.
 - b. The mark FURNISH AS CORRECTED (or "MAKE CORRECTIONS NOTED") means there are minor clarifications or changes required on the submittal, but the submittal appears to conform to the respective requirements of the Contract Documents upon incorporation of the reviewer's corrections, and that fabrication, assembly, manufacture, installation, application, and erection of the illustrated and

- described product may proceed. Submittals so marked need not be resubmitted unless the CONTRACTOR challenges the reviewer's exception.
- c. The mark REVISE AND RESUBMIT (or "AMEND AND RESUBMIT") means that the submittal is in noncompliance with the Contract Documents and must be corrected and the entire package resubmitted. Fabrication, assembly, manufacture, installation, application, and erection of the illustrated and described product may proceed after incorporation of the reviewer's corrections and verification by the ENGINEER that the reviewer's corrections have been properly incorporated in the submittal. Resubmission within the time period specified is also required if the CONTRACTOR challenges the reviewer's corrections.
- d. The mark "REJECTED" (or "REJECTED-SEE REMARKS") means that the submittal is deficient to the degree that the reviewer cannot correct the submittal with a reasonable degree of effort, and the submittal does not meet the intent of the Contract Documents. The CONTRACTOR has not made a thorough review of the submittal, and that the entire submittal package needs revision to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the Contract Documents.
- 5. Resubmittals will be handled in the same manner as first submittals. On resubmittals the CONTRACTOR shall direct specific attention, in writing, on the letter of transmittal and on resubmitted shop drawings by use of revision triangles or other similar methods, to revisions other than the corrections requested by the ENGINEER, on previous submissions. Any such revisions that are not clearly identified shall be made at the risk of the CONTRACTOR. The CONTRACTOR shall make corrections to any work done because of this type revision that is not in accordance to the Contract Documents as may be required by the ENGINEER.
- 6. Partial submittals will not be reviewed. The ENGINEER will be the only judge as to the completeness of a submittal. Submittals not complete will be returned to the CONTRACTOR, and will be considered "rejected" until resubmitted. The ENGINEER may at his option provide a list or mark the submittal directing the CONTRACTOR to the areas that are incomplete.

1.08 PERMITS

- A. Obtain all permits and licenses necessary to the prosecution of the work. Submit a copy of all permits and licenses to the Engineer within 30 days of issuance.
- B. The Contractor and all his subcontractors, vendors and service providers shall comply with the regulations as stated in each permit for the applicable portion of the work governed by the respective permit. Failure by the Contractor, its subcontractors, vendors and service providers to comply with any permit requirements may cause monetary fines or other such retribution against the TVMWD by the permit-granting agency. Permit fines or other such retribution against the TVMWD that result from the acts or negligence of the Contractor, its subcontractors, vendors and service providers shall be paid for by the Contractor by deducting from the monies due the Contractor under this Contract.

1.09 SHOP DRAWINGS

A. Wherever called for in the Contract Documents, or where required by the Engineer, the Contractor shall furnish to the Engineer for review, via email in PDF format one copy of each

shop drawing submittal. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication and installation drawings, erection drawings, lists, graphs, operating instruction, catalog sheets, data sheets, and similar items. Unless otherwise required, said Shop Drawings shall be submitted to the Engineer at a time sufficiently early to allow review of same by the Engineer, and to accommodate the rate of construction progress required under the Contract.

- B. All Shop Drawings shall be accompanied by the TVMWD Engineer's standard submittal transmittal form which will be provided to the Contractor in Word format. Any submittal not accompanied by such a form, or where all applicable items on the form are not completed, will be returned for resubmittal.
- C. Normally, a separate transmittal form shall be used for each specific items or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single transmittal form will not be permitted.
- D. Except as may otherwise be provided herein, the Engineer will return via email of each submittal to the Contractor, with its comments noted thereon, within 20 calendar days following their receipt by the Engineer. It is considered reasonable that the Contractor shall make a complete and acceptable submittal to the Engineer by the second submission of a submittal item. The TVMWD reserves the right to withhold monies due the Contractor to cover additional cost of the Engineer's review beyond the second submittal.
- E. If copies of a submittal are returned to the Contractor marked "APPROVED" or "ACCEPTED" or "NO EXCEPTIONS TAKEN," formal revision and resubmission of said submittal will not be required,
- F. If a copy of the submittal is returned to the Contractor marked "AMEND-RESUBMIT," the Contractor shall revise said submittal and shall resubmit one copy via email of said revised submittal to the Engineer.
- G. If one copy of the submittal is returned to the Contractor marked "REJECTED-RESUBMIT," the Contractor shall revise said submittal and shall resubmit one copy via email of said revised submittal to the Engineer.
- H. Fabrication of an item may be commenced only after the Engineer has reviewed the pertinent submittals and returned copies to the Contractor marked either "NO EXCEPTIONS TAKEN" or "APPROVED" or "ACCEPTED" or "MAKE CORRECTIONS NOTED" Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis of claims for extra work.
- I. All Contractor submittals shall be carefully reviewed against the contract documents by an authorized representative of the Contractor, prior to submittal to the Engineer. A letter of affidavit shall be included with each submittal stating the contract documents have been reviewed and the submitted product is correct for the project application and in strict conformance with the contract documents. The letter affidavit must be dated and signed by both the Contractor and the product manufacturer or service provider. In the case of shop drawings, each sheet shall be so dated and signed for approval. No consideration for review by the Engineer of any Contractor submittals will be made for any items which are not accompanied with an affidavit. All submittals without an affidavit will be returned to the

- Contractor without action taken by the Engineer, and any delays caused thereby shall be the total responsibility of the Contractor.
- J. The Engineer's review of Contractor submittals shall not relieve the Contractor of the entire responsibility for the correctness of details and dimensions. The Contractor shall assume all responsibility and risk for any misfits due to any errors in Contractor submittals. The Contractor shall be responsible for the dimensions and the design of adequate connections and details.

1.10 PROPOSED SUBSTITUTES OR "OR EQUAL" ITEMS

- A. For convenience in designation in the Contract Documents, any material, product, or equipment to be incorporated in the Work may be designated under a brand or trade name or the name of a manufacturer and its catalog information. The use of any substitute material, product, or equipment which is equal in quality and utility and possesses the required characteristics for the purpose intended will be permitted, subject to the following requirements:
 - 1. The burden of proof as to the quality and utility of any such substitute material, product, or equipment shall be upon the Contractor.
 - 2. The Engineer will be the sole judge as to the quality and utility of any such substitute material, product, or equipment and its decision shall be final.
- B. Wherever in the Contract Documents the name or the name and address of a manufacturer or Supplier is given for a material, product, or equipment, or if any other source of a material, product, or equipment is indicated therefore, such information is given for the convenience of the Contractor only, and no limit, restriction, or direction is indicated or intended thereby, nor is the accuracy or reliability of such information guaranteed. It shall be the responsibility of the Contractor to determine the accurate identity and location of any such manufacturer, Supplier, or other source of any material, product, or equipment called for in the Contract Documents.
- C. The Contractor may offer any material, product, or equipment which it considers equal to those specified. Unless otherwise provided by law or authorized in writing by the Engineer, the substantiation of any proposed substitute or "or-equal" material, product, or equipment must be submitted within 10 days after the submission of the Bid to substantiate substitution of "or equal items. The Contractor, at its sole expense, shall furnish data concerning items it has offered as substitute or "or-equal" to those specified. The Contractor shall provide the data required by the Engineer to determine that the quality, strength, physical, chemical, or other characteristics, including durability, finish, efficiency, dimensions, service, and suitability are such that the substitute or "or-equal" item will fulfill its intended function.
- D. The Contractor's attention is further directed to the requirement that its failure to submit data substantiating a request for a substitution of an "or equal" item within said allowed period shall be deemed to mean that the Contractor intends to furnish one of the specific brand or trade-named material, product, or equipment specified in the Contract Documents and the Contractor does hereby waive all rights to offer or use substitute materials, products, or equipment in each such case. Wherever a proposed substitute material, product, or equipment has not been submitted within said 35-day period, or wherever the submission of a proposed substitute materials, product, or equipment fails to meet the requirements of the Specifications and an acceptable resubmittal is not received by the Engineer within said 35-day

period, the Contractor shall furnish only one of the materials, products, or equipment originally- named in the Contract Documents. Approval by the Engineer of a substitute item proposed by the Contractor shall not relieve Contractor of the responsibility for full compliance with the contract Documents and for adequacy of the substituted item. The Contractor shall also be responsible for resultant changes and all additional costs which the substitution requires in its work, the work of its subcontractors and of other contractors and shall effect such changes without cost to TVMWD.

E. Should the approved substitutions result in a lowering of project cost, the TVMWD may require as a condition of approval a contract cost reduction.

1.11 SAMPLES

- A. Unless otherwise specified, whenever in the Specifications samples are required, the Contractor shall submit not less than 3 units of each such sample item or material to the Engineer for approval at no additional cost to the TVMWD.
- B. Samples, as required herein, shall be submitted for approval a minimum of 21 days prior to ordering such material for delivery to the job-site, and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delays in the Work.
- C. All samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and manufacturer's names for identification and submittal to the Engineer for approval. Upon receiving approval of the Engineer, one set of the samples will be stamped and dated by the Engineer and returned to the Contractor, one set will be retained by the Engineer, and one set of samples shall remain at the job site for reference by the Engineer and the Resident Project Representative until completion of the Work.
- D. Unless otherwise specified, all colors and textures of specified items will be selected by the Engineer from the manufacturer's standard colors and standard materials, products, or equipment lines.

1.12 TECHNICAL MANUALS

- A. The Contractor shall furnish to the Engineer 6 identical sets of technical manuals. Each set shall consist of one or more volumes, each of which shall be bound in a standard size, 3-ring, loose-leaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches. A table of contents shall be provided which indicates all equipment in the technical manuals. Three sets shall be on waterproof paper/materials.
- B. The Contractor shall include for each item of mechanical, electrical, and instrumentation equipment of the technical manuals the following.
 - 1. Complete operating instructions, including location of controls, special tools or other equipment required, related instrumentation, and other equipment needed for operation.
 - 2. Lubrication schedules, including the lubricant SAE grade and type, temperature range of lubricants, and including frequency of required lubrication.
 - 3. Preventive maintenance procedures and schedules.
 - 4. Parts lists, by generic title and identification number, complete, with exploded views of each assembly.
 - 5. Disassembly and reassembly instructions.

- 6. Name and location of nearest supplier and spare parts warehouse.
- 7. Recommended trouble-shooting and start-up procedures.
- 8. Reproducible prints of the Record Drawings, including diagrams and schematics, as required under the electrical and instrumentation portions of these specifications.
- 9. Tabulation of proper settings for all control valves and other related equipment protection devices.
- 10. Detailed test procedures to determine performance efficiency of equipment.
- C. All technical manuals shall be submitted in final form to the Engineer not later than the 75-percent of construction completion date. All discrepancies found by the Engineer in the technical manuals shall be corrected by the Contractor within five (5) days from the date of written notification by the Engineer.
- D. Incomplete or unapproved technical manuals at the 75 percent construction point shall constitute sufficient justification to withhold payment for work completed beyond that period.

1.13 SPARE PARTS LISTS

A. The Contractor shall furnish to the Engineer 5 identical sets of spare parts information for all mechanical and electrical equipment. The spare parts list shall include the current list price of each spare part. The spare parts list shall be limited to those spare parts which each manufacturer recommends be maintained by the TVMWD in inventory. Each manufacturer or supplier shall indicate the name address, and telephone number of its nearest outlet of spare parts to facilitate the TVMWD in ordering. The Contractor shall cross-reference all spare parts lists to the equipment numbers designated in the Contract Documents. The spare parts lists shall be bound in standard size, 3-ring, loose-leaf, vinyl plastic hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches.

1.14 DAILY REPORTS

A. Provide for each work shift a written Daily Report to the Engineer describing the work performed, conditions encountered, weather conditions, delays to the work, accidents or safety concerns, and any construction problems or deviations from the requirements of the Contract Documents. Show on the Daily Report an itemized breakdown of all labor, material deliveries, equipment, and subcontract labor used in performing the work. Submit the Daily Report within two days after completion of the reported work shift.

1.15 RECORD DRAWINGS

- A. General: The Contractor shall keep and maintain, at the job site, one record set of Contract Drawings. On these, it shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction.
- B. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Contract Drawings. Said record drawings shall be supplemented by any detailed sketches as necessary or directed to indicate, fully, the Work as actually constructed.

- C. These master record drawings of the Contractor's representation of "as-built" conditions, including all revisions made necessary by addenda, change orders, and the like shall be maintained up-to-date during the progress of the Work.
- D. In the case of those drawings which depict the detail requirement for equipment to be assembled in the factory, the record drawings shall be updated by indicating those portions which are superseded by change order drawings or final shop drawings, and by including appropriate reference information describing the change orders by number and the shop drawings by manufacturer, drawing, and revision numbers.
- E. Record drawings prepared by the Contractor shall be accessible to the Engineer at all times during the construction period and shall be delivered to the Engineer upon completion of the work.
- F. Effect on progress Payments: Requests for partial payments will not be approved if the record drawings are not kept current. All such Record Drawings will be inspected by the Engineer each month, showing all variations between the Work as actually constructed and as originally shown on the Contract Drawings or other Contract Documents, and the TVMWD will not process monthly payment requests until such drawings are made current each month.
- G. Final Record Drawings: Upon substantial completion of the Work and prior to final acceptance by the TVMWD, the Contractor shall complete and deliver the completed set of Record Drawings to the Engineer for transmittal to the TVMWD, conforming to the construction records of the Contractor. This set of drawings shall consist of corrected plans showing the reported location of the Work. The information submitted by the Contractor and incorporated by the Engineer into the Record Drawings will be assumed to the reliable, and the Engineer will not be responsible for the accuracy of such information, nor for any errors or omissions which may appear on the Record Drawings as a result.
- H. Effect on Final Payment. Final payment will not be approved until the Contractor- prepared Final Record Drawings have been delivered to the Engineer. Said up-to- date, Record Drawings may be in the form of a set of prints with carefully plotted information overlaid in pencil.

1.16 CONSTRUCTION PHOTOGRAPHS

A. The Contractor shall provide monthly construction photographs showing the daily progress of the Work.

1.17 MEASUREMENT AND PAYMENT

A. Measurement and payment for work in this section will be considered as subsiding obligation of the Contractor and the cost thereof shall be in the applicable items listed in the Bid Schedule.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 33 23 – SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section includes information regarding shop drawings, product data, and samples.
- B. The OWNER, or its REPRESENTATIVE, shall review shop drawings, product data, and samples and return the submittals within 15 days.

C. Definitions:

- 1. Shop Drawings
 - a. Shop drawings, also known as record drawings, include fabrication, erection and installation, application, layout, and setting drawings, lists or schedules of materials and equipment, manufacturer's standard drawings, wiring and control diagrams, and all other drawings that may be required to show that the materials, equipment, and systems, and the positions these items, comply with Contract requirements.

2. Product Data

a. The term "product data" includes manufacturer-prepared descriptive literature, catalog sheets, brochures, performance data, test data, printed diagrams, schedules, illustrations, and other information furnished by the CONTRACTOR or the various product and materials suppliers to illustrate and describe a product, material, system, or assembly for some portion of the work.

3. Samples

a. Samples are physical examples which illustrate materials, equipment, colors, textures, finishes, functions, configuration, and work quality, and establish the standards of quality and utility by which the Work will be judged for acceptance.

1.02 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 01 33 00 SUBMITTAL PROCEDURES
 - 2. SECTION 01 60 00 PRODUCT REQUIREMENTS
 - 3. SECTION 01 77 00 CLOSEOUT PROCEDURES
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. Shop Drawings:
 - 1. Drawings shall be prepared in accordance with ANSI Y14, Drafting Standards Manual, and the following requirements (unless recommended otherwise by the ENGINEER):

a. Drawings shall be limited to the following standard sizes in inches:

Width	Length
8 1/2 inches (215.9mm)	11.0 inches (279.4mm)
11.0 inches (279.4mm)	17.0 inches (431.8mm)
17.0 inches (431.8mm)	22.0 inches (558.8mm)
22.0 inches (558.8mm)	34.0 inches (863.6mm)
24.0 inches (609.6mm)	36.0 inches (914.4mm)

- b. Each drawing shall have the following information in the title block.
 - 1) Drawing number, date, title, revision number, and sheet number.
 - 2) Contract number, Contract sheet number, Contract page number.
 - 3) Contractor's name.
 - 4) Subcontractor/manufacturer name (if applicable).
 - 5) Name of installation location.
- c. Each drawing task shall use symbols from one standard reference source. The CONTRACTOR shall furnish a complete symbol list that includes non-standard symbols used on the drawing.
- d. Each drawing shall include details necessary for the procurement, installation, maintenance, and repair of all components or facilities equipment provided.
 Change Order notices that are attached to drawings shall not constitute revised drawings. Each drawing shall include all changes and be upgraded to reflect the latest configuration.
- e. When specified, shop drawings shall be prepared and submitted electronically. Such drawings shall be created using AutoCAD or Microstation if approved by the ENGINEER. Shop drawings to be prepared and submitted electronically include shop drawings which will be utilized as illustrations and drawings in Operation and Maintenance Manuals.

B. Product Data

- 1. The CONTRACTOR shall modify manufacturers' standard diagrams, charts, illustrations, brochures, calculations, schematics, catalog cuts, and other descriptive data to delete information which is not applicable to the Contract. The CONTRACTOR shall supplement standard information with additional information applicable to this Contract, and indicate dimensions, clearances, performance characteristics, capacities, wiring and other diagrams, and controls.
- 2. If the CONTRACTOR utilizes drawings prepared by others, such drawings may include the standards and symbols of others if the drawings are a mix of existing product drawings and drawings prepared specifically for this Contract. In the event others provide drawings prepared specifically for this Contract, such drawings shall conform in symbols, media and standards to the CONTRACTOR's drawings.
- 3. The CONTRACTOR shall modify the manufacturer's printed installation, erection, application, and placing instructions to delete information which is not applicable to the Contract.

- 4. Product Data shall include the following:
 - Dates and revision dates.
 - b. Contract title and number.
 - c. Reference Contract Drawing numbers.
 - d. Applicable Contract Specification Section numbers.
 - e. Identification of product by description, model number, style number, serial number, or lot number.
 - f. The names of the CONTRACTOR, Subcontractors, Suppliers, and manufacturers as applicable.
 - g. Applicable standards, such as ASTM or Federal specification numbers.

5. Certificates of Compliance:

- a. The ENGINEER may permit the use of certain materials prior to sampling and testing if accompanied by a certificate of compliance stating that the materials involved comply in all respects with the requirements of the Contract Documents. The certificate shall be signed by the manufacturer of the material. A certificate of compliance shall be furnished with each lot of material delivered to the Work, and the lot so certified shall be clearly identified in the certificate.
- b. All materials used on the basis of a certificate of compliance may be sampled and tested at any time. The fact that material is used on the basis of a certificate of compliance shall not relieve the CONTRACTOR of responsibility for incorporating material in the Work which conforms to the requirements of the Contract Documents. Any such material not conforming to such requirements shall be subject to rejection whether in place or not.
- c. The ENGINEER reserves the right to refuse the use of material submitted for approval solely on the basis of a certificate of compliance.
- d. The form of the certificate of compliance and its disposition shall be as approved by the ENGINEER.

C. Samples

- 1. The CONTRACTOR shall furnish to the ENGINEER samples required by the Contract Documents. Samples shall be submitted without charge, with shipping charges prepaid. Materials for which samples are required shall not be used in the Work until approved in writing by the ENGINEER.
- 2. Each sample shall be labeled with the following data:
 - a. Name, number, and location on project;
 - b. Name of CONTRACTOR;
 - c. Material or equipment represented, and location in the project;
 - d. Name of producer, brand, trade name if applicable, and place of origin; and
 - e. Date of submittal.
- 3. The CONTRACTOR shall forward a letter to the ENGINEER submitting each shipment of samples and containing the information listed on the Sample Label specified herein.

Approval of a sample shall be only for the characteristics and use named in the submittal and approval, and shall not be construed to change or modify any Contract requirement. Before submitting samples, the CONTRACTOR shall assure itself that the materials or equipment will be available in the quantities required in the Contract, as no change or substitution shall be permitted after a sample has been approved unless such change or substitution is approved by the ENGINEER in writing.

- 4. Samples of material from local sources shall be taken by or in the presence of the ENGINEER. Samples taken otherwise shall not be considered for testing.
- 5. Inspection and tests will be made, but it is understood that such inspections and tests, if made at any point other than the point of incorporation in the work, in no way shall be considered as a guaranty of acceptance of any material which may be delivered later for incorporation in the work.
- 6. Approved samples not damaged in testing may be incorporated in the finished work if marked for identification and approved by the ENGINEER. Materials incorporated in the Work shall match the approved samples.
- 7. Failure of any material to pass the specified tests shall be sufficient cause for refusal to consider, under the Contract, any further samples of the same brand, make, or source of that material. The ENGINEER reserves the right to disapprove any material which has previously proven unsatisfactory in service.
- 8. Samples of material delivered to the site or installed in place may be taken by the ENGINEER for testing. Failure of samples to meet Contract requirements shall annul previous approvals of the item tested.

1.06 SUBMITTALS

- A. Submittal Procedures are described in **Section 01 33 00**.
- B. Unless notified otherwise by the OWNER or ENGINEER, the quantities for the applicable submittals shall be as specified below:
 - 1. The original and five (5) copies of the drawings.
 - 2. Six (6) copies of manufacturers' standard schematic drawings.
 - 3. Four (4) copies of CONTRACTOR's or manufacturers' calculations and six copies of manufacturers' standard data.
 - 4. Six (6) copies of manufacturers' printed installation, assembly, erection, application, and placement instructions.
 - 5. Three of each sample item specified in the various Specification Sections (where applicable), unless otherwise specified by the ENGINEER.
 - 6. Six (6) copies of inspection reports, test reports, and certificates of compliance.
 - 7. Where submittals are submitted to the ENGINEER for information or record purposes, submit two copies.
 - 8. The original and one copy of permits and licenses and other such documents obtained.

C. Other Submittals

1. Other submittals shall be furnished upon request for the ENGINEER's approval to verify compliance of all equipment and materials with the Contract Documents. These submittals shall include in addition to drawings: catalog cuts, certifications of compliance, or any other substantiating information or samples of material items as necessary.

D. Distribution

1. The CONTRACTOR shall duplicate and distribute reproductions of shop drawings, copies of product data, and samples, which bear company stamp of approval, to job site file, record documents file, subcontractors, suppliers, and any other entities requiring information.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 33 26 - SOURCE QUALITY CONTROL REPORTING

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section specifies the general requirements for submission of the CONTRACTOR's sources of materials, to be prepared and submitted to the ENGINEER.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. The CONTRACTOR shall submit to the ENGINEER a list of the CONTRACTOR's sources of materials. The list shall be submitted in sufficient time to permit proper inspections and testing of materials to be furnished from such listed sources in advance of their use.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 40 00 – QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes a brief description of general quality control, workmanship in relation to industry standards, and compliance with manufacturer's instructions.

1.02 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL

A. Verification of Dimensions

- 1. The CONTRACTOR shall lay out all work and shall be responsible for all lines, levels, grades, elevations and measurements of structures, and other work required under this contract.
- 2. The CONTRACTOR shall verify all site dimensions, project layout dimensions, setbacks, etc., shown on the drawings before laying out the work.
- 3. The CONTRACTOR shall notify the ENGINEER in writing of any error or discrepancy found and shall not proceed until the error or discrepancy is resolved.
- 4. The CONTRACTOR shall be responsible for correction of any work, which is done in error because of failure to verify dimensions.

B. Tests

- 1. The CONTRACTOR shall comply with any tests required by law, ordinance, rule, regulation, or order of any public authority having jurisdiction.
- 2. Special tests may be ordered by the ENGINEER in accordance with the contract documents or as agreed between the ENGINEER and CONTRACTOR in writing.
- 3. If the Specifications require testing by an independent testing laboratory, the CONTRACTOR shall select the testing laboratory and receive approval from the ENGINEER. After approval, the CONTRACTOR shall schedule all tests and shall deliver all test reports to the ENGINEER.
- 4. The CONTRACTOR is responsible for all costs involving testing with the exception of the following:
 - a. Special tests required by the ENGINEER. Special tests are to be paid for as stipulated in the contract documents or as otherwise agreed between the ENGINEER and CONTRACTOR in writing.

C. In order to produce work of the specified quality, the CONTRACTOR shall maintain quality control over supplies, manufacturers, products, services, site conditions, and workmanship.

1.06 WORKMANSHIP

- A. The CONTRACTOR and his/her workers shall comply with the highest prevailing industry standards in regard to work and safety.
- B. The CONTRACTOR shall provide workers who are qualified to perform all work to the specified quality.

1.07 MANUFACTURER'S INSTRUCTIONS

A. The CONTRACTOR shall comply with the manufacturer's instructions in full detail, including each step in sequence. If the manufacturer's instructions conflict with the Contract Documents, the CONTRACTOR shall request clarification from the ENGINEER before proceeding.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

T-SECTION 01 10 00

SUMMARY OF WORK AND SEQUENCE OF CONSTRUCTION

PART 1 - GENERAL

1.1 Work Covered by Contract Documents

A. Summary of Work, location, Work sequence, closeout, Contractor use of premises, and activities by others at Project site.

The Contractor shall provide and install a new 600 gpm vertical turbine well pump, well house, electrical and civil site improvements, and piping connection to the existing raw water line in the adjacent right of way.

- B. Work includes furnishing products, labor, tools, transportation, and services to:
 - 1. Protect existing facilities in place including existing irrigation lines, power poles, and utilities.
 - 2. Construct new 8" DIP pipelines per plans.
 - 3. Construct, develop, and test new well
 - 4. Furnish and install new MCC and future storage room.
 - 5. Furnish and install new well with 100-hp vertical turbine pump and motor.
 - 6. Construct new masonry building with steel roof, and building appurtenances, ventilation and lighting.
 - 7. Provide instrumentation and telemetry and provide coordination with TVMWD's SCADA integrator (Prime Systems Inc)
 - 8. Provide site improvements including percolation pond, fieldstone fencing, concrete drive ways, and asphalt around the well enclosure building.
 - 9. Pressure test new Work.
 - 10. Disinfect piping and appurtenances to local and AWWA standards.
- C. Furnish and install complete operating engineered systems, including appurtenant structural, mechanical and/or electrical mountings fittings or connections required for
 - 1. Compliance with Manufacturer's installation requirements.
 - 2. Compliance with applicable building, fire, plumbing, mechanical, electrical, and energy codes and standards, and
 - 3. As needed to permit systems to perform functions required by Contract Documents and described in Manufacturer's printed literature.
- D. Contractor's submission of bid shall constitute acknowledgment that, if awarded contract, they have relied upon and are relying upon their own examination of:
 - 1. Contract Documents
 - 2. Available geotechnical information.
 - 3. Work site
 - 4. Access to Work site
 - 5. Electrical service available at Work site.
 - 6. Conditions under which Work is to be performed
 - 7. Existing facilities on and near Work site.
 - 8. Data and matters requisite to completion of Work

1.2 Work Covered by Contract Documents (Wells)

- A. Intent of Contract Documents is to construct a complete and fully operational municipal supply well at the Miragrand site.
 - 1. Well design capacity is 600 gallons per minute (gpm).
- B. Work includes furnishing products, labor, tools, transportation, and services to construct, develop and test proposed well.

- C. Contractor's submission bid shall constitute acknowledgment that, if awarded the contract, they have relied upon and are relying upon their own examination of
 - 1. Contract Documents
 - 2. Available geotechnical information
 - 3. Work site
 - 4. Access to Work site
 - 5. Electrical service available at Work site.
 - 6. Conditions under which Work is to be performed
 - 7. Existing facilities on and near Work site.
 - 8. Data and matters requisite to completion of Work

1.3 Related Work

- A. Section 01 22 00: Unit Prices
- B. Section 01 32 00: Construction Progress Documentation
- C. Section 26 05 10: Common Work Results for Electrical

1.4 **Project Location and Site Conditions**

- A. Site conditions and required equipment environmental ratings are:
- B. Anticipated handled fluids and their properties are:
- C. Work and equipment shall be designed to satisfactorily operate under above conditions at project site.
 - 1. Incorporate derating and necessary oversizing to meet specified performance criteria into equipment design.
 - 2. Design equipment shall be designed to prevent damage from high or low ambient temperature within specified range, freezing, airborne dust, wind, and wet weather conditions.
 - 3. Outside air containing dust will be circulated to cool equipment.
 - 4. Electrical and mechanical equipment shall be suitably sealed.

1.5 Normal Working Hours

A. Normal working hours shall be as shown in General Provisions Section xxx.

or

- A. Conduct Work within the following Owner-accepted schedule:
 - 1. Normal Work Hours:
 - a. 7:00 am to 4:30 pm as amended by permit or noted on Plans.
 - 2. Noise-Restricted and Emission-Restricted Hours:
 - a. Restrict grinding, paving, sweeping, backup alarms equipment to hours after 8:00 am.
 - b. Idling trucks are acceptable after 7:00 am.
 - 3. Normal Work Hours involving lane closures or blockages within paved public right-of-way:
 - a. 8:00 am to 3:30 pm as amended by permit or noted on Plans.
 - b. Do not close or block streets, lanes, or alleys prior to these hours to allow impacted property owners time in morning to move vehicles before closures.
 - c. Set up of traffic control devices may begin 30 minutes prior to closure provided property owners are free to move vehicles.
 - d. Traffic control devices shall be off street by 3:30 pm and roads shall be open to traffic.
 - 4. Normal Work Days: Monday through Friday, excepting legal holidays.
 - 5. In addition, applicable permit conditions from governing agencies may further restrict working hours.
- B. Exceptions to this Work schedule shall be only as accepted in writing by Owner.
 - No Work shall be done outside of normal work hours and work days, except where necessary for public safety, care and protection of Work already performed, or other emergency
 - a. Provide written notice to Owner's Representative prior to any such emergency Work outside normal working hours.

- b. Provide written request to Owner's Representative 7 Calendar Days prior to Work outside normal working hours not required by emergency.
- Requests to work on Saturdays, Sundays, or legal holidays will be reviewed case-by-case
 and considered for acceptance based on additional costs to Owner, location of Work,
 nature of planned Work, and inconvenience to residents, businesses, community facilities,
 public events and activities associated with the proposed work day.
- 3. Owner reserves right to back-charge Contractor for costs incurred outside of standard work hours and days stated above.
- 4. Night work may be established as regular procedure by Contractor if they first obtain written acceptance from Owner.
 - Such notice may be revoked by Owner if Contractor fails to maintain adequate nighttime force and equipment for reasonable prosecution and to justify inspection of Work.

1.6 Reference Standards

A. Refer to Section 01 00 01 for listing of reference standards used.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION

3.1 Work Sequence

- A. The following staged sequence of construction shall apply, except as otherwise accepted in writing by Owner.
- B. The following Work sequence is provided for Contractor's convenience.
 - 1. It is not intended to dictate means and methods or cover every specific item of Work necessary
 - 2. It shall not relieve Contractor from their responsibility to coordinate and perform Work in accordance with Plans and Specifications.
 - 3. Elements under each stage are not necessarily sequential and may be subject to change by Owner.
 - 4. Prepare project schedule and as specified in Section 01 32 00.
 - 5. Changes to construction stages identified herein shall be proposed by Contractor and accepted in writing by Owner before implementation as described in Section 01 32 00.
 - 6. Complete Work not itemized in construction sequencing stages below in accordance with Contract documents and Contractor's proposed, Owner-accepted schedule.
- C. Notify Owner of conflicts of staging process within 30 calendar days of Notice of Award.
- D. General sequence of Work shall be:

E. Stage 1 Preparation

- 1. Before beginning Work, complete the following:
 - a. Coordinate with Servicing Electrical Utility regarding electric service to site, no existing electric service is available and Contractor shall provide for electrical power service/generators as needed to perform the work.
 - b. Obtain required permits, licenses and construction easements.
 - c. Call **Underground Service Alert** and utilities to obtain staking and marking of buried utilities.
 - d. Submit proposed schedule of Work, insurance and bonds.
 - e. Pothole as needed to supplement staking and marking.
 - f. Take preconstruction photographs.
 - g. Verify utility locations, field dimensions, pipe types and voltage and phase of on-site electrical services.
 - h. If discrepancies or conflicts are found, bring these to attention of Owner's Representative.

- i. Submit Shop Drawings and other submittals.
- j. Complete additional preliminary matters required by Contract Documents.
- 2. Begin manufacturing and shipping materials and equipment after receiving accepted submittals.

F. Stage 2 Mobilization

- 3. Provide traffic control facilities.
- 4. Construct temporary security fencing and appurtenances.
- 5. Construct new scaffolding, access facilities, and platforms required to perform Work
- 6. Construct sound attenuation devices as necessary.
- 7. Mobilize construction equipment.
- 8. Provide BMP's for SWPPP compliance.

G. Stage 5 Construction

- 9. Construct underground infrastructure, utilities, buried piping, and appurtenances.
- 10. Construct above-ground piping and well house facilities
- 11. Construct electrical and mechanical well house appurtenances.
- 12. Construct site civil improvements

H. Stage 7 – Mechanical Equipment Upgrades

- 1. Perform system disinfection
- 2. Startup and testing

I. Stage 9 Closeout

- 13. Remove temporary fencing, paving and construction equipment.
- 14. Provide operator training, including O&M manuals containing engineering Product Data and Shop Drawings on equipment.
- 15. Provide record drawings.
- 16. Clean up and restore construction areas.
- 17. Provide warranty as specified.

3.2 New Electrical Service

A. Refer to Section 26 05 10 for coordination requirements with servicing electrical utility.

3.3 Cooperation with Other Contractors

- A. Owner may have additional work performed in this area by other Contractors.
 - 1. Contract requires cooperation with those contractors in the area.
 - 2. Differences or conflicts which arise between Contractor and other contractors will be adjusted and determined by Owner.
 - 3. Contractor shall conduct their operations to minimize interference with work being done by other contractors.
 - a. Make good, promptly, injuries or damages to other contractors' work caused at Contractor's hands.

3.4 Contractor Use of Premises

- A. The following facilities shall remain operational throughout construction of Work:
 - 1. Water service.
 - 2. Do not shut off pipelines or power, or take action which might adversely affect Owner's use or operation of their facilities or premises without prior written authorization from Owner.
 - 3. Construct accepted signs, barricades and lights necessary to ensure public safety and safety of Owner's operators and personnel.
 - a. Provide steel plates across ditches to facilitate safe access of Owner's personnel to facilities.
- B. Contractor shall restrict their area of operations to avoid damage of trees and shrubs and shall not remove trees unless specifically directed by Owner.
- C. Contractor shall legally dispose of material removed.

D. Fences, walls, shrubs, sprinkler systems, substructures or other improvements removed or disturbed by Contractor during construction shall promptly be replaced and/or repaired at Contractor's sole expense to Owner's satisfaction.

3.5 Responsibility for Job Site Conditions

- A. Contractor shall assume sole and complete responsibility for jobsite conditions during course of construction of Work, including safety and health of persons and property; that this requirement shall apply continuously and not be limited to normal working hours
- B. Contractor shall defend, indemnify and hold Owner and design consultant harmless from any and all liability except that arising from sole negligence of Owner or design consultant.
- C. Refer to Section 01 35 26 for jobsite safety requirements.

3.6 Occupancy

A. Successful completion of pre-startup checkout and functional testing shall precede Owner's use or acceptance of completed Work.

END OF SECTION

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T-SECTION 01 21 00 BID OPTIONS

PART 1 - GENERAL

1.1 Work Included

- A. Administrative and procedural requirements governing Bid Options.
 - 1. All Bid Options are at the discretion of TVMWD to utilize and exercise or to omit from the project work.

1.2 Related Work

- A. Section 01 22 00: Unit Prices
- B. Section 01 33 00: Submittal Procedures

1.3 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - 1. SSPWC Standard Specifications for Public Works Construction §3-3 Extra Work

1.4 Unit Prices

A. Payment for Work under Bid Options shall be as specified in Section 01 22 00.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION

3.1 Preparation

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure each allowance item is integrated and interfaced with related Work.

3.2 Contract Closeout

A. At contact closeout, unused allowance amounts remaining shall be credited to Owner by Change Order.

END OF SECTION

4-19-dp 01 21 00 - Allowances - 1 of 2

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4-19-dp 01 21 00 - Allowances - 2 of 2

T-SECTION 01 22 00 UNIT PRICES

PART 1 - GENERAL

1.01 Description

- A. Measurement and payment for Bid Items listed in proposal shall be based upon use of lump sum or unit price method.
 - 1. Extra Work or changes in Work shall be accomplished as provided in Special Provisions.
- B. Refer to Special Provisions §1D-38 Progress Estimates" for additional requirements for preparing progress pay estimates.
- C. Payment for Work in each Section of these Contract Documents shall be included as part of lump sum or unit price bid amount for which such Work is appurtenant.
 - 1. No additional payment will be made for Work described in any Section for which no express bid item is provided.

1.02 Related Work

- A. Bid Proposal Form
- B. General Conditions
- C. Section 01 10 00: Summary of Work and Sequence of Construction
- D. Section 01 21 00: Bid Options
- E. Section 01 29 73: Schedule of Values

1.03 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Partial Payment	Submit monthly typewritten Payment Requests in 8½"x11" paper AIA format	
Requests	accepted by District	
Monthly Progress	Submit upon request supporting documents required for preparation of	
Estimate Backup	monthly progress estimates, including, but not limited to:	
Information	Invoices and receipts for equipment and materials	
	2. Updated schedules	
	3. Updated as-built drawings	
	4. Labor compliance records	
	5. Grant or loan funding required documents	
Final Payment Request	Submit typewritten Payment Requests in 8½ x11" paper AIA format accepted by District	
	Submit upon request supporting documents required for preparation of final	
	payment, including, but not limited to:	
	Invoices and receipts for equipment and materials	
	2. Updated as-built drawings	
	3. Labor compliance records	
	4. Grant or loan funding required documents	
	5. Lien waivers from all preliminary liens received by District	
	6. Release of Stop Notice(s)	

PART 2 - MATERIALS

2.01 General (Measurement)

A. Measurement for unit price quantities will be based upon appropriate Bid Item in proposal. Actual quantity of measurement shall be as constructed by Contractor in place in conformance with Plans and Specifications.

2.02 Linear Measurements

A. Pressure pipe, fencing, curbs, gutters, and other horizontal Work will be measured in horizontal plane along centerline of Work, through tees, bends, fittings, fence gates, driveways, meters, and valves, within limits of Work shown in Contract Documents.

2.03 Area Measurements

- A. Measurement for Bid Items involving area units will be based on horizontal-plane or verticalplane surface areas measured in units shown in bid schedule.
- B. In event of dispute, areas will be computed based on theoretical areas obtained from digital models, Autocad or Cogo prepared using best field surveys and record drawings available.
- C. For convenience, District may use "approximate areas" for payment based on 1 of the following procedures:
 - 1. Planimeter measurements using record drawings.
 - 2. Accepted mathematical formulas for circle or polygon areas.
- D. Measurements of paving or flatwork areas will measure area enclosed by exterior perimeter of measured surface. Areas of vaults, pads, maintenance hole covers, valve box covers, drainage features, hatches, pipe penetrations, bollards, and vents will be included within area measured for payment when surrounded by measured surface on 3 or more sides or at least 270° of arc measured from centers of circles.
- E. Measurements of wall, floor, and roof areas will measure area enclosed by exterior perimeter of measured surface. Areas of doors, gates, windows, hatches, duct penetrations, pipe penetrations, and vents will be included within area being measured for payment when surrounded by measured surface on 3 or more sides or at least 270° of arc measured from centers of circles.
- F. In absence of District-prepared survey and digital model, Contractor may, at their expense, retain licensed surveyor to prepare surveys and sealed calculations of theoretical areas obtained from digital models. In such case, Contractor's surveyor's computed volumes shall govern over "approximate areas" but shall not supersede similar surveys and digital models prepared at District's expense by licensed surveyor.

2.04 Volume Measurements

- A. Measurement for Bid Items involving volume units will be based upon volume measured in units shown in bid schedule.
 - 1. Gallons shall be US gallons.
- B. In event of dispute, payment volumes will be computed based on theoretical volumes obtained from digital terrain models prepared using best field surveys and record drawings available.
- C. For convenience, District may use "approximate volumes" for payment based on 1 of following procedures:
 - 1. Average end area volumes computed as product of average area of vertical or horizontal sections and intervening horizontal or vertical dimension.
 - 2. Accepted mathematical formulas for cylinder, cone, sphere, polyhedron or prism volumes.
 - 3. Analog volumes based on measured weights of delivered materials divided by densities shown in submittals or, in absence of submittal densities, values commonly accepted.
- D. In absence of District-prepared survey and digital terrain model, Contractor may, at their expense, retain licensed surveyor to prepare surveys and sealed calculations of theoretical volumes obtained from digital terrain models. In such case, Contractor's surveyor's computed volumes shall govern over "approximate volumes" but shall not supersede similar surveys and digital terrain models prepared at District's expense by licensed surveyor.

2.05 Weight Measurements

- A. Measurement for Bid Items involving weight units will be based upon weight measured in units shown in bid schedule.
 - 1. Pounds shall be avoirdupois pounds.
 - 2. Tons shall be 2000 lbs avoirdupois.
 - 3. Where Contract Documents require galvanizing, metal weights for payment shall include weight of zinc coating using table of zinc coating weights in ASTM A153.
 - 4. Weights of paint or other shop coatings shall be excluded from payment weights.
 - 5. Weights of temporary erection bolts, boxes, packing containers, and supports used during transportation shall be excluded from payment weights.
 - 6. Except as modified below for connecting bolts, weights of cap screws, anchor bolts, bolts, nuts, washers, and anchor pipe sleeves remaining in finished structure shall be computed based on nominal weights and dimensions shown in Shop Drawings.
- B. Scale weights for payment will be based on load certificates from state-certified platform scales delivered to District's Representative.
 - 1. Scale weights for metal shall be actual weight of members as determined by accurate platform scales.
 - 2. Where carload or truck weights are used, submit record to District's Representative containing itemized statement of dunnage and members included in each lot.
 - 3. Where protective coatings are applied, reduce scale weights as follows:
 - a. 0.25% for each coat of oil.
 - b. 0.5% for each shop coat of paint
 - c. 3.5% for hot-dip galvanizing when not required by Contract Documents
 - 4. Scale weights of members will not be required when quantities of structural steel are designated in Contract Documents in final quantities:
- C. Computed weights for metal shall be obtained using the following rules and assumptions.
 - 1. Density of structural steel and cast steel shall be assumed to be 0.2833 lbm/in³.
 - 2. Density of cast iron shall be assumed to be 0.2604 lbm/in³.
 - 3. Weights of rolled shapes and structural bars and plates shall be computed based on nominal weights and dimensions shown on Shop Drawings, deducting for copes, cuts, and open holes exclusive of bolt holes.
 - 4. Since no deduction to computed weights of structural steel members is made for bolt holes, weights of constructed members will be computed by adding weights of shop-driven and field-driven fasteners and weights of fillet welds.
 - 5. Weights of castings and fillets will be computed from Shop Drawing dimensions, deducting for openings or cuts in finished casting.
 - 6. Weights of pins and rollers will be computed from Shop Drawing dimensions, deducting for holes, openings, pockets, and metal removed by machine finishing.
 - 7. Pilot nuts and driving nuts for each size pin shall be furnished for erection Work, and weights of said nuts shall not be included in payment weights for pins and rollers.
 - 8. When members contain both alloy and carbon steel, computed weights shall be used to determine pay quantities.
 - 9. Weight of structural steel to be paid for shall not exceed computed weight by >1½%.
 - 10. If scale weight of any member is <97½% of computed weight of that member, member will be rejected and will not be included in pay quantities.
 - 11. If computed weights are used, weight to be paid for will be calculated weight as established by District's Representative, and no allowance will be made for weight in excess thereof.
 - 12. When estimated metal quantities required for Work are shown in Contract Documents, said estimated quantities shall payment quantities unless dimensions of Work shown on Plans is revised by District's Representative.
 - a. If Plan dimensions are revised, payment quantities will be adjusted accordingly

2.06 Contractor-Furnished Surveys

A. No payment will be made to Contractor for Contractor-furnished surveys other than such additional payment Contractor may be entitled to due to corrected payment quantities based on Contractor-furnished surveys.

2.07 <u>Unit Measurements</u>

A. Measurement for Bid Items involving units of item will be based upon quantity of units counted as indicated in Bid Item.

2.08 Payment of Unit Price Items

A. Payment for unit price Bid Items will be based upon amount shown in bid schedule multiplied by total installed quantity measurement of item.

2.09 Lump Sum Measurement

- A. Measurement for lump sum Bid Items will be considered as complete project or portion of project constituting a unit.
 - 1. Items to be included in lump sum Bid Items shall be as specified in proposal Bid Item and/or Standard or Special Provisions and as indicated on accepted Schedule of Values.

2.10 Payment Procedures

- A. District's Representative will prepare monthly progress estimate and submit progress estimate on 15th day of each month.
- B. Payment will be made within 30 days after receipt of satisfactory progress estimates.
- C. Payment will be based on amounts shown in bid schedule with percent completion based on:
 - 1. Measured quantities of Work installed for unit price items.
 - 2. Percent completed computed based on District-accepted schedule of values for lump sum items.
- D. Schedule of Completed Values shall be tabular listing of Work Items from District-accepted Schedule of Values.
 - 1. Schedule of Completed Values shall show for each Item of Work the Item Number; Description; Item Value; % and Value Complete for previous period; % and Value complete for current period; Value of Stored Materials (if any); and Total Billing Value.
 - 2. List each issued Field Order and Change Order on Schedule of Completed Values as a separate Item.
 - 3. Attach Schedule(s) of Completed Values to each Invoice presented for payment.

E. Present pay request in tabular format showing:

LUM	P SUM BID	ITEMS				_						
	ITEM ORIGINAL CONTRACT AMOUNT		TOTAL PREVIOUS BILLING		CURRENT BILLING		TOTAL BILLED TO DATE		% COMPLETE			
Bid Item No.	Work Item Description	Lump Sum Bid Amount			Valu	ie	Value		Value		%	
UNIT	UNIT PRICE BID ITEMS											
ITEM		ORIGINAL CONTRACT AMOUNT				TOTAL PREVIOUS BILLING		CURRENT BILLING		TOTAL BILLED TO DATE		% COMPLETE
Bid Item No.	Work Item Description	Quantity	Unit	Unit Price	Bid Amount	Quantity	Value	Quantity	Value	Quantity	Value	%
TOTA	AL CONTRA	CT		•	•	•		•	•			•
	ORIGINAL CONTRACT AMOUNT		TOTAL PREVIOUS BILLING		CURRENT BILLING		TOTAL BILLED TO DATE		% COMPLETE			

Total Contract Amount	Value	Value	Value	%
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- F. Payment shall be full compensation for furnishing supervision, lab or and services, operations, transportation, materials, equipment, tools, supplies, incidentals and appurtenances required for construction of Work item, complete, functional, tested, and in place in accordance with Contract Documents, including costs of permits and cost of compliance with regulations of public agencies having jurisdiction.
- G. No payment will be made for materials wasted or disposed of in manner not called for under Contract.
 - 1. This includes rejected material not unloaded from vehicles, material rejected after placement, and material placed outside Work limits shown.
 - 2. No compensation will be allowed for disposing of rejected or excess material.
- H. Whenever Work is performed by District at Contractor's request, cost thereof will be charged against Contractor, and may be deducted from amounts due or becoming due from District.
- I. If immediate action is required to prevent injury, death, or property damage, and precautions which are Contractor's responsibility have not been taken and are not reasonably expected to be taken, District may, after reasonable attempt to notify Contractor, cause such precautions to be taken and will backcharge cost thereof against Contractor, or may deduct such cost from amounts due or becoming due from District.
 - 1. District action or inaction under such circumstances shall not be construed as relieving Contractor or their Surety from liability.
- J. Payment shall not relieve Contractor from their obligations under Contract, nor shall such payment be construed as acceptance of Work.
 - 1. Payment shall not be construed as transfer of ownership of equipment or material to District.
 - Responsibility of ownership shall remain with Contractor who shall be obligated to store fully or partially completed Work for which payment has been made, or replace materials or equipment required to be provided under Contract which may be damaged, lost, stolen or degraded prior to acceptance of Work.
- K. Warrantee or quarantee periods shall not be affected by time of payment.
- L. If, within time fixed by law, a properly executed notice to stop payment is filed with District, due to Contractor's failure to pay for labor or materials used in Work, money due for such labor or materials will be withheld from payment to Contractor in accordance with applicable laws.
- M. Partial payments made after Contract completion date will reflect amounts withheld for Liquidated Damages.
 - 1. Such partial payments made to Contractor, or their Sureties, will not constitute waiver of District's Liquidated Damages.
- N. Partial payments may be made for materials and equipment delivered to jobsite or District's yard or warehouse, inventoried upon delivery, suitably and safely stored within secure storage area at Work site.
 - 1. Requests for payment of materials and equipment delivered to jobsite or District's yard or warehouse shall be accompanied by copies of invoices, bills of lading, delivery receipts, or other suitable documentation showing proof of delivery and cost.
 - 2. If requested by District's Representative, provide additional data as may be reasonably required to support submitted Invoice.
- O. Unless District has agreed in writing to partial payment for material and equipment, Contractor shall pay storage, financing, and other costs associated with ordering, receiving, and storing materials and equipment until materials and equipment can be incorporated into Work.

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- P. If Work on Saturdays, Sundays, legal holidays, or outside of specified work hours is requested by Contractor and approved by District's Representative, Contractor shall pay to District additional costs borne by District beyond those costs typically required for Work within District-accepted work schedule.
 - 1. Such costs may include, but not be limited to overtime and additional inspection costs.
 - 2. Exceptions to this requirement include special work schedules described in Contract Documents at time of bidding, negotiated change orders, work schedules required by permits or regulatory agencies, and schedule changes for District's convenience.

2.11 Work Not Listed in Bid Schedule

A. Include costs for related Work and appurtenances required and/or implied by Permits and Contract Documents but not listed as a separate Bid Item under appropriate Bid Item or items within Bid Schedule.

2.12 **Protecting Existing Utilities**

- A. No Bid Item is provided for Work described in Section 31 05 50 protecting existing utilities.
- B. Payment for locating, potholing, exposing, and protecting existing utilities will be included in price bid for Work items for which such Work is appurtenant.
- C. Payment for abandoning or removing existing utilities will be included in price bid for Work items for which such Work is appurtenant.
- D. <u>Utility Protection or Relocation by Contractor as Shown in Contract Documents</u>: When work on a utility is shown within Contract Documents to be done by Contractor, but is not included as a separate bid item, Contractor shall make arrangements and coordinate with utility District regarding schedule for performance of Work.
 - 1. Include costs for such Work in unit prices or lump sum amounts bid for various Contract items.
 - 2. Submit proposed method of relocation or protecting utility for review.
 - 3. Review by District will not relieve Contractor of any responsibility.
- E. <u>Utility Relocation by Contractor for Contractor's Convenience:</u> Temporary relocation or alteration of any utility, desired by Contractor solely for their convenience in performance of Work, to a position or condition other than that provided for on Contract Documents shall be Contractor's own responsibility.
 - Make arrangements with utility or property owners regarding such Work. Repair, replacement or relocation of buried utilities shall be completed at Contractor's expense by either Utility's forces, or by contractor accepted by Utility in writing and properly licensed to perform Work.
 - 2. Costs of such Work for Contractor's convenience shall be absorbed in unit prices or lump sum amounts bid for various Contract items at no additional cost to District.
- F. <u>Utility Relocations by District</u>: When Contract Documents indicate a utility is to be relocated, altered, or reconstructed by forces other than Contractor, District will conduct negotiations in respect to such work and work will be done at no cost to Contractor.
 - 1. No additional compensation will be given for delays or inconvenience by others to finish their Work on schedule due to unforeseen difficulties.
- G. <u>Unknown Utility Installation by Others During Contract Work</u>: If utility is disclosed or installed subsequent to award of Contract, and utility is not shown on Contract Documents, with reasonable accuracy, and said utility is found to occupy space required to be occupied by Work, District's Representative will determine whether utility requires location, relocation, removal, repair of damages, alteration, support or protection.
 - 1. District will determine method and manner of accomplishing such Work and may order Contractor to do so pursuant to Change Order issued by District.

- 2. Perform Work in accordance with Contract Documents provided or accepted by District and in accordance with the following:
 - a. Where undisclosed utilities are discovered and located by Contractor when performing this Contract, immediately notify District in writing.
 - b. When said utility is found to occupy space required to be occupied by part of permanent Works to be constructed under Contract or parallel to permanent works and within vertical planes on each side at distance away equal to maximum allowable trench width measured in plane 12" above top of pipe, exclusive of branches or other facilities, as specified in Contract Documents, or to be within specified excavation pay lines (when such are specified in Contract Documents); District shall arrange for relocation or alteration of said utility or require Contractor to do same.
 - c. Utilities found to cross excavation, but not intercepting permanent Work to be constructed or interfering with construction shall be maintained in place at Contractor's expense.
 - d. Utilities which interfere with construction technique in use shall be protected or relocated.
 - e. When said utility is more or less parallel with, and any portion of it does not lie within vertical planes specified herein above, or does not lie within excavation pay lines (when such are specified or shown on Contract Documents), advise District thereof, and in cooperation with utility owner, provide and place necessary support for proper protection to guarantee continuous and safe operation of utility.
 - f. Maintain continuous sanitary sewer service.
 - g. Should existing sanitary sewer or maintenance hole extend within proposed excavation, submit method of construction or support for acceptance by District, and assume all responsibilities therefor.
 - h. Costs for such Work shall be borne by Contractor.
 - i. If Work is done by others, provide time and working space for protection and relocation as required.
 - j. District will compensate Contractor for their direct costs of locating, relocating, removal, repair, support or protecting undisclosed utilities, together with cost of equipment used for Work necessarily idled during such Work.
 - k. Contractor will be granted extension of time for completion of Contract equal to time determined by District, to be reasonably necessary to perform the Extra Work, and District will not assess liquidated damages against Contractor for delay in completing Work when such delay was caused by District's failure of District to provide for removal or relocation of such utility facilities.
 - I. Contractor will not be entitled to extra compensation or extension of time when Extra Work is required to repair damage to undisclosed utilities caused by failure of Contractor to exercise reasonable care.
 - m. Contractor will not be entitled to compensation for indirect or consequential costs or damages incurred as a result of Extra Work required.
 - n. When directed or accepted by District, changes in line or grade of structure being built may be made to avoid utilities.
 - o. Additional costs because of such changes will be paid for by Change Order as Extra Work.

2.13 Payment for Testing

- A. Party responsible for payment for testing is identified in individual sections of Contract Documents under tests required.
 - 1. Where Specifications are silent regarding responsible party paying for tests, costs of first tests will be paid by District.

- B. If testing or inspection indicates failure of material or procedure to meet Contract Document requirements, District will back-charge Contractor for retesting and re-inspection costs incurred by testing or inspection agency of District's choice.
 - 1. Such charges will be deducted from progress payments due Contractor.
- C. Additional tests and inspections not specified herein but requested by District will be paid for by District, unless result of such tests and inspections are found to not comply with Contract Documents, in which case District will pay costs for initial testing as well as retesting and re-inspection and back-charge Contractor for retesting and re-inspection.
- D. Costs for additional tests or inspections required because of change in materials being provided or change of source or supply shall be paid by Contractor direct to testing laboratory.
- E. Cost of testing which is required solely for convenience of Contractor in his scheduling and performance of Work shall be borne by Contractor.
- F. Contractor shall pay costs for correcting deficiencies.

2.14 Changes in Quantities Initiated by District

A. Refer to General Conditions §10.7 "Allowable Quantity Variations" for additional requirements for payment where Work quantities differ from Bid quantities.

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- B. District may change Contract Documents or character and quantity of Work provided total arithmetic dollar value of all changes, both additive and deductive, does not exceed 25% of Contract Price.
 - 1. Changes in Bid Option Items with stipulated prices will not be considered to contribute toward this total.
- C. Should it become necessary to exceed this limitation, change shall be documented by written Supplemental Agreement between Contractor and District unless both parties agree to proceed under Change Order.
- D. Changes ordered in Work items which do not substantially change character of Work from that shown in Contract Documents, will be accompanied by proportional adjustment in payment to reflect quantity changes using unit prices bid, provided Bid quantity does not change by >25%.
- E. Where Bid quantities under a Bid Item are limited to 2 or 3 integral units (eg. 2 valves) the 25% figure above shall be revised upward (to 50% or 34% respectively) to permit addition or deletion 1 integral unit without changing Bid price.
- F. Payment for quantities in >125% of quantities (or appropriate percentage for 2- or 3-unit Bid Items) will be made at mutually agreed rate lower than Bid amount since Contractor's fixed costs shall be deemed to have been recovered through payment for Bid quantity at Contract unit price.
- G. Payment for quantities <75% (or appropriate percentage for 2- or 3-unit Bid Items) will only be adjusted by mutual agreement if Contractor requests so in writing.
 - 1. In no case will payment be less than Contractor is entitled to under original Bid prices nor more than payment due for 75% (or appropriate percentage for 2- or 3-unit Bid Items) of Bid quantity at Contract Unit Price.
- H. If mutual agreement cannot be reached, District may direct Contractor to proceed on basis of Extra Work as covered in General Provisions.
- I. Should a Bid Item be eliminated in its entirety, payment will be made to Contractor for actual out-of-pocket costs incurred in connection with eliminated item prior to written notification from District of deletion of Bid Item.

- 1. Where applicable, Contractor will also be reimbursed for out-of-pocket shipping costs and Manufacturer's restocking fees.
- J. If materials have been ordered prior to date of written notification of deletion of Bid Item and order cannot be cancelled, Contractor will be paid for actual cost of ordered item and ordered material shall become District's property.
- K. In no case shall expenses such as bonding costs expressly covered under other Bid Items be double-charged to District.

PART 3 - EXECUTION

3.01 Scope

A. This section defines Bid Items listed in Bid schedule and describes measurement and payment provisions for each item.

3.02 Specification Sections with No Bid Item

- A. Where specification sections are included but no pay item(s) are expressly set forth for Work within those sections, include costs of Work described within those sections under bid items for Work for which the Work within those specification sections is appurtenant.
- B. Specification sections for which no pay item is set forth include but are not limited to:
 - 1. Section 01 10 00: Reports, Standard Drawings, Standard Specifications, and Accepted Materials List
 - 2. Section 01 10 01: Summary of Work and Sequence of Construction
 - 3. Section 01 10 02: Sequence of Operation
 - 4. Section 01 10 03: Coordination
 - 5. Section 01 10 04: Maintenance of Plant Operation
 - 6. Section 01 11 11: Green Building Standards Code Compliance
 - 7. Section 01 21 00: Bid Options
 - 8. Section 01 22 00: Unit Prices
 - 9. Section 01 24 00: Cost Reduction Incentive Proposals
 - 10. Section 01 29 73: Schedule of Values
 - 11. Section 01 31 19: Project Meetings
 - 12. Section 01 32 00: Construction Progress Documentation
 - 13. Section 01 32 23: Construction Survey Staking
 - 14. Section 01 32 33: Construction Photographic and Video Documentation
 - 15. Section 01 33 00: Submittal Procedures
 - 16. Section 01 35 13: Special Project Procedures
 - 17. Section 01 35 26: Governmental Safety Requirements
 - 18. Section 01 35 43: Environmental Procedures
 - 19. Section 01 35 44: Environmental Procedures for Hazardous Materials
 - 20. Section 01 40 00: Quality Requirements
 - 21. Section 01 41 26: Permit Requirements
 - 22. Section 01 42 13: Abbreviations and Acronyms
 - 23. Section 01 45 30: Chemical Resistance (Pickle Jar) Test
 - 24. Section 01 45 31: Infiltration Capacity Test
 - 25. Section 01 45 32: Handheld Viscometer Test
 - 26. Section 01 50 00: Temporary Facilities and Controls
 - 27. Section 01 57 23: Temporary Storm Water Pollution Control, BMP Implementation and Erosion Control/Compliance with SWPPP Requirements
 - 28. Section 01 61 00: Common Product Requirements
 - 29. Section 01 63 00: Product Substitution Procedures
 - 30. Section 01 65 00: Project Delivery Requirements
 - 31. Section 01 66 00: Project Storage and Handling Requirements
 - 32. Section 01 73 00: Execution
 - 33. Section 01 73 24: Seismic Restraint
 - 34. Section 01 73 33: Mechanical Identification
 - 35. Section 01 74 00: Cleaning and Waste Management
 - 36. Section 01 77 00: Closeout Procedures

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37. Section 03 08 50: Leakage Testing of Hydraulic Structures
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- 38. Section 03 10 00: Concrete Forming
- 39. Section 03 15 00: Concrete Accessories
- 40. Section 03 20 00: Concrete Reinforcing
- 41. Section 03 22 00: Fabric and Grid Reinforcing
- 42. Section 03 23 00: Stressed Tendon Reinforcing
- 43. Section 03 23 10: Stressed Tendon Reinforcing for Post-Tensioned Anchors
- 44. Section 03 23 13: Stressed Tendon Reinforcing for Prestressed Concrete Tanks
- 45. Section 03 24 00: Fibrous Reinforcing
- 46. Section 03 25 50: Tank Wall Base and Top Joint
- 47. Section 03 27 17: Externally-Bonded Fiber-Reinforced-Polymer (FRP) Strengthening System
- 48. Section 03 32 10: Cement Mortar
- 49. Section 03 35 00: Concrete Finishing
- 50. Section 03 35 19: Colored Concrete finishing
- 51. Section 03 35 33: Stamped Concrete Finishing
- 52. Section 03 39 00: Concrete Curing
- 53. Section 03 60 00: Grouting
- 54. Section 03 64 23: Epoxy-Injection Grouting
- 55. Section 04 05 00: Masonry Mortaring and Grouting
- 56. Section 05 05 19: Post-Installed Concrete Anchors
- 57. Section 05 05 23: Metal Fastenings and Welds
- 58. Section 05 40 00: Cold-Formed Metal Framing
- 59. Section 09 90 00: Painting and Coating
- 60. Section 09 92 00: Galvanizing
- 61. Section 09 96 56: Epoxy Linings and Coatings
- 62. Section 10 14 00: Signage
- 63. Section 10 73 17: Fabric Canopies
- 64. Section 31 05 50: Protecting Existing Utilities
- 65. Section 31 23 00: Excavation and Fill
- 66. Section 31 23 13: Subgrade Preparation
- 67. Section 31 23 33: Trenching and Backfilling
- 68. Section 32 11 00: Untreated Base Courses
- 69. Section 32 12 23: Tack Coats
- 70. Section 32 13 73: Concrete Paving Joint Sealants
- 71. Section 32 91 19: Topsoil Placement and Grading
- 72. Section 33 01 13: Pipeline Dewatering, Ventilation, and Support Services
- 73. Section 33 01 40: Service Lateral Connection Sealing
- 74. Section 33 05 26: Utility Identification
- 75. Section 33 05 31: Pipeline Joint Materials
- 76. Section 33 05 32: Flange Insulating Kits and Threaded Insulated Bushings
- 77. Section 33 05 33: Couplings, Tie Rods, Flange Connectors, and Unions
- 78. Section 33 05 34: Grooved and Shouldered (Victaulic Style) Couplings
- 79. Section 33 05 37: Wall Pipes, Seep Rings, and Penetrations
- 80. Section 33 05 38: Hangers and Supports
- 81. Section 33 05 39: Manual Valve Operators
- 82. Section 33 08 11: Pressure Testing and Flushing of Water Utilities
- 83. Section 33 08 31: Leakage and Infiltration Testing of Gravity Sewer Pipelines
- 84. Section 33 11 18: Cement-Mortar lining and Coating of Steel Pipe
- 85. Section 33 11 19: Mastic and Tape-Wrap Systems for Metal Pipe
- 86. Section 33 11 20: Polyethylene Encasement for Iron Pipe, Fittings, Couplings, and Valves
- 87. Section 33 11 21: Brass and Copper Pipe
- 88. Section 33 12 22: Bronze Valves 3-inches and Smaller
- 89. Section 33 12 23: Stainless Steel Valves 3-inches and Smaller
- 90. Section 33 12 24: Plastic Valves
- 91. Section 33 13 00: Disinfecting Water Utility Pipelines
- C. Payment for obtaining and complying with permits during construction, including NPDES permits, building permits, encroachment permits, excavation permits, drilling permits, disposal permits, temporary easements, licenses, inspection fees, and Federal, State and local taxes will be included in prices bid for Work for which such costs are appurtenant.

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- D. Payment for shoring and bracing will be included in price bid in bid item for shoring and bracing.
- E. Payment for confined space entry procedures and safety provisions shall be included in lump-sum bid item for Confined Space Entry and other safety requirements.
- F. If environmental procedures require Contractor to stop Work for more than 8 hours, Contractor will be reimbursed under Change Order for standby or remobilization costs.
- G. Include costs of temporary facilities and controls under Bid Items for Work for which temporary facilities and controls is required.
- H. Payment for water furnished by Contractor for construction use will be included in price bid for items to which it is appurtenant.
 - 1. Payment under these items will include full compensation for furnishing labor, products, tools and equipment and doing work necessary to develop sufficient water supply and furnishing necessary equipment for applying water as specified.
- Payment for sanitary facilities will be included in price bid for "Mobilization/Demobilization" / major Work items for which mobilization and demobilization are required.
- J. Payment for power furnished by Contractor for construction use will be included in price bid for items to which it is appurtenant.
 - 1. Payment under these items will include full compensation for furnishing labor, products, tools, and equipment and doing work necessary to obtain and distribute power for construction purposes.
- K. Payment for other temporary utilities furnished by Contractor for construction use will be included in price bid for items to which it is appurtenant.
 - Payment under these items will include full compensation for furnishing labor, products, tools, and equipment and doing work necessary to obtain and distribute power for construction purposes.
- L. Payment for providing construction aids to be furnished by Contractor in support of construction activities will be included in price bid for items to which it is appurtenant.
 - 1. Payment under these items will include full compensation for furnishing labor, products, tools, and equipment and doing work necessary to obtain, distribute, and use temporary utilities for construction purposes.
- M. Payment for dust control, including dust palliatives and water supply and application will be included in price bid for Work items for which dust control during construction is required.
- N. Payment for costs arising from fire or prevention of fire will be included in price bid for items of work for which fire protection during construction is needed.
- O. Payment for noise control facilities will be included in price bid for items of Work where noise control facilities are required during construction.
- P. Payment for providing site security will be included in price bid for items to which it is appurtenant.
 - 1. Payment under these items will include full compensation for furnishing labor, products, tools, and equipment and doing work necessary to comply with site security requirements.

3.03 Bid Item 01 – Mobilization/Demobilization, Bonds, and Permits

- A. Amount bid for Mobilization/Demobilization shall not exceed 5.0% of Contractor's Bid total.
 - 1. Amounts bid in excess of stipulated 5.0% cap will not be paid until project completion.
- B. Work to be paid for under mobilization shall include:
 - 1. Providing bonds and insurance.
 - 2. Obtaining temporary easements.

- 3. Arranging for and establishing storage yard and staging area.
- 4. Possessing OSHA required notices and establishing safety programs.
- 5. Obtaining required permits.
- 6. Submitting initial submittals and project schedule.
- 7. Initiating contact with servicing electrical utility to coordinate installation of electrical service.
- 8. Locating existing utilities.
- 9. Providing preconstruction photos and videos.
- 10. Performing required surveys.
- 11. Performing required testing.
- 12. Moving operations onto site.
- 13. Providing project signs.
- 14. Providing temporary utilities.
- 15. Providing temporary facilities.
- 16. Providing temporary security fencing and monitoring.
- 17. Providing site maintenance and cleanup.
- 18. Providing noise attenuation.
- 19. Providing field offices.
- 20. Conforming to General Provisions and Special and Supplementary Conditions.
- C. Work to be paid for under demobilization shall include:
 - 1. Regrading ground surfaces to restore preconstruction grades.
 - 2. Reconstructing berms, fences, walls, structures and improvements.
 - 3. Repairing damage to pavement, flatwor4k, landscaping and irrigation.
 - 4. Removing splatter, grease, stains, fingerprints, dust, labels and other laitance from finished Work.
 - 5. Repairing improvements damaged by Contractor's operations.
 - 6. Cleaning slabs, paving and ground surfaces.
 - 7. Restoring damaged finishes and nameplates.
 - 8. Removing temporary facilities, utilities, and structures.
 - 9. Legally disposing of waste.
- D. Work to be paid for under this item shall also include protecting existing survey monuments in place and, if Contractor's operations disturb such monuments, hiring registered land surveyor to reestablish and reset disturbed monuments.
- E. Work to be paid for under this item shall also include installing, maintenance and removal of necessary BMPs for SWPPP purposes required by Regional Water Quality Control Board, including establishment of erosion control plan and reporting procedures, placement of erosion control measures, monitoring, reporting, payment of fines due to Contractor's negligence and appurtenant Work required by Contract Documents.
- F. Work to be paid for under this item shall include temporary bypass facilities, including connections to existing buried or above-ground piping, piping, valves, concrete coring, pumping facilities, electrical Work, fencing, protecting and securing temporary equipment and appurtenant Work to maintain District's facilities in operation throughout construction.
- G. Work to be paid for under this item shall also include payment for demobilization, removal of temporary facilities, cleanup of construction site, providing record drawings, well completion report, operation and maintenance manuals, and warranties, complete in place.
- H. Payment for verification of field dimensions and utility locations will be included in price bid for items of Work which may require relocation or refitting if field dimensions differ from those shown on plans.
- I. Payment for Bid Item No. 1 Mobilization shall be made according to the following schedule upon acceptance from District:

- 1. Upon completion of mobilization, 50% of amount bid for this item (or 50% of stipulated 5.0% cap, whichever is less, will be made to Contractor with first progress payment.
- 2. Once total amount of progress payments earned to date exceeds 50% of original contract amount, payment to 75% of amount bid for this item (or 75% of stipulated 5.0% cap, whichever is less, will be paid to Contractor as part of next monthly partial payment estimate of total amount earned to date.
- 3. Remainder will be paid as part of final contract payment upon project completion.
- J. Cost for preparing SWPPP, complying with SWPPP requirements, and complying with storm water pollution prevention best management practices when no SWPPP is available, shall be included in the various bid items set forth in these documents and no additional compensation will be granted.

3.04 Bid Item 02 — Traffic Control

A. Lump sum Bid Item for Contractor costs for equipment, training and personnel to maintain traffic control in areas impacted by the work. Costs include permitting costs, traffic control equipment required by permitting, labor and materials.

3.05 Bid Item 03 - Well House Building w/Fieldstone Cladding

- A. Lump sum Bid Item for Contractor costs to construct all building structural elements including:
 - 1. Reinforced concrete slab
 - Masonry walls and fieldstone cladding
 - 3. Roofing and access hatch
 - 4. Doors and exterior appurtenances
 - 5. Interior walls, ceiling
 - 6. Painting and coatings
- B. Submittal for the roof trusses is required from the Contractor within 45 calendar days of the NTP.

3.06 Bid Item 04 – HVAC (AC and Ventilation)

A. Lump sump Bid Item for Contractor costs for providing and installing ventilation and air cooling systems per the project drawings. Costs include duct work, thermostat controls, sound attenuating building intake louvers, and equipment.

3.07 Bid Item 05 – Asphalt Drive and Paving

A. Lump sum Bid Item for Contractor costs for providing asphalt drive and paving as shown in the project drawings.

3.08 Bid Item 06 – Fieldstone Storm Swales

A. Lump sum Bid Item for Contractor costs for providing and installing fieldstone lined storm swales per the project drawings.

3.09 Bid Item 07 - Wrought Iron Fencing

A. Lump sum Bid Item for Contractor costs for providing and installing wrought iron fencing and fieldstone clad pilasters per the project drawings. Costs include fencing, masonry pilasters and fieldstone cladding, gates, locking mechanisms, painting, electronic gates, and lighting.

3.10 Bid Item 08 – Export Native Soil Materials – Percolation Pond Construction

A. Lump sum Bid Item for Contractor costs for excavation, transport, and legal disposal of export native soil from the project site from construction of the percolation pond and other site improvements. Costs include any permitting or testing requirements for disposal.

3.11 Bid Item 09 - Concrete Access Drives, Pads, and Curbing, and Misc

A. Lump sump Bid Item for Contractor costs to provide and install concrete drives, equipment pads, curbing, and miscellaneous concrete work and grouting where shown in the project drawings.

3.12 Bid Item 10 – Well Header Piping and Appurtenances

- A. Lump sum Bid Item for Contractor costs for 6 and 8 inch welded steel piping for the well header discharge and well to well lines and appurtenances.
- B. Items include but not limited to.
 - 1. Motorized gate valves, 6 inch and 8 inch
 - 2. Swing check valve
 - 3. Air release valve assembly
 - 4. Magnetic flow meter
 - 5. Pipe supports
 - 6. Sampling taps
 - 7. Coatings and linings
 - 8. Other header appurtenances as shown in the plans

3.13 Bid Item 11 - Yard Piping an Pond Outlet Structure

A. Lump sum Bid Item for Contractor costs for 6 and 8 inch welded steel piping for the well discharge and well to waste piping in the site yard. Costs include the outlet structure and outlet valve assembly as shown in the project plans.

3.14 Bid Item 12 – Provide and Install Vertical Turbine Pump and Motor

- A. Lump sum Bid Item for Contractor costs to provide and install a vertical turbine pump at the site's predeveloped well down-hole.
- B. Coordinate with the pump supplier on installation requirements to ensure the installation meets requirements for equipment warrantees from the supplier.
- C. Work to be paid for under this item shall include purchase and installation of the pump, connection to discharge header and providing a functional system.
- D. Submittal for the pump is required from the Contractor within 15 calendar days of the NTP.

3.15 Bid Item 13 - Electrical: MCC & Switchboard, Portable Generator Connection, etc

- A. Lump sum Bid Item for Contractor costs to provide and install the new MCC, switchboard, portable generator hookup, and all well building electrical.
- B. <u>Submittal for the MCC equipment is required from the Contractor within 45 calendar days</u> of the NTP.

3.16 Bid Item 14 – SCADA and Telemetry

A. Lump sum Bid Item for Contractor costs to provide and install SCADA telemetry communications equipment, hardware and software, electrical, and integration of new well process data points to the existing TVMWD SCADA system. Contractor shall coordinate the MCC installation and equipment with TVMWD 's SCADA integrator's design and provided PLC.

3.17 <u>Bid Item 15 – Yard, Electrical and Security, Future Conduits</u>

A. Lump sum Bid Item for Contractor costs to provide and install electrical features in the site yard including building and site power, security, motorized gates, lighting, and future conduits.

3.18 Bid Item 16 – Miscellaneous Electrical Improvements

A. Lump sum Bid Item for Contractor costs to provide and install miscellaneous electrical required to provide full function to all instruments and features shown in the plans. Electrical power, communications, wiring and conduits shall be provided to enable full function of all systems in the project design documents.

3.19 Bid Item 17 - Pressure Testing and Disinfection of Piping and Equipment

A. Lump sum Bid Item for Contractor costs to provide all materials and perform pressure testing and disinfection of piping and equipment installed as part of the project work.

3.20 Bid Item 18 – Startup and Testing and Training

- A. Lump sum Bid Item for Contractor costs to provide all materials, pump and other equipment supplier representatives onsite and remote assistance, to perform startup and testing of the project new equipment and pumping systems. The startup shall include the new pump, its motor control center, remote SCADA connections, instrumentation calibrations, and provide equipment adjustments modifications or additions as needed.
- B. Work to be paid for under this item shall include the development and the review process for the new pump system and equipment operations and maintenance manuals to be developed and provided by the Contractor.
- C. Work to paid under this item includes the training of the TVMWD staff on the new project installed systems and review with staff the Contractor provided O&M manuals. testing for asbestos and other hazardous materials before demolition, removal, handling, and legal disposal of asbestos or other hazardous materials, including remediation, encapsulation, transportation, and applicable landfill and disposal fees.
- D. Work to be paid under this item includes providing a written statement from the pump supplier that the pump installation, and startup and testing results meet the supplier's requirements for warranty enforcement as witnessed by their onsite representative.

3.21 Bid Option Item O-1 – Option for Field Orders

- A. Bid Option 1 has been set aside for procurement and installation of noise abatement materials as shown in the plans.
- B. This Bid Option may be omitted at the discretion of the District.

END OF SECTION

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T-SECTION 01 29 73 SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 Work Included

- A. This section describes preparation of Schedule of Values providing breakdown of labor, materials, tools, equipment and other costs for measurement and payment purposes.
 - 1. Schedule shall show division of Work between Contractor and each Subcontractor.
 - 2. Break Schedule of Values down according to each Specification Division within each project area or structure on site.
 - 3. Include item in Schedule for County and State taxes plus cost items for bond, insurance, temporary facilities and mobilization.
 - 4. Schedule shall itemize items for purchase/delivery, costs for each item and material for which Contractor will request payment prior to installation.
 - 5. Each item shall include overhead and profit directly proportional to direct cost of that item over total Contract cost.
- B. Refer to General Provisions §C-29 "Payments to Contractor" for additional requirements for schedule of values.
- C. Refer to Special Provisions §D-6 "Breakdown of Contract Price" for additional requirements for schedule of values.
- D. Provide Schedule of Values breakdown:
 - 1. On lump sum Bid Items >\$25,000.
 - 2. On smaller lump sum Bid Items where Contractor desires to break down Work items for their convenience or to facilitate payment.
- E. Assign prices to Bid Items which aggregate to Contract Price.
 - 1. Base prices on costs associated with scheduled activities for each Bid Item.
- F. Finalized Schedule of Values will not be accepted until Contractor has responded to Owner's review comments.
 - 1. Provide supporting data, including certified payrolls, as requested by Owner's Representative for Schedule items.
- G. Prepare Schedule of Materials and Equipment Costs providing information necessary for Owner to document asset valuations for Owner's Asset Management program.

1.2 Related Work

- A. Section 01 21 00: Allowances
- B. Section 01 22 00: Unit Prices
- C. Section 01 32 00: Construction Progress Documentation

1.3 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for schedule of values.

PART 2 – MATERIALS (not used)

PART 3 – EXECUTION

3.1 Submittals

A. Submit Schedule of Values and Schedule of Equipment and Materials Costs deliverables as described herein and in accordance with the following timeline:

DELIVERABLE	SUBMITTAL TIME
Preliminary Schedule of Values (Categories Only)	Within 10 Calendar Days from Notice of Award

Schedule of Values	Within 21 Calendar Days from Notice of Award
Schedule of Values; review and resubmittal	Within 28 Calendar Days from Notice of Award
Schedule of Equipment and Materials Costs	Coincident with first submittal of O&M manuals / record
	drawings

B. Upon request, support prices with data which will substantiate their correctness.

3.2 Schedule of Values

- A. Submit Schedule of Values listing each Bid Item identified in Bid Schedule and breaking down large Bid Items for major subcomponents of Work.
- B. Schedule of Values shall contain itemized list of Bid Items and also include detailed breakdown of lump sum or unit price Bid Items >\$25,000 (before extension) to facilitate payment and Owner's asset management.
- C. Schedule of Values may contain additional breakdown where desired to substantiate requests for partial payment as Work progresses.
- D. Separate Work under bid items as follows:
 - 1. Where Work occurs at multiple sites, itemize value of Work at each site.
 - 2. Where Work occurs within multiple structures, itemize value of Work within each structure.
 - 3. Where Work is divided between Work within structures, in yard, and/or offsite Work, separate value of Work by structure, yard, and off-site Work.
 - 4. Where Work supports multiple large (and different) equipment items, separate value of Work by equipment category supported.
 - 5. Where Work supports multiple utilities separate Work by utility type.
- E. Itemize proposed values for the following major Work components.
 - 1. Total value of Division 1 Overhead and General Requirements Work.
 - a. Separate by milestones for mobilization, ongoing expenses, and startup-commissioning.
 - 2. Total value of Division 2 demolition Work
 - 3. Total value of Division 3-6 structural Work.
 - a. Itemize value of earthwork, subgrade preparation, concrete foundation, concrete slabs, concrete columns, concrete roofs, concrete stairs, masonry walls, metal framing, metal roofing, wood framing, and wood roofing as appropriate.
 - b. Minor structures valued at < \$25,000 may be listed as 1 item.
 - 4. Total value of Division 7-14 architectural Work.
 - a. Itemize value of thermal and moisture protection, openings, finishes, and other Work as appropriate.
 - b. Itemize fieldstone cladding of the building exterior
 - 5. Total value of Division 21-23 mechanical Work.
 - a. Itemize value of fire suppression, plumbing, and HVAC Work as appropriate.
 - 6. Total value of Division 25-28 electrical Work
 - a. Separate electrical yard facility work by duct bank designation and substations.
 - b. Itemize value of conduit-raceways, cable-wire installation, switchgear, equipment installation, communications, electronic safety-security, terminations, and lighting as appropriate.
 - c. Itemize MCC installation work
 - d. Itemize VFD controls systems.
 - e. Itemize SCADA related work.
 - 7. Total value of Division 31 and 32 civil site Work.
 - a. Itemize value for clearing and grubbing, earthwork, import or export, finish grading, base courses, asphalt paving, concrete paving, fencing and site improvements, irrigation, and planting as appropriate.
 - 8. Total value of Division 33 utilities Work

- a. Itemize breakdown by each utility category (water, recycled water, wastewater, stormwater, fuel or natural gas, hydronic or steam, electrical, and communications as appropriate.
- b. Itemize value of each pipeline.
- 9. Total value of Division 40-48 process Work.
 - a. Provide itemized breakdowns for each major improvement.
 - b. Provide itemized breakdowns for site preparation, piping systems, major equipment items, instrumentation, and telemetry-control,
- F. Contractor and Owner's Representative shall meet and jointly review preliminary Schedule of Values and make adjustments in value allocations if, in Owner's opinion, these are necessary to establish fair and reasonable allocation of values for major Work components.
 - 1. Front end loading will not be permitted.
 - 2. Owner may require reallocation of major Work components from items in above listing if in opinion of Owner's Representative such reallocation is necessary.
- G. Owner shall be sole judge of acceptable numbers, details and description of values established.
 - 1. If, in Owner's Representative's opinion, more Schedule of Values items are necessary than proposed, add additional items and provide greater detail as requested.
 - 2. Make adjustments deemed necessary to value allocation or level of detail and submit revised detailed Schedule of Values to Owner for record.

3.3 Changes to Schedule of Values

- A. Changes to CPM Schedule to add activities not included in original schedule but included in original work (schedule omissions) shall have values assigned as accepted by Owner's Representative.
 - 1. Reduce other activity values to provide equal value adjustment increases for added activities as approved by Owner.
- B. If Contractor and Owner agree to adjust original Schedule of Values because of inequities discovered in original accepted detailed Schedule of Values, increases and equal decreases to values for activities may be made.

3.4 Schedule of Materials and Equipment Costs

- A. Submit Schedule of Materials and Equipment Costs for items as described herein and shown in example below to establish baseline value for Owner's Asset Management system.
- B. The following does not represent complete list of materials and equipment required for this project.

EXAMPLESCHEDULE OF EQUIPMENT AND MATERIALS COSTS

EQUIPMENT / MATERIALS / FUNCTION / DESCRIPTION	SIZE / CAPACITY	DESCRIPTION / MFG / MODEL NUMBER	LOCATION	MATERIALS COST (UNIT PRICE)	ESTIMATED INSTALLED COST (UNIT PRICE)
Sewer Force Main	6"	DIP, Class 350, restrained joint, ceramic epoxy lined	Buried	\$54/LF	\$75/LF
Magnetic Flow Meter	4"	E+H, Proline Promag 53W1H- ULGBAA0BAAA1	Lift Station Discharge Piping	\$3,750	\$5,000
Submersible Sewage Pump	5 hp, 125 gpm	KSB, Model KRT E 80- 200/34XG	Lift Station Wet Well	\$5,250	\$7,500
Swing Check Valve	4"	APCO, 6000 series	Lift Station Discharge Piping	\$775	\$1,100

C. Provide required information for equipment and materials listed in Owner-furnished equipment and materials cost spreadsheet.

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T-SECTION 01 78 36 PRODUCT WARRANTIES

PART 1 - GENERAL

1.1 Work Included

- A. Warranties are required for all Work furnished under this contract.
- B. Refer to General Provisions §C-28 "Guarantee" for additional requirements for warranties.
- C. Refer to Special Provisions §D-40 "Guarantee" for additional requirements for warranties.
- D. Manufacturer's warranties shall not relieve Contractor of liability required under Contract Documents.
 - 1. Such warranties only shall supplement Contractor's responsibility.
- E. Where Manufacturer's advertised warranty exceeds minimum warranty requirements stipulated, Manufacturer's advertised warranty shall remain in force for duration of advertised warranty period after Contract-stipulated warranties have expired.

1.2 Related Work

- A. Section 01 22 00: Unit Prices
- B. Section 01 33 00: Submittal Procedures
- C. Section 01 40 00: Quality Requirements
- D. Section 01 75 00: Starting and Adjusting
- E. Section 01 77 00: Closeout Procedures

1.3 Submittals

A. Furnish the following submittals.

	J	
SUBMITTAL DESCRIPTION		
Warranty	For equipment bearing Manufacturer's warranty in excess of one year, furnish copy	
	of warranty to District with District named as beneficiary.	

1.4 <u>One-Year Product Warranties</u>

- A. Warranties shall cover improper assembly or erection, defective workmanship and products, and incorrect or inadequate operation.
- B. Warranties shall contain no disclaimer limiting liability to purchase price of products or materials.
- C. Furnish 1-year warranty for Work and manufactured items unless otherwise stated.
 - 1. Warranty shall cover parts, labor, and prompt service for repair of defects, performance failure or damage due to normal wear and tear or due to any cause other than acts of God, or intentional or active and extreme abuse of product.
 - Warranty period shall extend 1 year beyond Final Acceptance of completed contract by District.
- D. In addition to Manufacturer's standard warranty, furnish services of factory-authorized and factory-trained service technician to promptly provide repair service for equipment for specified warranty period.
 - 1. This service shall be provided at no cost to District and shall include cost of replacement parts and labor required during warranty period.
- E. Correct within 10 Calendar Days following receipt of notice from District of unsatisfactory material or workmanship which may be discovered during warranty period.
- F. Correct unsatisfactory material or workmanship without extra charge, notwithstanding that faulty Work may have been overlooked in prior inspections and accepted by District.

1.5 Inspection of Installation by Manufacturer

- A. Should Manufacturer or supplier of any product have reason to suspect said Manufacturer's product has not been installed in accordance with Manufacturer's warranty requirements, Manufacturer shall have right to send their factory authorized representative to inspect facility prior to Final Acceptance.
- B. Should Manufacturer's factory-authorized representative elect to inspect installation, Manufacturer shall promptly notify District in writing of observed deficiencies in installation procedures which might affect required warranty.
- C. Should Manufacturer elect to forego inspection of installation of their products, Manufacturer shall be precluded from claiming faulty installation by others as relief from honoring furnished warranties.

1.6 Eleven-Month Anniversary Warranty Inspection

- A. Warranty inspection will be conducted during 11th month following completion of Work and prior to release of bonds.
- B. District will establish date for warranty inspection and will notify Contractor at least 30 Calendar Days in advance.
 - 1. If notification of inspection date does not occur within 12 months after final acceptance, first anniversary inspection shall be considered to be waived.
- C. Warranty Inspection Report will be prepared by District's Representative and delivered to Contractor.
 - 1. It will set forth the number and type of failures observed and names of persons making inspection.
- D. Locations found in warranty inspection where paving, coating, or paint has peeled, bubbled, or cracked, and locations where rusting is evident will be considered system failures.
 - 1. Repair defective work identified during warranty inspection by removing deteriorating paving, coating or paint system, cleaning surface, and repaving, recoating, or repainting with same system. Electrically test repaired painted areas.
- E. If area of failure >25% of total paved, coated or painted area on any structure or surface, remove and recoat entire paving, coating or paint system per original specification.
- F. Repair other failed products found in warranty inspection per warranty requirements.

1.7 Three-Year Product Warranties and Other Extended Warranties

- A. 3-year warranty shall be 3-year parts-and-labor non-prorated warranty extending from date of District's final acceptance.
 - 1. Warranty need not exceed 5 years from date of shipping.
- B. Extended warranties shall cover parts, labor and prompt service for repair of defects, performance failure or damage due to normal wear and tear, or due to any cause other than acts of God, District's failure to perform minimum maintenance as set forth in O&M instructions furnished with warranty, or intentional or active and extreme abuse of product.
 - 1. Warranty period shall extend stipulated number of years beyond Final Acceptance of completed contract by District.
 - 2. Extended warranties shall cover District's full cost of restoring non-functional components to their full function as described in Contract Documents and in Manufacturer's published literature.
 - 3. Prorated warranties will not be accepted.
 - 4. Replacement of damaged parts with old or recycled parts will not be accepted.
- C. Should Manufacturer refuse to provide full extended warranty, Contractor may be required to purchase extended warranty or negotiate with District to compensate District with fair value for shorter warranty period.
- D. Repair or replace Work that may prove to be defective in workmanship and/or materials within warranty period, along with Work which may be damaged or displaced during performance of warranty Work, at no additional expense to District.

- E. Where sections of specifications stipulate longer warranty period than stipulated in this section, the longest and most stringent warranty requirement shall apply.
- F. Warranty period shall begin on the earliest of 2 milestones:
 - 1. Date of formal notification of completion or
 - 30 Calendar Days after both substantial completion and District taking over beneficial use of project.
- G. Warranties shall cover:
 - 1. Parts
 - 2. Labor
 - 3. Servicing
 - 4. Removal or Installation Charges
 - 5. Setup and Reconfiguration of System with Replacement Parts
 - 6. Shipping
- H. Replace defective parts with new parts.
- I. Where part is replaced during warranty period, extend warranty for replaced part and shipping to at least1 year following replacement date.
 - 1. Warranty for labor shall be unchanged.
- J. In emergency situations, if warranty service is not immediately available from Manufacturer, District will perform repairs to re-establish proper operation of actuator and valve.
- K. Maintenance or repair work performed by District during warranty period shall not be cause for voiding warranty.
- L. Following notification of Contractor of extended warranty issue, Contractor or their agent shall have 10 Calendar Days to inspect and 30 Calendar Days to remedy defective work.
- M. Failure to perform within this stipulated period will result in damages being assessed against Contractor and responsible parties retroactive to date of discovery.

1.8 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for product warranties.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION (not used)

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T- ECTION 01 79 00

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 Work Included

- A. System demonstration and commissioning.
- B. Requirements for equipment Manufacturer's services.
- C. Training of Owner's personnel.
- D. Refer to Section 01 75 00 for requirements for pre-operational checkout of equipment prior to System Demonstration.
- E. Design testing procedures to replicate, as nearly as possible, conditions of operation.
- F. Carefully design testing procedures to ensure equipment is not damaged.
- G. Once testing procedures are accepted by Owner's Representative, provide checkout, alignment, adjustment and calibration sign off forms for each item of equipment.
 - 1. Forms will be used in field by Contractor and Owner's Representative jointly to ensure each item of electrical and mechanical equipment is properly installed and tested.
- H. Complete specified testing and system demonstration prior to startup.
- I. Contractor is advised that failure to observe these procedures may place acceptability of Work into question.

1.2 Related Work

- A. Section 01 22 00: Unit Prices
- B. Section 01 33 00: Submittal Procedures
- C. Section 01 75 00: Starting and Adjusting
- D. Section 01 78 23: Operation and Maintenance Data
- E. Section 01 78 43: Spare Parts

1.3 System Description

- A. Proceed in logical, step-wise sequence to demonstrate equipment has been properly serviced, aligned, balanced, connected, calibrated, and adjusted prior to operation.
- B. Manufacturer's representatives during startup shall be factory-authorized personnel with full authority granted by Manufacturer to perform, supervise, and direct start-up and remedial Work and issue certifications required of Manufacturer.
- C. When specified in individual Specification sections, arrange and pay for material or equipment suppliers or Manufacturers to provide qualified personnel (field service representatives) to perform the following:
 - 1. Observe site conditions, conditions of surfaces and installation, and quality of workmanship.
 - 2. Assist during product (system, subsystem, or component) installation to include observation, guidance, instruction of applicator's or installer's assembly, erection, installation or application procedures.
 - 3. Inspect, check, and adjust as required for product (system, subsystem, or component) to function as warranted by Manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.
 - 4. Revisit site as required to correct problems and until installation and operation are acceptable to Owner's Representative.
 - 5. Resolve assembly or installation problems attributable to, or associated with, respective Manufacturer's products and systems.

- 6. Perform and record results of Manufacturer's standard and recommended inspections, functional and performance testing, inspections and tests specified in these documents, and startup and evaluation of installed Work.
- 7. Supply required test equipment.
- 8. Be responsible for protection of material and equipment and safety of personnel during testing.
- 9. Instruct and supervise field repairs and adjustments.
- 10. Train Owner's personnel in operation and maintenance of respective product as required.
- 11. Perform other services normally provided by field representative's company or specified elsewhere in these Specifications.

1.4 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Manufacturer's	For items requiring warranties exceeding one year, submit daily copies of Manufacturers'	
Inspection Reports and	representatives' field notes, data, and reports of Manufacturer's field activities, actions	
Certificate of Proper Installation taken, and test results to Owner's Representative within 30 days of completion. If activities are at end of Contract duration, complete actions within Contract Time		
	For items requiring warranties exceeding one year, submit Manufacturer's Certificate of	
	Proper Installation.	
System Demonstration	Submit prior to receipt of progress payments in excess of 60% of Contractor's total bid	
Plan	amount for Work.	
	Describe each system to be tested, functional test methods, test materials, test	
	instruments and recorders, and results to be recorded.	
	List requirements necessary to demonstrate successful operation.	
	Submit step-by-step description of materials, equipment, and personnel required.	
	Identify duration of testing and startup operations.	
	Include continuous 72-hour demonstration of operation of entire installed system.	
	Shorter demonstration period may be authorized by Owner's Representative if external	
	constraints make 72-hour test impractical.	
	Demonstrate operation of instruments, set points, alarms, telemetry, software, safety	
	interlocks, protective logic functions, and back-up operation modes.	
	Incorporate Manufacturer's start-up and demonstration procedures.	
	Owner may modify proposed procedures as deemed necessary to demonstrate system	
	operation.	
	Operate new equipment through entire no-load to full-load range	
	Submit sample testing signoff forms for equipment and systems to be tested.	
Testing Signoff Forms	Submit blank forms 7 Calendar Days prior to start of System Demonstration.	
System Demonstration	Submit for final operations test period.	
Log		
Training Schedule	List specified equipment and systems requiring training services and show	
	Respective Manufacturer	
	Estimated dates for installation completion	
	3. Scheduled training dates.	
	Update and adjust schedule to ensure training of appropriate personnel deemed	
necessary by Owner and to allow full participation by Manufacturer's repr		
	Adjust schedule for interruptions in operability of equipment.	
Training Outline Submit for instruction program for Owner's personnel		
	See requirements below in Part 3.	
Lesson Plan	Submit at least 30 calendar days prior to scheduled training for Owner's personnel.	
	See requirements below in Part 3.	

1.5 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for demonstration and training.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION

3.1 Preparation

- A. Notify Owner's Representative of time and place of system demonstrations at least 14 Calendar Days before they begin.
- B. Arrange for representatives of equipment suppliers and subcontractors to be present as required to successfully demonstrate installed system.
- C. Provide gages, meters, recorders and monitors as required to supplement or augment instrumentation system provided under this contract to properly demonstrate equipment fully satisfies requirements of Contract Documents.
 - Specifically select devices employed for purpose of measuring performance of facility's equipment and systems to provide level of uncertainty consistent with variables to be monitored.
 - 2. Instruments shall be recently calibrated.
 - 3. Be prepared at all times to demonstrate, through re-calibration, uncertainty of instruments employed for testing purposes.
 - 4. Perform calibration procedures in accordance with applicable standards of ASTM, ISA and IEEE.
 - 5. Adequacy of gages, meters, recorders and monitors shall be subject to review of Owner's Representative.
- D. Furnish and install temporary valves, fittings, bulkheads, taps or other items necessary for system demonstration.
- E. Unless otherwise specified, provide at no expense to Owner, power, fuel, water, power, utilities, supplies, lubricants, chemicals, materials, replacement parts, testing equipment, testing media, labor and necessary items and Work required to complete specified tests, inspection, and system demonstration.
 - 1. Provide at no expense to Owner temporary heating, ventilating and air conditioning for areas requiring it where permanent facilities are not complete and operable at time of installed tests.
 - 2. Maintain temporary facilities until permanent systems are in service.
- F. Before system demonstration complete the following:
 - 1. Identify and label equipment with nameplates.
 - 2. Remove shipping blocks.
 - 3. Clean equipment.
 - 4. Repair damaged or scratched finishes.
 - 5. Inspect for broken and missing parts
 - 6. Review and collect Manufacturer's Installation Instructions and Shop Drawings for delivery to Owner's Representative.
- G. Prior to system demonstration, provide test runs described in Section 01 75 00 to verify parts and subsystems are in place and in working order.
 - Owner's costs for delays during system demonstration due to Contractor's failure to pretest system and verify products are in place and functional will be back-charged to Contractor.
- H. Provide signoff forms for installed and operational testing to be accomplished under this contract.
 - 1. Provide sign off forms containing provisions for recording relevant performance data for original testing and at least 3 re-tests for each item of mechanical, electrical and instrumentation equipment provided or installed under this contract.
 - 2. Provide separate sections to record values for pre-operation checkout, initials of representatives of equipment manufacturers, Contractor and Owner's Representative.

- 3. Sign off forms shall include motor and driven device on same form and provide at least the following information:
 - a. Equipment name
 - b. Manufacturer
 - c. Model
 - d. Serial Number
 - e. Equipment tag number
 - f. Diagram showing bearing locations
 - g. Operating parameters
 - h. Test equipment
 - i. Witness signatures
 - j. Date
- I. Maintain master file of equipment sign off sheets, which shall be available for inspection by Owner's Representative.
 - 1. Upon completion of testing, furnish Owner's Representative with original and two copies of sign off sheet for each equipment item.
- J. Following system demonstration, start-up shall only be attempted as function of normal plant operation in which plan process flows and levels are routine and equipment operates automatically in response to flow and level parameters shall be considered only upon receipt of written request by Contractor.

3.2 System Demonstration

- A. System demonstration shall conform to Owner-accepted System Demonstration Plan submittal.
- B. Perform systems demonstration in presence of Owner's Representative who will record results on sign-off forms submitted.
 - 1. Start up and operate individual subsystems, pieces of equipment, instruments, and other Work.
- C. Proceed with testing on step-by-step basis in accordance with Contractor's submitted and accepted System Demonstration Plan.
 - 1. Each individual step in procedures shall be witnessed by Owner's Representative.
- D. Contractor's testing Work shall be accomplished by skilled team of specialists under direction of coordinator whose sole responsibility shall be orderly, systematic testing of equipment, systems, structures and complete facility as a unit.
 - 1. Operate equipment and systems during plant operational testing period, to greatest extent practicable, at conditions which represent full range of operating parameters as defined by Contract Documents.
- E. Disassemble, inspect, and replace defective components of equipment exhibiting unusual or unacceptable operating characteristics.
- F. Failure to meet specified requirements shall be cause for retesting at Contractor's expense until requirements are met.
 - 1. Interruption of continuous operation test due to equipment malfunction shall be cause to restart test after repairs.

3.3 Field Quality Control

A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Finished	Installation &	Visual inspection of finished installation	1 inspection	Owner	Owner
Installation	Leakage				
	Motor	Before energizing machines, visually	All motors	Contractor	Contractor
	Installation	inspect for serviceability.			

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
		Check Manufacturer's Installation Instructions for correct lubrication and ventilation. Align motors with driven equipment. Check nameplate for electrical power requirements.			
	Motor Insulation	Test motor insulation winding to winding with ohmmeter or micro-ohmmeter and record results	All motors	Contractor	Contractor
	Motor Test Run	Test run motors uncoupled or unloaded before placing into operation. Check motor for rotation, speed, current, and temperature rise under normal load and record results.	All motors	Contractor	Contractor
		Maintain proper color codes for phase identifications. This may require lead swaps at motor for proper rotation. Use motor phase rotation meter prior to lead connection at motor to minimize alter-swaps	All motors	Contractor	Contractor
	System Demonstration	Demonstrate compliance to Contract Documents and Manufacturer's printed literature using accepted system demonstration plan described above	One 72-hour demonstration without interruption. (If test is interrupted, clock restarts at zero for 72-hour demonstration)	Contractor (Owner will pay for test water)	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

- B. Provide qualified technicians and calibrated test instruments as needed to perform tests.
 - 1. Provide certifications for test instruments.
 - 2. Since coordination with other crafts and Contractors will often be required, workers assigned to checkout shall be available outside normal working hours when necessary.
- C. In addition, furnish Contractor's personnel, as needed, to make adjustments or alterations recommended by equipment Manufacturer's representatives.
- D. Promptly correct defects and malfunctions disclosed during System Demonstration, including malfunctions of equipment or control systems, leakage, excessive vibration and excessive noise.
 - 1. Work failing to perform its intended function, and which cannot be repaired, shall be replaced with new equipment.
- E. Following testing, remove bulkheads and temporary equipment.
- F. Dispose of test water according to local regulations and NPDES requirements.
- G. Inspect for loose connections, leaking fluids, and any irregularities.
- H. Check field-aligned equipment for required alignment and realign if necessary.

3.4 Training of Owner's Personnel

A. Training shall take place on-site or in Owner's offices.

- B. Do not commence training of Owner personnel prior to substantial completion of Work, unless accepted in writing by Owner.
- C. After functional testing is complete, conduct training and instruction program on system operation for Owner-designated personnel.
- D. Furnish services of qualified factory-trained and authorized instructors from applicable equipment Manufacturers, subject to acceptance by Owner.
 - 1. Factory-trained instructors shall be familiar with Owner's facility operation requirements in addition to being familiar with their products.
 - 2. Factory-trained instructors shall be fluent in written and spoken English.
 - No substitute instructors will be accepted unless prior written acceptance is obtained from Owner.
- E. Include instruction covering:
 - 1. Overview of system,
 - 2. Basic operation theory,
 - 3. Preventative maintenance,
 - 4. Routine maintenance and repair,
 - 5. Safety procedures,
 - 6. "Hands-on" operation of equipment.
- F. If not otherwise specified, base duration of program on complexity of equipment involved.
 - 1. Obtain Owner's acceptance of instruction adequacy before terminating program.
- G. Consult Owner to schedule instruction.
- H. Provide accepted Operation and Maintenance Manual for specific pieces of equipment or system at least 10 Working Days prior to training session for that piece of equipment or system.
- I. Provide combination of classroom and field/machine shop training.
 - 1. Conduct classroom training at Owner's specified location.
- J. Provide "hands-on" demonstrations of common troubleshooting and corrective maintenance repairs as described in Contractor's proposed Lesson Plan.
 - 1. Provide tools and equipment to conduct demonstrations.
 - 2. Submit requests for supplemental assistance and facilities with proposed Lesson Plan.
- K. As part of training, provide attendees with names, contact persons, telephone numbers and addresses of authorized service centers within 100-mile radius of jobsite for equipment on which training is taking place.
- L. System demonstration testing, final operation testing, and instruction of Owner's personnel may be performed simultaneously, subject to prior approval of extent of consolidation.
- M. The following training is required:

		CLASSROOM	FIELD	APPROXIMATE
ITEM	LOCATION	TRAINING DURATION	TRAINING DURATION	NUMBER OF ATTTENDEES
System Overview	On-site	2 hours	2 hours	3-12 people
Pilot-Operated Control Valves	On-site	2 hours	2 hours	3-12 people

3.5 Lesson Plan

- A. Include in Contractor's proposed Lesson Plan, as a minimum, elements presented in Outline of Lesson Plan below.
 - 1. Identify specific components and procedures in proposed Lesson Plan, and tailor it to Owner's needs.
- B. Submit resumes of instructors providing training.
- C. Detail specific instruction topics in Contractor's proposed Lesson Plan.

- D. Reference training aids to be used in instruction and attach where applicable to proposed Lesson Plan.
 - 1. Describe "Hands-On" demonstrations planned for instruction.
- E. Use submitted Operation and Maintenance Manuals as basis for instruction.
- F. Submit schedule of dates and estimated duration of each segment of training Lesson Plan.
- G. Allow for multiple sessions when several groups or shifts are involved.
- H. Lesson Plan Outline
 - 1. General Information
 - a. Identify course title and objectives.
 - b. Identify recommended types of attendees (e.g. managers, engineers, operators, maintenance.)
 - c. Identify suggestions for audiovisual equipment to be provided by Owner.
 - d. Provide brief course description and course content.
 - e. Describe format of classroom training (lecture, demonstration) and field training (demonstration, or hands-on)
 - f. Identify handout materials.
 - g. Identify supplementary self-study materials
 - 2. Equipment Operation
 - a. Describe equipment's operating (process) function.
 - b. Describe equipment's fundamental operating principals and dynamics.
 - c. Identify equipment's mechanical, electrical and electronic components and features.
 - d. Identify support equipment associated with operation of subject equipment (i.e., air intake filters, valve actuators, motors).
 - e. Provide standard operating procedures to cover start-up, routine monitoring and shut-down of equipment.
 - f. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each equipment item.
 - g. For equipment or systems requiring seasonal operation or maintenance, perform demonstration of required O&M procedures for all seasons.
 - h. Describe emergency procedures, interlocks, and safety items and procedures, such as lock-out/tag-out.
 - i. Prepare and insert additional data in Operations and Maintenance Manuals when need for additional material becomes evident during instruction.
 - 3. Detailed Component Description
 - a. Identify and describe in detail each component's function.
 - b. Where applicable, group related components into subsystems.
 - c. Describe subsystem functions and their interaction with other subsystems.
 - d. Identify and describe in detail equipment safeties and control interlocks.
 - 4. Describe Preventive Maintenance (PM)
 - a. Describe PM inspection procedures required to:
 - b. Perform inspection of equipment in operation.
 - c. Spot potential trouble symptoms (anticipate breakdowns).
 - d. Forecast maintenance requirements (predictive maintenance).
 - e. Define recommended PM intervals for each component.
 - f. Provide lubricant and replacement part recommendations and limitations.
 - g. Describe appropriate cleaning practices and recommended intervals.
 - 5. Equipment Troubleshooting
 - a. Define recommended systematic troubleshooting procedures.
 - b. Provide component specific troubleshooting checklist.
 - c. Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.
 - 6. Equipment Corrective Maintenance
 - a. Describe recommended equipment preparation requirements.
 - b. Identify and describe use of any special tools required for maintenance of equipment.

- c. Describe component removal/installation and disassembly/assembly procedures.
- d. Perform at least 2 "hands-on" demonstrations of common corrective maintenance repairs.
- e. Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
- f. Define recommended torqueing, mounting, calibration and/or alignment procedures and settings, as appropriate.
- g. Describe recommended procedures to check/test equipment following corrective repair.

3.6 Training Aids

- A. Incorporate training aids as appropriate to assist in instruction.
 - 1. At minimum, include text and figure handouts with training aids.
 - 2. Other appropriate training aids are:
 - a. Audio-visual aids (e.g., films, slides, videotapes, overhead transparencies, posters, blueprints, diagrams, catalogue sheets).
 - b. Equipment Cutaways and Samples (e.g. spare parts, damaged equipment).
 - c. Tools (e.g. repair tools, customized tools, measuring and calibrating instruments).
- B. Furnish complete training materials to include Operation and Maintenance data to be retained by each trainee.
- C. Contractor's instructor shall use descriptive class handouts during instruction.
 - 1. Provide quality reproductions of photocopied class handouts.
 - 2. Provide class handouts during instruction with frequent references made to them.
 - 3. Customized handouts developed especially for instruction are encouraged.
 - 4. Attach handouts planned for instruction with Contractor's proposed Lesson Plan.

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SECTION 01 01 02 - SITE GEOTECHNICAL REPORT

PART 1 - GENERAL

The following section contains the geotechnical soils report for the site.

SECTION 01 01 01 - CEQA MITIGATION MEASURES AND REQUIREMENTS

PART 1 - GENERAL

The follow excerpt from the project CEQA study and contains requirements the Contractor shall adhere to all times. The full document is available upon request.

SECTION 01 00 00 – GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. The General Conditions apply to all divisions and sections of this Engineering Specification, which shall be used to perform work as shown on the plans and as specified, and shall be properly coordinated with work as described in the related Specifications.
- B. The Drawings and these Specifications are complementary to each other; what is called for by one shall be as binding as if called for by both. If there is any conflict between what is shown on the drawings and what is written in the Specifications, the details described on the drawings shall take precedence and the CONTRACTOR shall communicate the conflicts to the ENGINEER in a timely manner.

C. Safety

1. The CONTRACTOR shall be familiar with, and shall at all times conform to the regulations of the "OSHA General Industry Occupational Safety and Health Standards," "OSHA Safety and Health Regulations for Construction," and other applicable state and municipal standards and regulations.

1.02 REFERENCED SECTIONS – NONE

1.03 CITED STANDARDS

- A. Standards listed as "Reference Standards" in the various sections of these contract documents are hereby incorporated into these Specifications by reference.
- B. Referenced documents shall include all revisions, amendments, supplements, or addenda issued on or before the date of advertising for bids.
- C. All specification sections included shall conform to the requirements of the following standard specifications, of the latest revisions, as applicable:
 - 1. State Standard Specifications, Issued by: Department of Transportation, 2009.
 - 2. NSF 60 Drinking Water Treatment Chemicals Health Effects
 - 3. NSF 61 Drinking water system components Health effects, Editorial revision to NSF/ANSI 61 2002

1.04 NOTED RESTRICTIONS – NONE

1.05 QUALITY CONTROL

- A. Best Management Practices (BMPs)
 - 1. Best Management Practices (BMPs) related to the work of this project are found in the following sections and their sub-sections:
 - a. SECTION 01 40 00 QUALITY REQUIREMENTS

- b. SECTION 01 60 00 PRODUCT REQUIREMENTS
- 2. Additional BMPs may also be included throughout specific sections of each Division of these specifications in order for the CONTRACTOR to conduct work in an environmentally responsible manner.
- B. The ENGINEER shall be responsible for obtaining necessary permits for groundwater treatment work.
- C. The ENGINEER shall be responsible for submitting Notice of Intent (NOI) to State Water Resources Control Board for coverage under the most recent Construction General Permit for the discharge of storm water.
- D. Storm Water Pollution Prevention Plan
 - 1. The ENGINEER will be responsible for preparing the Storm Water Pollution Prevention Plan (SWPPP).
 - 2. The CONTRACTOR shall be responsible for implementation of the SWPPP.
- E. Water Quality Management Plan
 - 1. This project is subject to the requirements of the City's Storm Water and Urban Runoff Control Regulation Ordinance which implements the requirements of the Regional Water Quality Control Board's Water Quality Management Plan (WQMP) Prior to the issuance of any demolition, grading or construction permits for the project the Owner must receive approval of the WQMP. A WQMP has been submitted to the Department of Public Works. The Contractor shall coordinate its efforts in compliance with the substantial requirements of the WQMP. The substantial requirements of the WQMP have been incorporated into the drawings and such documentation is available to the Contractor prior to bidding upon request.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 78 39 – PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section includes the CONTRACTOR's requirements in regard to the project record documents.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. Prior to requesting final payment, the CONTRACTOR shall obtain and submit the following items to the OWNER or ENGINEER:
 - 1. Manufacturers' representatives' installation, testing and startup reports.
 - 2. Keying.
 - 3. Maintenance stock items, spare parts and special tools.
 - 4. Completed record drawings (also known as "As Built" drawings).
 - 5. Certificates of inspection and acceptance by local governing agencies having jurisdiction.
 - 6. Releases from all parties who are entitled to claims against the subject project, property or improvement pursuant to the provisions of law.
 - B. Record Drawings
 - 1. The Record drawings shall be kept current with the work and shall be subject to inspection by the ENGINEER at any time.
 - 2. Prior to acceptance of the work, the CONTRACTOR shall submit the record prints to the ENGINEER.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 78 23 – OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section includes the CONTRACTOR's requirements in regard to the facility's Operation and Maintenance Data. The CONTRACTOR has overall responsibility to obtain the necessary data from and compile the data as set forth in this specification, including items or equipment purchased by the OWNER and delivered to the CONTRACTOR for installation.
- B. The Operating and Maintenance (O&M) Manual is prepared to provide a ready reference to all important pieces of mechanical and electrical equipment installed on the project. It is also to provide the necessary operating and maintenance data for use by service personnel. It is also to provide information required for checking equipment performance or for planning of plant expansion or redesign.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. The O&M Manuals will be submitted in three-ring binder with insert labels in the cover and spine identifying the project and device name. Stick-on, taped or pasted labels are not acceptable.
 - B. Equipment will not be accepted until approval and submittal of final O&M manuals.

1.05 QUALITY CONTROL

- A. Operation and Maintenance (O&M) Manual
 - 1. For the O&M Manual, the Contractor shall provide, at a minimum, the following:
 - a. A comprehensive and applicable operating and maintenance manual.
 - b. Nameplate data including equipment identification number (as identified on the Drawings), model number, serial number, operating range, and power supply.
 - c. Manufacturer's instruction, description of system operation, start-up data, and troubleshooting lists.
 - d. Manufacturer's instructions, calibration schedule and instructions, lubrication schedule, and type and cleaning procedures.
 - e. Electrical wiring diagram and schematic.
 - f. Complete parts list identifying material of construction, and the manufacturer's recommended repair parts listing.
 - g. Name, address and phone number for manufacturer, sales representative and nearest parts warehouse.

- B. All information included shall be legible and sufficiently marked to indicate the exact size, model, type, etc., of equipment furnished and installed.
- C. The number of binders (or "volumes") required will depend on the amount of information to be catalogued.

1.06 SUBMITTALS

- A. The CONTRACTOR shall submit all approved O&M technical manuals to the ENGINEER. The ENGINEER will then prepare the O&M Manual.
- B. Manuals from the CONTRACTOR shall contain descriptive drawings and data which identify equipment installed at the project and detail the procedures and parts required to maintain and repair the equipment. Copies of approved submittals shall be included for all equipment.
- C. The ENGINEER submittals shall include the following:
 - 1. Two sets of the draft O&M manual shall be submitted for review.
 - 2. Four sets of the final O&M manual and an electronic copy on portable media drive(s) shall be submitted to the following:
 - a. Three sets and portable media drive(s) to the OWNER
 - b. One set for the ENGINEER
 - 3. The manuals will be submitted in a three-ring binder with insert labels in the cover and spine identifying the project and device name. Stick-on, taped or pasted labels are not acceptable.
 - 4. The quantities of drawings, manufacturer's literature, or other data required for these manuals are in addition to those otherwise required for normal distribution for approval during the construction period.
- D. Equipment will not be accepted until approval and submittal of final O&M manuals.

PART 2 - PRODUCTS

2.01 O&M MANUAL COMPONENTS

A. Page Size

1. All pages shall be standard 8-1/2" x 11" size or approximate multiples (preferably 17" x 11") folded to 8-1/2 x 11 inch manila pockets, which shall have standard three-ring side punching for insertion in the binders. The equipment name, drawing description and number shall be written on the face of each manila pocket.

B. Drawings

1. All drawings larger than 8-1/2" x 11" shall be folded and inserted in individual 8-1/2" x 11" manila pockets, which shall have standard three-ring side punching for insertion in the binders. The equipment name, drawing description and number shall be written on the face of each manila pocket.

C. Binders

- 1. Binders shall be Buckram binders with block lettering for sheet size 8-1/2" x 11" with 2" to 3-1/2" expandable metal capacity as required for the project. The number of binders, however, shall be based on not filling them beyond 4".
- D. The following information shall appear on the front cover and backbone of both the Well and Treatment Plant O&M Manuals, as applicable:
 - 1. "Operation and Maintenance Manual."
 - 2. Project Name (and volume number if more than one volume).
 - 3. OWNER's name.
 - 4. ENGINEER's name.
 - 5. General CONTRACTOR's name.
- E. Item 5 need not be printed on the backbone.
- F. Contents and Indexing:
 - 1. Manuals shall contain descriptions of the building systems in sufficient detail to adequately indicate the type of systems installed and the basic details of their operation.
 - 2. All purchased equipment data shall be used to designate the sections. Within each section additional indexing of component parts may be required.
 - 3. Operation and Maintenance Manuals shall contain to the fullest extent all possible information pertinent to the equipment. The arrangement and type of information to be filed shall be as follows:
 - a. Copy of purchase order change (if any).
 - b. Outline drawings, special construction details, "as built" electrical wiring and control diagrams for all major and supplementary systems.
 - c. Manufacturer's test or calculated performance data and certified test curves.
 - d. Installation, operating, and maintenance instructions, including a complete parts list and sectional drawing with parts identification numbers. Mark with model, size and plan number.
 - e. Manufacturer's brochure marked to indicate exact equipment purchased.

 Brochures on component parts supplied by a manufacturer with his equipment, but not manufactured directly by him, shall also be included.
 - f. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols.
 - g. Written warranties.
 - h. Include a Table of Contents. The contents shall be divided with tabbed index dividers into the following suggested parts:
 - 1) Building and System Descriptions
 - 2) Purchased Equipment Data
 - 3) Test Reports and Valve Charts

- 4) Start-Up and Operation
- 5) Preventative Maintenance Recommendations
- i. A copy of the approved submittals for each piece of equipment, and a copy of all testing, adjusting and balancing reports, and wiring diagrams marked with model and size and plan symbol.
- j. Operating and Maintenance Manuals data for Part I shall be obtained directly from the mechanical and electrical consultants. (Allow consultant preparation cost.)
- k. The index shall contain the name and address of the manufacturer and, if different, where replacement and repair parts may be obtained.

PART 3 - EXECUTION - NOT USED

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes requirements for closeout procedures, final cleaning, and project record documents.

1.02 REFERENCED SECTIONS

A. Related Sections are listed below:

- 1. SECTION 01 78 23 OPERATION AND MAINTENANCE DATA
- 2. SECTION 01 78 39 PROJECT RECORD DOCUMENTS
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL

A. Closeout Procedures

1. The CONTRACTOR shall make all repairs and replacements promptly upon receipt of written order from the OWNER / ENGINEER. If the CONTRACTOR fails to make such repairs or replacements promptly the OWNER / ENGINEER reserves the right to do the Work and the CONTRACTOR and his/her surety shall be liable to the OWNER for the cost thereof. Replacement of earth fill, backfill or resurfacing where it has settled below the required finish elevations shall be considered as part of such required repair work.

B. Final Cleaning

- 1. Final cleaning shall be executed prior to the final inspection.
- 2. The CONTRACTOR shall clean the site, sweep paved area, and clean any other surfaces.
- 3. Waste and surplus materials, rubbish and construction facilities shall be removed from the project and from the site.

C. Project Record Documents

- 1. Documents shall be stored separate from those used for construction.
- 2. The CONTRACTOR shall keep documents current and shall not conceal any work until required information has been recorded.
- 3. At Contract Closeout, the CONTRACTOR shall submit documents with a transmittal letter containing the date, project title, CONTRACTOR's name and address, list of documents, and the signature of the CONTRACTOR.

1.06 SUBMITTALS

- A. When the CONTRACTOR considers his/her work has reached final completion, the CONTRACTOR shall submit a certification that states that the Contract Documents have been reviewed, work has been inspected, and that the work is complete in accordance with the Contract Documents and is ready for the OWNER's inspection. The inspection shall include start-up and testing of all installed equipment.
- B. The request shall be made in writing, addressed to the ENGINEER, at least seven days in advance of the requested date of the final inspection.
- C. In addition to submittals required by the Conditions of the Contract, the CONTRACTOR shall provide submittals required by governing authorities, and shall submit a final statement of accounting giving the total adjusted contract sum, previous payments, and the sum remaining due.
- D. The OWNER will issue a final change order reflecting approved adjustments to the contract sum not previously made by change order.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 FINAL CLEANUP

A. The CONTRACTOR shall promptly remove, from the vicinity of the completed work, all rubbish, unused materials, concrete forms, construction equipment and temporary structures and facilities used during construction. Final acceptance of the Work by the ENGINEER will be withheld until the CONTRACTOR has satisfactorily complied with the requirements for final cleanup of the project site.

SECTION 01 75 13 – CHECKOUT PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section describes the Checkout Procedures to be performed by the CONTRACTOR. Equipment testing and plant startup are required for satisfactory completion of the contract and shall be scheduled and completed within the contract time.

1.02 REFERENCED SECTIONS

- A. Division 26 Electrical
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL

A. Equipment Testing

- 1. The CONTRACTOR shall provide the services of an experienced and authorized representative of the manufacturer of each item of equipment indicated in the equipment schedules that shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation.
- 2. The CONTRACTOR shall have the manufacturer's representative revisit the Work site as often as necessary until any and all problems are corrected.
- 3. The CONTRACTOR shall require that each manufacturer's representative furnish to the ENGINEER a written report addressed to the City certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts and has been operated satisfactorily under full-load conditions.
- 4. The CONTRACTOR shall be responsible for scheduling all operations testing. The CONTRACTOR shall furnish all personnel, power, water, chemicals, fuel, oil, grease and all other necessary equipment, facilities and services required for conducting the tests.
- 5. The CONTRACTOR is advised that the ENGINEER and operating personnel will witness operations testing and that the manufacturer's representative shall be required to instruct the operating personnel in correct operation and maintenance procedures.
- 6. This instruction shall be scheduled with the OWNER / ENGINEER at least ten (10) days in advance and shall be provided while the equipment is fully operational. The CONTRACTOR shall have previously furnished the technical manuals required under Sections 01 33 00 Submittal Procedures and 01 78 23 Operation and Maintenance Data.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION – NOT USED

SECTION 01 71 39 – DETOUR CONSTRUCTION AND FACILITIES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Detouring pedestrian and vehicular traffic includes but is not necessarily limited to:
 - 1. Regulating pedestrian and vehicular traffic in and around the perimeter of the work site.
 - 2. Maintaining the right of access of the public to private property unless closure is contemplated.
 - 3. Notifying public of intended closures of access to private properties.
 - 4. Maintaining existing services.

1.02 RELATED WORK

A. Any specific traffic control provisions listed on the project drawings or in the special provisions, or requested by engineer.

1.03 ACCESS RIGHTS OF PUBLIC

- A. Consider the access rights of the public at all times. Cause <u>no</u> unnecessary inconvenience.
- B. Provide and maintain safe and adequate pedestrian and vehicular access to fire hydrants, commercial and industrial establishments, churches, schools, parking lots, service stations, motels, fire and police stations, hospitals and establishments of similar nature. Access to these facilities shall be continuous and unobstructed.
- C. Maintain vehicular access to residential driveways to the property line except when necessary construction precludes such access for reasonable periods of time. If backfill has been completed to such extent that safe access may be provided and the street is opened to local traffic, immediately clear the street and driveways and provide and maintain access. Provide temporary drive approaches at all times except when concrete is being placed or cured.
- D. Non-compliance with the details of Section 1.03 will result I liquidated damages being assessed per the requirements of these Specifications.

1.04 MAINTAINING EXISTING SERVICES

- A. Cooperate with the various parties involved in the delivery of mail and the collection and removal of trash and garbage to maintain existing schedules for these services.
- B. Ensure that no interruption occurs in mail delivery, trash and garbage collection. This shall include the Contractor's responsibility to pick up scheduled garbage collection and haul to nearest point of suitable access as determined by the agency.

- C. Facilitate the garbage or trash pick up in the following manner:
 - 1. If operations interfere with garbage or trash pick up operations, notify all affected residents and business ahead of time by written notice. Inform them in the notice not to put out their garbage or trash for pick up at the appointed time and tell them another time will be set up to collect their garbage or trash. It will be collected when unrestricted vehicular access is assured for all the affected area residents and businesses. Deliver a copy of the notice to the Engineer for approval before it is delivered to the affected citizens.

1.05 NOTICE OR CLOSURE

- A. At least 48 hours in advance in closing, or partially closing, or of any re-opening any street, alley, or other public thorough-fare, notify emergency services corporations, Police, Fire, Traffic and Engineering Departments.
- B. Notify in writing all abutting property owners at least two (2) days prior to excavation in front of said abutting properties. Deliver a copy of the notice to the Engineer for approval before it is delivered to the affected citizens.
- C. In open streets, no intersection, driveway, or parking entrance shall be blocked more than one (1) working day. No intersection shall remain closed to vehicular traffic overnight.

1.06 REFERENCES

- A. Federal High Way Administration Manual on Uniform Traffic Control Devices.
- B. Caltrans Traffic Control Manual.

PART 2 - PRODUCTS

2.01 TEMPORARY TRAFFIC CONTROL DEVICES

A. All warning signs, warning lights, barricades, lights, temporary signals and other protective devices shall be in accordance with 2016 Work Area Traffic Control Handbook.

PART 3 - EXECUTION

3.01 GENERAL TRAFFIC REGULATIONS

A. Unless provided for otherwise in this section, regulate all pedestrian and vehicular traffic in and adjacent to the work site in accordance with 2016 Work Area Traffic Control Handbook standards and the manual of Uniform Traffic Control Devices.

3.02 TRENCH EXCAVATIONS

A. Any excavation left open during hours of darkness shall be protected with flashing light barricades, as required by OSHA.

3.03 CONSTRUCTION OPERATIONS

- A. The Contractor shall provide for two-way traffic through construction operations, except where conditions warrant, as determined by the Engineer, one-way traffic will be allowed. One-way traffic provisions shall apply when fresh bituminous material is being placed, when half-width pavement is being laid, or when necessary due to construction operations. The contractor shall furnish adequately trained flagmen, warning signs and warning lights, and if necessary, pilot cars for the safe control of traffic. During suspension of work, two-way traffic shall be provided.
- B. The contractor shall erect warning signs in advance of any place on the project where operations interfere with the use of the road by traffic, and at all intermediate points where the new work crosses or coincides with an existing road. Such warning signs shall be constructed and erected in accordance with the plans.

3.04 BARRICADES

A. Furnish, place and maintain all safety devices, danger signs, barricades, etc., required for all pedestrian and traffic control in accordance with the requirements specified in the Manual of Uniform Traffic Control Devices.

3.05 FLAGGING

A. Flagging personnel shall be considerate to motorists, and project a safe, professional image while flagging. Flaggers shall refrain from using abusive language while on the job.

SECTION 01 71 37 – TRAFFIC REGULATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope: Provide operation and maintenance equipment, services, personnel, traffic control and protective devices, as required to expedite vehicular traffic flow in the areas designated for improvements as shown on the drawings.

1.02 REFERENCES

- A. ANSI D6.1: Manual on Uniform Traffic Control Devices for Streets and Highways.
- B. ATSSA: American Traffic Safety Services Association.

1.03 QUALITY ASSURANCE

A. All work within any highway right-of-way shall be performed in accordance with applicable safety regulations contained in the "Manual on Uniform Traffic Control Devices."

1.04 FLAGGERS

A. Flaggers to be knowledgeable of ANSI D6.1.

PART 2 - PRODUCTS

2.01 SIGNS, TAGS, SIGNALING AND BARRICADES

A. Signs, Tags and signaling and barricade devices shall comply with ANSI D6.1

PART 3 - EXECUTION

3.01 PREPARATION

- A. Notify the Engineer of areas to be rendered impassable or otherwise obstructed due to construction operations so routing of emergency vehicles and Owner's operations vehicles can be coordinated.
- B. Notify City of all scheduled disruptions to traffic flow at least 24 hours prior to initiating proposed action.

3.02 TRAFFIC CONTROL DEVICES AND SIGNS

A. Provide and operate traffic control devices and directional signs to direct and maintain an orderly flow of traffic in all areas under Contractor's control, or affected by Contractor's operations.

TRAFFIC REGULATION 01 71 37 - 1

- B. Mount traffic control and directional signs on barricades or posts at the following locations:
 - 1. Changes of direction of a roadway and at each crossroad
 - 2. Detours
 - 3. Parking areas
- C. Spacing and configuration of all construction signs shall conform to ANSI D6.1.

END OF SECTION

TRAFFIC REGULATION 01 71 37 - 2

SECTION 01 71 31 – PROTECTION OF EXISTING FACILITIES

PART 1 - GENERAL

1.01 GENERAL

- A. The Contractor shall protect all existing utilities, piping and improvements not designated for removal and shall restore damaged or temporarily relocated utilities, piping and improvements to a condition equal to or better than they were prior to such damage or temporary relocation.
- B. The Contractor shall verify the exact locations and depths of all underground piping and utilities shown and not shown and shall make exploratory excavations of all piping and utilities that may interfere with the Work. It shall be the Contractor's responsibility to ascertain the actual location of all existing utilities, piping and other improvements that will be encountered in its construction operations and to see that such utilities or other improvements are adequately protected from damage due to such operations.
- C. <u>Maintaining in Service</u>: All pipelines, electrical, power, telephone, communication cables, gas and water mains shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the Engineer are made with the Owner. Where the proper completion of the Work requires the temporary or permanent removal and/or relocation of an existing utility or other improvement the Contractor, after necessary scheduling and approval, shall remove and, without unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to the Engineer and the Owner of the facility. In all cases of such temporary removal or relocation, the Work shall be accomplished by the Contractor in a manner that will restore or replace the utility or improvement to a new condition meeting the specification requirements.
- D. All repairs to a damaged utility or improvement are subject to inspection and approval by an authorized representative of the improvement owner before being concealed by backfill or other work.

1.02 RIGHTS-OF-WAY

A. The Contractor shall not do any work or enter upon the rights-of-way of any oil, gas, sewer or water pipeline; any telephone or electric transmission line; any fence; or any other structure, until notified by the Engineer that the Owner has secured authority to do so. After authority has been obtained, the Contractor shall give the governing utility proper advanced notice of its intention to begin work.

1.03 RESTORATION OF PAVEMENT AND SIDEWALKS

A. All paved areas and sidewalks not designated for replacement, cut or damaged during construction shall be replaced with similar materials and of equal thickness to match the

existing adjacent undisturbed areas unless otherwise noted. All sidewalks and pavements which are subject to partial removal shall be neatly saw-cut in straight lines.

1.04 UNDERGROUND UTILITIES NOT SHOWN OR INDICATED

A. If the Contractor damages existing utilities, piping or improvements that are not shown or the location of which was not made known to the Contractor prior to excavation and the damage was not due to failure of the Contractor to exercise reasonable care the Contractor shall immediately notify the Engineer. If directed by the Engineer repairs shall be made by the Contractor under the provisions for changes and extra work contained in Articles 13, 14 and 15 of the General Conditions.

1.05 NOTIFICATION BY THE CONTRACTOR:

A. Prior to any excavation in the vicinity of any existing underground facilities, including water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications or telecommunication cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way, the Contractor shall notify the respective authorities representing the owners or agencies responsible for such facilities not less than three (3) working days prior to excavation so that a representative can be present during such work if they are required to do so.

SECTION 01 71 23.16 – CONSTRUCTION SURVEYING

PART 1 - GENERAL

- 1.01 THE REQUIREMENT
 - A. Permanent Survey Markers
 - B. The CONTRACTOR shall be responsible for the preservation of survey monuments and bench marks except as noted herein. At least two (2) working days before the start of construction, the CONTRACTOR shall submit acceptable preconstruction survey tie notes to the OWNER'S office. These survey tie notes will be for all survey markers or bench marks that may be lost or disturbed due to construction. Lost or disturbed monuments shall be replaced at the CONTRACTOR'S expense by a California licensed land surveyor or registered civil ENGINEER authorized to practice land surveying. Post construction survey monument ties acceptable to the OWNER shall be submitted to the OWNER'S office before the completion of The ENGINEER will reestablish the monuments and bench marks where survey services are provided by the ENGINEER, providing the CONTRACTOR protects the preconstruction reference points. In this case, where the monuments are to be removed or damaged by the CONTRACTOR, the CONTRACTOR shall notify the ENGINEER in writing seven (7) calendar days before starting the Work.
 - C. All site work such as conflicts with existing utilities, additional subsurface investigation, and surveying shall be included in this section.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. It is not the responsibility of the OWNER to maintain the most accurate and most recent record DRAWINGS. The OWNER is not responsible for any costs of the items disturbed or damaged by the CONTRACTOR's operation.
 - B. The CONTRACTOR will not be permitted to use existing sewer systems (if any) as drain lines for the construction work. The CONTRACTOR shall be responsible for all surface water runoff and/or groundwater tributary to the pipeline and/or trenches constructed and shall supply the necessary dewatering and pumping equipment for handling those flows during construction.
 - C. Existing Utility Lines
 - 1. The CONTRACTOR is responsible for locating any possible existing underground utilities in order to properly complete site work. The CONTRACTOR shall contact the OWNER or ENGINEER immediately upon discovery of additional utilities in the area prior to starting and during the performance of the work.
 - 2. Water, sewer, gas, power and telephone service to buildings shall be maintained with a minimum of interruption throughout the construction of the contract work. No such service shall be intentionally interrupted without the approval of the respective utility

- company concerned, and without first giving due warning to the occupants of said dwelling or business establishment.
- 3. The CONTRACTOR shall avoid disturbance and/or displacement of existing utilities and shall provide all temporary and permanent supports and other required protection.

D. Existing Power Lines

- 1. If the proposed work is in close proximity to overhead and underground power lines which could be hazardous to construction personnel and/or other persons, the CONTRACTOR shall properly protect the wires, pole supports, or other power line appurtenances to avoid disturbances to those facilities.
- 2. The CONTRACTOR shall also operate all machinery and conduct all other construction activities in a manner, which will assure protection of all construction personnel and other persons against the described hazard.

E. Existing Gas Lines

- 1. The CONTRACTOR shall avoid disturbance and/or displacement of underground gas lines and their associated facilities and shall provide all temporary and permanent supports required to protect and prevent exposure to construction personnel and/or other persons.
- 2. If gas lines are exposed during construction and leakage is detected, the CONTRACTOR shall suspend all construction work in those areas immediately. The OWNER of the pipeline shall be immediately advised of the condition, and construction shall not resume until all repairs have been properly completed.

F. Landscaping, Existing Trees, and Vegetation

- 1. The CONTRACTOR shall protect existing trees, shrubbery, and other vegetation that is to remain in place against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials, excess foot or vehicular traffic, or improper parking of vehicles on vegetation. Temporary fences, barricades or guards are to be provided as required to protect trees and vegetation to be left standing.
- 2. Trees and other vegetation to remain within limits of contract work shall be watered as required to maintain their health during course of construction operations.
- 3. Protection shall be provided for roots over 1-1/2" diameter cut during construction operations. Coat cut faces with a wound paint formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
- 4. The CONTRACTOR shall repair or replace trees and vegetation that will remain, which are damaged by construction operations, in a manner acceptable to the ENGINEER and property OWNER if work is performed on private property. The ENGINEER may employ an Arborist to repair damages to trees and shrubs at the CONTRACTOR's expense when deemed necessary.

G. Existing Valves and/or Other Existing System Appurtenances

1. The CONTRACTOR shall not operate existing system valves, hydrants or other appurtenances at any time. If the existing items described are required to accommodate

construction, the CONTRACTOR shall provide the OWNER with an advance notice and shall receive approval from the OWNER before use of the existing appurtenances.

1.05 QUALITY CONTROL

- A. The CONTRACTOR shall conduct all work in accordance with the applicable rules and regulations of specified governing agencies, and in accordance with the laws, rules, and/or regulations of all other authorities having jurisdiction over the required construction work. Any required permits shall be obtained and paid for by the CONTRACTOR (including all city permit fees and charges).
- B. The CONTRACTOR shall determine the exact location of existing structures, underground piping, or conduit which would be in the vicinity or possibly affected by the CONTRACTOR's operation.
- C. The CONTRACTOR shall relocate existing items or mark these existing items if removal is not required, and shall protect any underground facility.
- D. The CONTRACTOR shall schedule and coordinate all construction activities and shall cooperate with the OWNER's operating personnel to provide a minimum of interruptions to the operations of other present facilities.

E. Property Restoration

- 1. CONTRACTOR shall restore landscaping to original condition.
- 2. The CONTRACTOR shall assume <u>all responsibility</u> and <u>liability</u> for property damages, bodily injury, or financial losses and interruptions of service that may result from his/her construction activities which affect structures, facilities, water lines, gas lines, power lines, electric conduits, sewer lines, telephone lines, cable TV lines, and all service facilities connected thereto.
- 3. The CONTRACTOR shall be responsible for the relocation, repairing, reconstruction, and re-installation of damaged or disturbed items due to his/her construction activities.
- 4. Damaged or disturbed items shall be re-installed or restored to their original condition as soon as possible and prior to completion of work. Restoration shall be approved by the authority having jurisdiction over the disturbed items. There shall be no extra cost to the OWNER.
- 5. Items not specifically stated in the Specifications that are removed, damaged, destroyed, or defaced due to neglect or carelessness on the part of the CONTRACTOR shall be repaired or replaced by the CONTRACTOR if determined so by the ENGINEER.

1.06 SUBMITTALS

A. Record DRAWINGS

1. The CONTRACTOR is responsible for maintaining accurate record DRAWINGS, also known as "As-Built" DRAWINGS. Record DRAWINGS shall consist of <u>red lined</u> marked Contract DRAWINGS and shall be available to the OWNER or ENGINEER at any time upon request. The record DRAWINGS shall be delivered to the OWNER upon completion of the project.

- 2. Record drawing mark-ups are defined as design DRAWINGS whether provided by the Company, the CONTRACTOR, or others, upon which the CONTRACTOR has recorded all variations or changes between the work as built and observed by the CONTRACTOR, and the work as shown in the design DRAWINGS provided at the time of award or approval by the Company.
- 3. The CONTRACTOR shall keep one <u>up-to-date record copy</u> of all DRAWINGS for all deviations or modifications in location or elevation of any underground installation from that shown on the Contract DRAWINGS.
- 4. All As-Built drawing mark-ups submitted by the CONTRACTOR shall be provided on the latest issue "Approved for Construction," "D" size paper.
- 5. The As-Built DRAWINGS shall include, but not be limited to, the following: location of all underground pipes, fittings, valves, stub-outs, plugs, and service lines, as constructed.
- 6. As-Built mark-ups provided by the CONTRACTOR shall include final well locations, pipeline routings and the lateral and vertical extent of trench excavation. All locations and elevations shall be identified by qualified survey crews and tied to the California Coordinate System NAD 83 in feet. Survey shall be in accordance with the respective pipeline and well installation Specifications.
- 7. As-Built DRAWINGS kept by the CONTRACTOR are considered as part of the work such that any application for payment, approved percentage of completion, etc., is contingent upon the As-Built DRAWINGS being up-to-date with that portion of the construction.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Replacement in Kind

1. Except as indicated on the DRAWINGS or as specifically authorized by the utility OWNER, reconstruct utilities with new material of the same size, type, and original quality as that removed.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Replace in kind improvements that are cut, removed, damaged, or otherwise disturbed by the construction.
- B. Where utilities are parallel to or cross the pipeline trench but do not conflict with the permanent work to be constructed, follow the procedures given below and as indicated on the DRAWINGS. Notify the utility OWNER 48 hours in advance of the crossing construction and coordinate the construction schedule with the utility OWNER's requirements.
- C. Determine the true location and depth of utilities and service connections which may be affected by or affect the work. Determine the type, material, and condition of these utilities. The CONTRACTOR shall pothole all utilities, except those listed in the contract documents as already being potholed, prior to submitting pipe laying DRAWINGS. The CONTRACTOR shall submit a set of potholing plans to the OWNER prior to submitting laying diagrams. In

addition, the CONTRACTOR shall expose all utilities at least 500 lineal feet in advance of the start of pipeline excavation.

3.02 PROCEDURES

A. Protect in Place: Protect utilities in place, unless abandoned, and maintain the utility in service, unless otherwise specified on the DRAWINGS or in the Specifications.

B. Adjacent Existing Underground Utilities

- 1. Whenever possible, environmental piping should be laid at least 10 feet, horizontally, from any existing or proposed water mains. If local conditions prevent a lateral separation of 10 feet, environmental piping may be laid closer than 10 feet to a water main as long as one of the following are performed:
 - a. It is laid in a separate trench.
 - b. It is laid in the same trench with the water main located at one side of a bench of undisturbed earth.
 - c. In either case (a or b) the elevation of the top (crown) of the environmental pipe line is at least 18" below the bottom (invert) of the water main.
- 2. Whenever the environmental pipeline must cross under existing water mains, pipeline shall be laid at such an elevation that the top of the pipeline is at least 18" below the bottom of the water main.
- 3. Where significant utility conflicts are to be encountered, each pipeline shall be installed with a steel casing pipe at all such locations.
- 4. CONTRACTOR shall provide temporary support for all pipelines crossing the proposed trench. All pipelines 18 inches in diameter or larger crossing over the proposed water main with less than 4 feet of clearance shall have a temporary support. CONTRACTOR shall submit DRAWINGS of his method of temporary support to the ENGINEER for review. All pipelines less than 18 inches in diameter and crossing over the proposed water main with less than 2 feet of clearance shall be protected by pouring one (1) sack of sand/cement slurry from the top of the water main to the bottom of the crossing pipeline.

C. Lines and Grades for Water Lines and Underground Electrical Conduit

- 1. The CONTRACTOR shall employ a competent survey crew, approved by the ENGINEER, to lay out the work from the initial points of instruction as given by the ENGINEER. They shall set all offset stakes, set, test, and check all elevations and levels and other parts of the construction as the work progresses.
- 2. The CONTRACTOR shall furnish all flagging, nails, spikes, stakes, paint, and marking devices required for the survey and layout work. The CONTRACTOR shall also furnish personnel to assist the ENGINEER in checking the survey and layout work if required throughout the entire Contract period.
- 3. The ENGINEER will not provide surveying services to the CONTRACTOR. The CONTRACTOR shall retain the services of a qualified instrument man to perform the required survey work.
- 4. The CONTRACTOR shall furnish personnel to assist the ENGINEER for checking grades and locating existing facilities if requested.

- 5. The CONTRACTOR shall be responsible for protecting and safeguarding all benchmarks established by the ENGINEER and all existing property stakes, pins, monuments, etc. Any benchmarks, property stakes, pins, or monuments disturbed during construction activities shall be re-established and replaced by the CONTRACTOR's survey crew at no additional cost to the OWNER.
- 6. Property corner markers, boundary monuments, etc., disturbed or moved shall be restored, in conformance with the property deed description by a licensed land surveyor. Restoration of the markers or monuments shall be certified by said surveyor on a map prepared and stamped by him which shows the work accomplished. One copy of the map will be given to the property OWNER and one copy given to the ENGINEER.

D. Abandoned Utilities

1. Cut and Plug Ends: Cut abandoned utility lines (conduits) and plug the ends with brick and mortar or concrete plug. Plug utility lines with an 8-inch wall of brick and mortar or 8-inch concrete plug from the cut end of the pipe. Remove and dispose of abandoned utilities within the trench excavation.

E. Temporary Relocations

- 1. The CONTRACTOR, with the approval of the ENGINEER, shall remove items, which would interfere with his/her pipe installation operations, and shall re-install these items after construction is complete.
- 2. The CONTRACTOR shall disassemble items and store items for later reinstallation, as required. The CONTRACTOR shall disassemble the items carefully and store them in a safe location, and in a manner to prevent damage. Any damage to the items, as a result of the CONTRACTOR's neglect during removal, disassembly, storage, and/or reinstallation shall be replaced or repaired to the satisfaction of the ENGINEER at the CONTRACTOR's expense.

3.03 TESTING – NONE

3.04 CLEANUP

- A. Immediately after all construction operations have been completed, the CONTRACTOR shall thoroughly clean the area of all excess materials, debris, plant and equipment for which he or she is responsible. The CONTRACTOR shall also restore grounds, lawns, driveways, streets, roadways, pipes, drain lines, banks, ditches, and all other areas to their original condition and to the satisfaction of the ENGINEER and shall leave the premises in a neat and operable condition.
- B. Cleanup and restoration operations must be completed within a reasonable time following installation of any particular section of pipeline.

SECTION 01 71 18 – SITE ACCESS AND STORAGE

PART 1 - GENERAL

1.01 HIGHWAY AND STREET LIMITATIONS

- A. The CONTRACTOR shall make its own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits and other limitations affecting transportation and ingress and egress to the site of the Work. It shall be the CONTRACTOR's responsibility to construct and maintain any haul roads required for its construction operations.
- B. Nothing herein shall be construed to entitle the CONTRACTOR to the exclusive use of any public street, utility right-of-way or the site of the Work during the performance of the Work hereunder. The CONTRACTOR shall conduct its operations so as not to interfere unnecessarily with the authorized work of utility companies, other agencies, or the Owner's plant personnel. No street or access shall be closed without first obtaining permission of the Engineer or proper governmental authority. Where excavation is being performed in primary streets or highways one (1) lane in each direction shall be kept open to traffic at all times unless otherwise provided or shown. Fire hydrants on or adjacent to the Work shall be kept accessible to fire-fighting equipment at all times. Temporary provisions shall be made by the CONTRACTOR to assure the use of sidewalks, access routes and the proper functioning of all gutters, sewer inlets and other drainage facilities.
- C. <u>Traffic Control</u>: For the protection of traffic in public streets and plant operating personnel at the site of the Work, the CONTRACTOR shall provide, place and maintain all necessary barricades, traffic cones, warning signs, lights and other approved safety devices. The CONTRACTOR shall take all necessary precautions for the protection of the Work and the safety of the Owner's personnel and the public. All barricades and obstructions shall be illuminated at night.

1.02 CONTRACTOR'S WORK AND STORAGE AREA

A. The CONTRACTOR is solely responsible to designate and arrange for its use any addition property required for project execution. The property associated to the Work is assigned for the CONTRACTOR'S exclusive use during the term of the Contract as an office, storage and shop area for its construction operations relative to this contract as is reasonable. Access to the Wadsworth well site shall be maintained at all time to PWP personnel. CONTRACTOR shall be solely responsible for the security of its tools, supplies and equipment at the site.

SECTION 01 71 13 – MOBILIZATION

PART 1 - GENERAL

1.01 GENERAL

- A. Mobilization shall include the obtaining of all permits; moving onto the site of all equipment; furnishing and erecting temporary buildings and other construction facilities; all as required for the proper performance and completion of the Work. Mobilization shall include, but not be limited to, the following principal items:
 - 1. Moving on to the Owner's site of all equipment required for first month operations.
 - 2. Installing temporary construction power, wiring and lighting facilities.
 - 3. Establishing fire protection equipment and instructing designated personnel in the operation of such apparatus.
 - 4. Providing field office trailer for the CONTRACTOR complete with furnishings and utility services. Owner will furnish the temporary power and water for the CONTRACTOR's field offices. CONTRACTOR to furnish and install necessary piping, wiring and disconnects.
 - 5. Providing all on-site CONTRACTOR communication facilities.
 - 6. Providing on-site CONTRACTOR's sanitary facilities.
 - 7. Arranging and setting up the CONTRACTOR's work and storage yard.
 - 8. Obtaining all required permits.
 - 9. Posting all OSHA required notices and establishment of safety programs.
 - 10. Have CONTRACTOR's superintendent at the jobsite full time.
 - 11. Submittal of Construction Schedule.
 - 12. Install Owner furnished project sign.

END OF SECTION

MOBILIZATION 01 71 13 - 1

SECTION 01 66 00 – PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes details pertaining to packaging and handling, transportation and delivery, and storage and protection of the products to be used at the site.

1.02 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 01 32 16 CONSTRUCTION PROGRESS SCHEDULE

1.03 CITED STANDARDS – NONE

1.04 NOTED RESTRICTIONS

A. Products, materials and equipment not stored in a manner that will insure the maintaining of a new condition will be rejected by the ENGINEER. Such rejected products, materials and equipment shall be immediately removed from the work site.

1.05 PACKAGING AND HANDLING

- A. The CONTRACTOR shall avoid bending, scraping, or overstressing materials and equipment. Projecting parts shall be protected by blocking with wood, by providing bracing, or by other methods approved by the ENGINEER.
- B. Materials and equipment shall be protected from soiling and moisture by wrapping or by other methods approved by the ENGINEER.
- C. Small parts shall be packaged in containers such as boxes, crates, or barrels to avoid dispersal and loss. The CONTRACTOR shall firmly secure an itemized list and description of contents to such a container.

1.06 TRANSPORTATION AND DELIVERY

- A. Arrange deliveries of materials and equipment in accordance with the Project Schedule specified in **Section 01 32 16 Construction Progress Schedule**, and coordinate to avoid conflict with work and conditions at the site.
- B. Deliver materials in undamaged condition, in manufacturers' unopened containers or packaging (where applicable), dry, with identifying labels intact and legible.
- C. The CONTRACTOR shall provide the equipment and personnel to handle products by methods to prevent soiling or damage.
- D. Deliver cement, prepared dry mortar mixes, grouting material, plaster, and coloring material in original, unopened and sealed containers, bearing the brand and manufacturer's name.

E. Refer also to the individual Specifications Sections for detailed requirements as applicable.

1.07 STORAGE AND PROTECTION

- A. The receiving, storage, quality, and inventory control of equipment and materials required for the work of this Contract shall be the sole responsibility of the CONTRACTOR. Storage shall be arranged to provide easy access for inspection and identification of each shipment.
- B. Materials shall be stored in such a manner as to ensure the preservation of their quality and fitness for the work and to facilitate inspection.
- C. Sheltered, weather tight, or heated weather tight storage shall be provided as required to protect materials and equipment from weather damage and corrosion.
- D. The CONTRACTOR shall store manufactured materials in accordance with the various manufacturers' instructions. The temperature and humidity shall be maintained within the ranges required by the various manufacturers' instructions.
- E. Blocking, platforms, pallets, or skids shall be provided for materials and equipment subject to damage by contact with earth or pavement. Clearances shall be provided from adjacent surfaces for stored materials requiring natural ventilation.
- F. Packaged materials shall be stored in their original unbroken packages or containers. Protect materials and equipment from damage and corrosion during warehousing operations.
- G. For exterior storage of fabricated products, the products shall be placed on sloped supports aboveground. Products subject to deteriorations shall be covered with impervious sheet covering and ventilation shall be provided to avoid condensation.
- H. Loose granular materials shall be stored on solid surfaces in a well-drained area to prevent mixing with foreign matter.
- I. Perform periodic inspections of stored materials to assure that materials are maintained under specified conditions, and are free from damage or deterioration.
- J. Fabricated structural components shall be stored on supports above ground and in a manner to prevent accumulation of water and warping. Products subject to deterioration from atmospheric conditions shall be covered in a manner that will provide adequate ventilation to avoid condensation.
- K. Continue protection of materials and equipment from damage and corrosion after installation until final acceptance of the work. Refer also to the individual Specifications Sections for detailed requirements, as applicable.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 60 00 – PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes details pertaining to products, the quality of materials to be used, and appurtenances and accessories.

1.02 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 01 40 00 QUALITY REQUIREMENTS

1.03 QUALITY OF MATERIALS

- A. Materials, equipment, appliances, fixtures, and fabricated assemblies to be incorporated in the work shall be new unless indicated or specified otherwise in the Contract Documents.
- Additional quality assurance provisions for materials and equipment are specified in Section 01 40 00 Quality Requirements.

1.04 PRODUCTS

A. General

- 1. All products including but not limited to material, equipment, and systems, shall comply with the Specifications and referenced standards as minimum requirements.
- 2. Fifteen (15) days after the date established in notice to proceed, the CONTRACTOR shall submit a complete list of major products proposed for use including the name of the manufacturer and model number of each product.

B. Product Substitutions

- 1. The CONTRACTOR may submit a request for substitution for any products specified by only one manufacturer. Products specified by naming several manufacturers shall have NO substitutions allowed.
- 2. The OWNER shall only consider requests from the CONTRACTOR for substitution if the request is made within fifteen (15) after the date established in notice to proceed.
- 3. The CONTRACTOR shall document each request with complete data substantiating compliance of the proposed substitution with the Contract Documents.
- 4. Prior to requesting a product substitution, the CONTRACTOR shall do the following:
 - a. Investigate the proposed product and determine that it meets or exceeds the specified product in all respects.
 - b. Make sure that the proposed product will provide the same warranty as the specified product.
 - c. Coordinate installation and make sure that changes do not require substantial additions to the work to be performed.

- d. Waive claims for additional costs, which may subsequently become apparent.
- C. Product substitutions will not be considered when they are indicated or implied on shop drawings or product data submittals without a separate written request, or when acceptance requires substantial revision of the Contract Documents.
- D. The OWNER will determine acceptability of a proposed substitution, and will notify the CONTRACTOR of acceptance or rejection in writing within a reasonable time.
- E. The CONTRACTOR shall make only one request for substitution for each product and if the proposed substitution is rejected, the CONTRACTOR shall provide the specified product.

1.05 APPURTENANCES AND ACCESSORIES

- A. Products to be incorporated in the Work shall be furnished as complete assemblies or systems with all appurtenances and installation anchors, fasteners, and accessories as required to provide a complete and finished product installation.
- B. Installed products with moving parts shall be fully operable at proper settings and levels in accordance with the respective manufacturers' instructions and recommendations.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 57 19 – TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section covers the CONTRACTOR'S responsibilities in regard to diversion and control of surface water runoff, dewatering of pipeline trenches and structural excavations, and other elements required for control of water if the site conditions should dictate the need.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. Prior to the CONTRACTOR performing any excavation, the CONTRACTOR shall submit his/her proposed dewatering diversion plan to the ENGINEER a minimum of 17 days prior to starting excavation, for review. The submittal shall include method, installation, and details of the proposed dewatering diversion system.

PART 2 - PRODUCTS

- 2.01 MATERIALS
 - A. Materials and equipment required for control of water shall be furnished and maintained by the CONTRACTOR, as required to perform the construction.

PART 3 - EXECUTION

- 3.01 PREPARATION
 - A. Perform all permanent construction in area free from water.
 - B. The necessary machinery, appliances and equipment shall be provided and operated to keep excavations free from water during construction, and to dispose of the water so as not to cause injury to public or private property or to cause a nuisance or a menace to the public.
 - C. During excavation, construction of structures, installation of pipelines and sewers, placing of structural and trench backfill, and the placing and setting of concrete, excavations shall be kept free of water except as specified. Surface runoff shall be controlled so as to prevent entry or collection of water in excavations.

SECTION 01 56 26 - TEMPORARY FENCING

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section provides a description of the CONTRACTOR's responsibilities related to temporary fencing.
- 1.02 REFERENCES SECTIONS
 - A. Related Sections are shown below.
 - 1. SECTION 01 14 13 ACCESS TO SITE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 TEMPROARY FENCING
 - A. The CONTRACTOR shall provide temporary fencing and/or security measures.
 - B. Temporary security measures shall obtain City's approval prior to removal of existing fencing. The CONTRACTOR shall provide the City and County with access to gate as appropriate.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 55 26 - TRAFFIC CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section provides a description of the CONTRACTOR's responsibilities and restrictions related to traffic control.

1.02 REFERENCES SECTIONS

- A. Related Sections are shown below.
 - 1. SECTION 01 14 13 ACCESS TO SITE

1.03 CITED STANDARDS – NONE

1.04 NOTED RESTRICTIONS

- A. ALL CONSTRUCTION TRAFFIC shall utilize Walnut Ave for access for Treatment Plant work.
- B. Contractor shall prepare Traffic Control Plans and submitted to the City for approval to work in in all streets and at the site.

1.05 TRAFFIC CONTROL

A. For the protection of traffic in public streets and plant operating personnel at the site of the Work, the CONTRACTOR shall provide, place and maintain all necessary barricades, traffic cones, warning signs, lights and other approved safety devices. The CONTRACTOR shall take all necessary precautions for the protection of the Work and the safety of the OWNER's personnel and the public. All barricades and obstructions shall be illuminated at night.

1.06 SUBMITTALS

- A. The CONTRACTOR shall provide a written Traffic Control Plan for the ENGINEER and City for approval seven (7) days prior to beginning on respective project site. Plans and impacts to treatment plant operations and access requirements shall receive prior approval.
- B. The CONTRACTOR shall provide a Drawing of the Traffic Control Plan for the ENGINEER and PWP/County for approval 4 weeks prior to beginning on respective pipeline project sites and traffic notification shall be placed at least 2 weeks prior to the construction activity or as required by the TVMWD. Plans and impacts to water delivery/distribution shall receive prior approval.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

TRAFFIC CONTROL 01 55 26 - 1

SECTION 01 52 19 - SANITARY FACILITIES

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section includes details pertaining to temporary sanitary facilities to be used during the by the CONTRACTOR during the construction period.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. The CONTRACTOR shall provide separate sanitary facilities during the entire construction period unless noted otherwise by the OWNER or ENGINEER.
 - B. The CONTRACTOR shall provide clean and sanitary temporary toilet conveniences, washing facilities, and potable drinking water for the use of all people engaged with the work.
 - C. The CONTRACTOR shall supply sanitary facilities with toilet paper, paper towels, paper cups, and any related supplies as required.
 - D. Toilet Facilities
 - 1. Fixed or portable chemical toilets shall be provided wherever needed for the use of employees. Toilets at construction job sites shall conform to the requirements of Subpart D, Section 1926.51 of the OSHA Standards for Construction.
 - E. Sanitary and Other Organic Wastes
 - 1. The CONTRACTOR shall establish adequate and regular collection of all sanitary and organic wastes.
 - 2. All wastes and refuse from sanitary facilities provided by the CONTRACTOR or organic material wastes from any other source related to the CONTRACTOR's operations shall be disposed of in a manner satisfactory to the OWNER and in accordance with all laws and regulations pertaining thereto.
 - 3. The CONTRACTOR may install temporary piping for toilet facilities to discharge into the incoming sewer.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 52 00 - CONSTRUCTION FACILITIES

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section includes details pertaining to temporary construction facilities such as storage facilities, facilities for installed products, and sanitary facilities.
- 1.02 REFERENCED SECTIONS
 - A. Related Sections are listed below:
 - 1. SECTION 01 11 00 SUMMARY OF WORK
 - 2. SECTION 01 52 19 SANITARY FACILITIES
 - 3. SECTION 01 77 00 CLOSEOUT PROCEDURES
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. The CONTRACTOR shall provide temporary facilities for installed products or storage of tools, materials, and equipment. The CONTRACTOR shall provide an on-site or logistically close field office trailer for the duration of the project, complete with all necessary equipment, furnishing and utility services including telephones. The CONTRACTOR shall control traffic in the immediate area of these facilities to minimize damage, and shall construct such facilities in locations indicated or approved by the ENGINEER.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

- 3.01 CLEANUP
 - A. The CONTRACTOR is responsible for removing and disposing off-site all accumulated waste, materials, and equipment as a part of final cleanup.
 - B. The CONTRACTOR shall clean and repair any damages caused by installation or use of temporary facilities. Any existing facilities used shall be restored to its original condition.

SECTION 01 51 36 – TEMPORARY WATER

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section includes the CONTRACTOR's responsibilities in regard to temporary water.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. The CONTRACTOR shall not make connections to, or draw water from any fire hydrant or pipeline without first obtaining permission of the authority having jurisdiction over the use, and from the agency owning the electrical or water system.
 - B. For each of such connection made to a water system, the CONTRACTOR shall first attach to the fire hydrant or pipeline a valve, backflow preventer, and a meter, if required by the said authority, of a size and type acceptable to said authority and agency.

1.05 QUALITY CONTROL

- A. Temporary Water Supply
 - 1. The CONTRACTOR shall lawfully obtain water from an existing source with adequate supply and quality suitable for all domestic and construction purposes as instructed by the ENGINEER.
 - 2. The CONTRACTOR shall be responsible for furnishing any required extension cords, hoses, etc., and all water used shall be potable water, unless noted otherwise by the ENGINEER.
 - 3. The CONTRACTOR shall pay the costs for water used for construction purposes. However, abuse of this privilege by the CONTRACTOR will warrant the OWNER the right to discontinue use of this water supply and make the CONTRACTOR responsible for supply of his/her own needs.
 - 4. Utility or plant effluent water may be used for hydraulic structures and pipeline testing as approved by the ENGINEER.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

- 3.01 CLEANUP
 - A. The CONTRACTOR shall remove all materials and equipment used. Affected improvements shall be restored to their original condition, or better, to the satisfaction of the ENGINEER.

END OF SECTION

TEMPORARY WATER 01 51 36 - 1

SECTION 01 51 33 – TEMPORARY TELECOMMUNICATIONS

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section includes the CONTRACTOR's responsibilities in regard to temporary telecommunications.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. The OWNER or ENGINEER's telephone system shall not be used by the CONTRACTOR's work force.
- 1.05 QUALITY CONTROL
 - A. Communications
 - 1. The CONTRACTOR shall provide and maintain at all times during the progress of the work no less than one telephone (land line or cell) in good working order, at its own field construction office.
 - 2. Each telephone shall be connected to an established exchange for toll service and with all other telephones utilized by the CONTRACTOR.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 51 13 – TEMPORARY ELECTRICITY

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section includes the CONTRACTOR's responsibilities in regard to temporary electricity. All work shall conform to the applicable requirements of the OSHA Standards for Construction.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. The CONTRACTOR shall not make connections to electrical power service without first obtaining permission of the authority having jurisdiction over the use, and from the agency owning the electrical or water system.
- 1.05 QUALITY CONTROL
 - A. Temporary Electrical Power and Lighting
 - 1. The CONTRACTOR shall connect to an existing power service to perform site work. The CONTRACTOR is responsible for providing branch wiring, feeders, connections, and distribution boxes to provide service and lighting.
 - 2. The CONTRACTOR may request the installation of temporary power poles (if necessary) in locations where electricity is required. The CONTRACTOR shall contact the utility company upon the ENGINEER's approval.
 - 3. The CONTRACTOR shall pay the costs of energy used, and shall maintain all temporary power systems required to perform the work in a safe and satisfactory manner.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

- 3.01 CLEANUP
 - A. The CONTRACTOR shall remove all materials and equipment used. Affected improvements shall be restored to their original condition, or better, to the satisfaction of the ENGINEER.

SECTION 01 51 00 – TEMPORARY UTILITIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section includes details pertaining to temporary utilities to be used by the CONTRACTOR. It shall be the CONTRACTOR's responsibility to provide equipment that is adequate for the performance of the Work under this Contract within the time specified.
- B. All equipment shall be kept in satisfactory operating condition, shall be capable of safely and efficiently performing the required Work and shall be subject to inspection and approval by the ENGINEER at any time within the duration of the Contract. All work hereunder shall conform to the applicable requirements of the OSHA Standards for Construction.

1.02 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 01 11 00 SUMMARY OF WORK
 - 2. SECTION 01 51 13 TEMPORARY ELECTRICITY
 - 3. SECTION 01 51 36 TEMPORARY WATER
 - 4. SECTION 01 77 00 CLOSEOUT PROCEDURES

1.03 CITED STANDARDS – NONE

1.04 NOTED RESTRICTIONS

- A. The CONTRACTOR shall not make connections to, or draw water from any fire hydrant or pipeline without first obtaining permission of the authority having jurisdiction over the use, and from the agency owning the electrical or water system.
- B. For each of such connection made to a water system, the CONTRACTOR shall first attach to the fire hydrant or pipeline a valve, backflow preventer, and a meter, if required by the said authority, of a size and type acceptable to said authority and agency.
- C. The OWNER'S OR ENGINEER'S telephone system shall not be used by the CONTRACTOR's work force.

1.05 QUALITY CONTROL

A. Please see the quality control requirements under the individual sub-sections.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 CLEANUP

A. Before final acceptance of work, the CONTRACTOR shall remove all materials and equipment related to temporary facilities and controls. Affected improvements shall be restored to their original condition, or better, to the satisfaction of the ENGINEER and to the agency owning the affected utility.

SECTION 01 45 16.13 – CONTRACTOR QUALITY CONTROL

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section describes CONTRACTOR Quality Control requirements.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. The CONTRACTOR shall be licensed by the State of the project, and shall maintain workers' compensation insurance, general liability insurance and a valid City business license.
 - B. They must provide the Licensing Division with their Federal Employer I.D. # and or their Social Security Number.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 45 16 - FIELD QUALITY CONTROL PROCEDURES

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section describes field quality control procedures to be performed by the CONTRACTOR.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. Explosives and Blasting
 - 1. The use or storage of explosives on the work or site will not be permitted.

1.05 QUALITY CONTROL

A. Chemicals

1. All chemicals used during project construction or furnished for project operation, whether soil sterilant, herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall show approval for use by either the U. S. Environmental Protection Agency or the U. S. Department of Agriculture. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer.

B. Cultural Resources

- 1. The CONTRACTOR's attention is directed to the National Historic Preservation Act of 1966 (16 U.S.C. 470) and 36 CFR 800 which provides for the preservation of potential historical architectural, archeological or cultural resources (hereinafter called "cultural resources"). If potential cultural resources are discovered during subsurface excavations at the site of construction, the following procedures shall be instituted:
 - a. The CONTRACTOR shall immediately notify the ENGINEER.
 - b. The ENGINEER will issue a Field Order directing the CONTRACTOR to cease all construction operations at the location of such potential cultural resources find.
 - c. Such Field Order shall be effective until such time as a qualified archeologist can be called to assess the value of these potential cultural resources and make recommendations to the State Historical Society Archeologist.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 DUST ABATEMENT AND RUBBISH CONTROL

A. The CONTRACTOR shall provide under the Contract all necessary measures to prevent its operation from producing dust in amounts damaging to property or causing a nuisance to the plant personnel and operations or to persons living in or occupying buildings in the vicinity.

The CONTRACTOR shall be responsible for damage resulting from any dust originating from its operations. The dust abatement measurers shall be continued throughout the length of the contract.

- B. During the progress of the work the CONTRACTOR shall keep the site of the work and other areas used by it in a neat and clean condition and free from any accumulation of rubbish.
- C. The CONTRACTOR shall dispose of all rubbish and waste materials of any nature occurring at the work site, and shall establish regular intervals of collection and disposal of such materials and waste. The CONTRACTOR shall also keep its haul roads free from dirt, rubbish and unnecessary obstructions resulting from its operations.
- D. Disposal of all rubbish and surplus materials shall be off the site of construction in accordance with local codes and ordinances governing locations and methods of disposal and in conformance with all applicable Safety Laws and Health Standards for Construction.

SECTION 01 42 19 – REFERENCE STANDARDS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section includes details pertaining to the referenced standards used in these Specifications and their abbreviations.
- B. In these Specifications, whenever references are made to published specifications, codes, standards or other requirements, it shall be understood that only the latest published specifications, standards or requirements of the respective issuing agencies, as of the date that the work is advertised for bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes.

1.02 REFERENCED SECTIONS – NONE

1.03 CITED STANDARDS

A. The Contract Documents contain references to various standard specifications, codes, practices, and requirements for materials, equipment, work quality, installation, inspections, and tests, which references are published and issued by the organizations, societies, and associations listed in 1.05 Abbreviations by abbreviation and name. These references are hereby made a part of the Contract Documents.

1.04 NOTED RESTRICTIONS

- A. No requirements set forth herein or shown on the drawings shall be waived because of any provision of, or omission from, said standards or requirements.
- B. Whenever a referenced standard contains administrative requirements, including measurement and payment provisions, such as the standard specifications of various government entities, utility districts, and other agencies, such administrative requirements shall not apply to the Work of this Contract. References to such standards shall be applicable to the pertinent technical provisions only.

1.05 QUALITY CONTROL

- A. In case of conflict between codes, reference standards, drawings and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the ENGINEER for clarification and directions prior to ordering or providing any materials or labor. The CONTRACTOR shall bid the most stringent requirements.
- B. References in the Contract Documents to "Standard Specifications" shall mean the Manual of Standard Specifications as Published by the American Public Works Association, including all current supplements, addenda and revisions thereof.

1.06 ABBREVIATIONS

A. When an organization's abbreviation or acronym is used in the Contract Documents and throughout the Specifications, it shall be understood to mean the full name of the respective organization as shown below:

_		
1.	AASHTO	American Association of State Highway and Transportation Officials
2.	ACI	American Concrete Institute
3.	AFPA	American Forest and Paper Association
4.	AISC	American Institute of Steel Construction
5.	AISI	American Iron and Steel Institute
6.	ANSI	American National Standards Institute
7.	APA	American Plywood Association
8.	ASME	American Society of Mechanical ENGINEERs
9.	ASTM	American Society for Testing and Materials
10.	AWPA	American Wood Preservers Association
11.	AWPI	American Wood Preservers Institute
12.	AWS	American Welding Society
13.	AWWA	American Water Works Association
14.	CBC	California Building Code
15.	COEM	City of El Monte
16.	CRSI	Concrete Reinforcing Steel Institute
17.	EJCDC	ENGINEERs Joint Contract Documents Committee
18.	IBC Officials (ICB)	International Building Code of the International Conference of Building O)
19.	NACE	National Association of Corrosion ENGINEERs
20.	NCMA	National Concrete and Masonry Association
21.	NEC	National Electrical Code
22.	NEMA	National Electrical Manufacturers Association
23.	NFPA	National Fire Protection Association
24.	NSF	National Sanitation Foundation
25.	OSHA	Occupational Safety and Health Administration
26.	SSPC	Steel Structures Painting Council
27.	UL	Underwriters Laboratories Inc.
28.	USACE	U.S. Army Corps of ENGINEERs
29.	WIC	Woodwork Institute of California

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION – NOT USED

SECTION 01 42 13 – ABBREVIATIONS

PART 1 - GENERAL

1.01 GENERAL

A. Wherever in these Contract Documents the following abbreviations or acronyms are used, they shall have the meanings indicated as follows:

1.02 ABBREVIATIONS AND ACRONYMS:

١.٠	02 1	ADDREVIATION	S AND ACRONTMS.
	A.	AA	Aluminum Association
	B.	AAMA	Architectural Aluminum Manufacturer's Association
	C.	AASHTO	American Association of the State Highway and Transportation
			Officials
	D.	ACI	American Concrete Institute
	E.	AGC	Associated General Contractors
	F.	AGMA	American Gear Manufacturer's Association
	G.	AI	The Asphalt Institute
	H.	AIA	American Institute of Architects
	I.	AISC	American Institute of Steel Construction
	J.	AISI	American Iron and Steel Institute
	K.	AITC	American Institute of Timber Construction
	L.	AMCA	Air Moving and Conditioning Association
	M.	ANSI	American National Standards Institute, Inc.
	N.	APA	American Plywood Association
	O.	API	American Petroleum Institute
	P.	APWA	American Public Works Association
	Q.	ASA	Acoustical Society of America
	R.	ASAE	American Society of Agriculture Engineers
	S.	ASCE	American Society of Civil Engineers
	T.	ASHRAE	American Society of Heating, Refrigerating and Air Conditioning
			Engineers
	U.	ASLE	American Society of Lubricating Engineers
	V.	ASME	American Society of Mechanical Engineers
	W.	ASQC	American Society for Quality Control
	X.	ASSE	American Society of Sanitary Engineers
	Y.	ASTM	American Society for Testing and Materials
	Z.	AWPA	American Society for Preservers Association
	AA.	AWPI	American Wood Preservers Institute
	BB.	AWS	American Welding Society
	CC.	AWWA	American Water Works Association
	DD.	BHMA	Builders Hardware Manufacturer's Association
	EE.	CGA	Compressed Gas Association
	FF.	CLFMI	Chain Link Fence Manufacturer's Institute
	GG.	CMA	Concrete Masonry Association
	HH.	CRSI	Concrete Reinforcing Steel Institute

ABBREVIATIONS 01 42 13 - 1

II.	ETL	Electrical Test Laboratories
JJ.	ICBO	International Conference of Building Officials
KK.	IEEE	Institute of Electrical and Electronics Engineers
LL.	IES	Illuminating Engineering Society
MM.	IPC	Institute of Printed Circuits
NN.	IPCEA	Insulated Power Cable Engineers Association
OO.	ISA	Instrument Society of America
PP.	MBMA	Metal Building Manufacturer's Association
QQ.	NACE	National Association of Corrosion Engineers
RR.	NBS	National Bureau of Standards
SS.	NEC	National Electrical Code
TT.	NEMA	National Electrical Manufacturer's Association
UU.	NFPA	National Fire Protection Association
VV.	NFPA	National Forest Products Association
WW.	NGLI	National Lubricating Grease Institute
XX.	OSHA	Occupational Safety and Health Administration
YY.	PCA	Portland Cement Association
ZZ.	SMA	Screen Manufacturer's Association
AAA.	SMACCNA	Sheet Metal and Air Conditioning Contractors National
		Association
BBB.	SSPC	Steel Structures Painting Council
CCC.	SSPWC	Standard Specifications for Public Works Construction
DDD.	UBC	Uniform Building Code
EEE.	UL	Underwriters Laboratories, Inc.
FFF.	WCRSI	Western Concrete Reinforcing Steel Institute
GGG.		Wire Reinforcement Institute, Inc.
ННН.	WWPA	Western Wood Products Association

END OF SECTION

ABBREVIATIONS 01 42 13 - 2

SECTION 01 40 00 – QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes a brief description of general quality control, workmanship in relation to industry standards, and compliance with manufacturer's instructions.

1.02 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL

A. Verification of Dimensions

- 1. The CONTRACTOR shall lay out all work and shall be responsible for all lines, levels, grades, elevations and measurements of structures, and other work required under this contract.
- 2. The CONTRACTOR shall verify all site dimensions, project layout dimensions, setbacks, etc., shown on the drawings before laying out the work.
- 3. The CONTRACTOR shall notify the ENGINEER in writing of any error or discrepancy found and shall not proceed until the error or discrepancy is resolved.
- 4. The CONTRACTOR shall be responsible for correction of any work, which is done in error because of failure to verify dimensions.

B. Tests

- 1. The CONTRACTOR shall comply with any tests required by law, ordinance, rule, regulation, or order of any public authority having jurisdiction.
- 2. Special tests may be ordered by the ENGINEER in accordance with the contract documents or as agreed between the ENGINEER and CONTRACTOR in writing.
- 3. If the Specifications require testing by an independent testing laboratory, the CONTRACTOR shall select the testing laboratory and receive approval from the ENGINEER. After approval, the CONTRACTOR shall schedule all tests and shall deliver all test reports to the ENGINEER.
- 4. The CONTRACTOR is responsible for all costs involving testing with the exception of the following:
 - a. Special tests required by the ENGINEER. Special tests are to be paid for as stipulated in the contract documents or as otherwise agreed between the ENGINEER and CONTRACTOR in writing.

C. In order to produce work of the specified quality, the CONTRACTOR shall maintain quality control over supplies, manufacturers, products, services, site conditions, and workmanship.

1.06 WORKMANSHIP

- A. The CONTRACTOR and his/her workers shall comply with the highest prevailing industry standards in regard to work and safety.
- B. The CONTRACTOR shall provide workers who are qualified to perform all work to the specified quality.

1.07 MANUFACTURER'S INSTRUCTIONS

A. The CONTRACTOR shall comply with the manufacturer's instructions in full detail, including each step in sequence. If the manufacturer's instructions conflict with the Contract Documents, the CONTRACTOR shall request clarification from the ENGINEER before proceeding.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 33 26 - SOURCE QUALITY CONTROL REPORTING

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section specifies the general requirements for submission of the CONTRACTOR's sources of materials, to be prepared and submitted to the ENGINEER.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. The CONTRACTOR shall submit to the ENGINEER a list of the CONTRACTOR's sources of materials. The list shall be submitted in sufficient time to permit proper inspections and testing of materials to be furnished from such listed sources in advance of their use.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 33 23 – SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section includes information regarding shop drawings, product data, and samples.
- B. The OWNER, or its REPRESENTATIVE, shall review shop drawings, product data, and samples and return the submittals within 15 days.

C. Definitions:

- 1. Shop Drawings
 - a. Shop drawings, also known as record drawings, include fabrication, erection and installation, application, layout, and setting drawings, lists or schedules of materials and equipment, manufacturer's standard drawings, wiring and control diagrams, and all other drawings that may be required to show that the materials, equipment, and systems, and the positions these items, comply with Contract requirements.

2. Product Data

a. The term "product data" includes manufacturer-prepared descriptive literature, catalog sheets, brochures, performance data, test data, printed diagrams, schedules, illustrations, and other information furnished by the CONTRACTOR or the various product and materials suppliers to illustrate and describe a product, material, system, or assembly for some portion of the work.

3. Samples

a. Samples are physical examples which illustrate materials, equipment, colors, textures, finishes, functions, configuration, and work quality, and establish the standards of quality and utility by which the Work will be judged for acceptance.

1.02 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 01 33 00 SUBMITTAL PROCEDURES
 - 2. SECTION 01 60 00 PRODUCT REQUIREMENTS
 - 3. SECTION 01 77 00 CLOSEOUT PROCEDURES
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. Shop Drawings:
 - 1. Drawings shall be prepared in accordance with ANSI Y14, Drafting Standards Manual, and the following requirements (unless recommended otherwise by the ENGINEER):

a. Drawings shall be limited to the following standard sizes in inches:

Width	Length
8 1/2 inches (215.9mm)	11.0 inches (279.4mm)
11.0 inches (279.4mm)	17.0 inches (431.8mm)
17.0 inches (431.8mm)	22.0 inches (558.8mm)
22.0 inches (558.8mm)	34.0 inches (863.6mm)
24.0 inches (609.6mm)	36.0 inches (914.4mm)

- b. Each drawing shall have the following information in the title block.
 - 1) Drawing number, date, title, revision number, and sheet number.
 - 2) Contract number, Contract sheet number, Contract page number.
 - 3) Contractor's name.
 - 4) Subcontractor/manufacturer name (if applicable).
 - 5) Name of installation location.
- c. Each drawing task shall use symbols from one standard reference source. The CONTRACTOR shall furnish a complete symbol list that includes non-standard symbols used on the drawing.
- d. Each drawing shall include details necessary for the procurement, installation, maintenance, and repair of all components or facilities equipment provided.
 Change Order notices that are attached to drawings shall not constitute revised drawings. Each drawing shall include all changes and be upgraded to reflect the latest configuration.
- e. When specified, shop drawings shall be prepared and submitted electronically. Such drawings shall be created using AutoCAD or Microstation if approved by the ENGINEER. Shop drawings to be prepared and submitted electronically include shop drawings which will be utilized as illustrations and drawings in Operation and Maintenance Manuals.

B. Product Data

- 1. The CONTRACTOR shall modify manufacturers' standard diagrams, charts, illustrations, brochures, calculations, schematics, catalog cuts, and other descriptive data to delete information which is not applicable to the Contract. The CONTRACTOR shall supplement standard information with additional information applicable to this Contract, and indicate dimensions, clearances, performance characteristics, capacities, wiring and other diagrams, and controls.
- 2. If the CONTRACTOR utilizes drawings prepared by others, such drawings may include the standards and symbols of others if the drawings are a mix of existing product drawings and drawings prepared specifically for this Contract. In the event others provide drawings prepared specifically for this Contract, such drawings shall conform in symbols, media and standards to the CONTRACTOR's drawings.
- 3. The CONTRACTOR shall modify the manufacturer's printed installation, erection, application, and placing instructions to delete information which is not applicable to the Contract.

- 4. Product Data shall include the following:
 - Dates and revision dates.
 - b. Contract title and number.
 - c. Reference Contract Drawing numbers.
 - d. Applicable Contract Specification Section numbers.
 - e. Identification of product by description, model number, style number, serial number, or lot number.
 - f. The names of the CONTRACTOR, Subcontractors, Suppliers, and manufacturers as applicable.
 - g. Applicable standards, such as ASTM or Federal specification numbers.

5. Certificates of Compliance:

- a. The ENGINEER may permit the use of certain materials prior to sampling and testing if accompanied by a certificate of compliance stating that the materials involved comply in all respects with the requirements of the Contract Documents. The certificate shall be signed by the manufacturer of the material. A certificate of compliance shall be furnished with each lot of material delivered to the Work, and the lot so certified shall be clearly identified in the certificate.
- b. All materials used on the basis of a certificate of compliance may be sampled and tested at any time. The fact that material is used on the basis of a certificate of compliance shall not relieve the CONTRACTOR of responsibility for incorporating material in the Work which conforms to the requirements of the Contract Documents. Any such material not conforming to such requirements shall be subject to rejection whether in place or not.
- c. The ENGINEER reserves the right to refuse the use of material submitted for approval solely on the basis of a certificate of compliance.
- d. The form of the certificate of compliance and its disposition shall be as approved by the ENGINEER.

C. Samples

- 1. The CONTRACTOR shall furnish to the ENGINEER samples required by the Contract Documents. Samples shall be submitted without charge, with shipping charges prepaid. Materials for which samples are required shall not be used in the Work until approved in writing by the ENGINEER.
- 2. Each sample shall be labeled with the following data:
 - a. Name, number, and location on project;
 - b. Name of CONTRACTOR;
 - c. Material or equipment represented, and location in the project;
 - d. Name of producer, brand, trade name if applicable, and place of origin; and
 - e. Date of submittal.
- 3. The CONTRACTOR shall forward a letter to the ENGINEER submitting each shipment of samples and containing the information listed on the Sample Label specified herein.

Approval of a sample shall be only for the characteristics and use named in the submittal and approval, and shall not be construed to change or modify any Contract requirement. Before submitting samples, the CONTRACTOR shall assure itself that the materials or equipment will be available in the quantities required in the Contract, as no change or substitution shall be permitted after a sample has been approved unless such change or substitution is approved by the ENGINEER in writing.

- 4. Samples of material from local sources shall be taken by or in the presence of the ENGINEER. Samples taken otherwise shall not be considered for testing.
- 5. Inspection and tests will be made, but it is understood that such inspections and tests, if made at any point other than the point of incorporation in the work, in no way shall be considered as a guaranty of acceptance of any material which may be delivered later for incorporation in the work.
- 6. Approved samples not damaged in testing may be incorporated in the finished work if marked for identification and approved by the ENGINEER. Materials incorporated in the Work shall match the approved samples.
- 7. Failure of any material to pass the specified tests shall be sufficient cause for refusal to consider, under the Contract, any further samples of the same brand, make, or source of that material. The ENGINEER reserves the right to disapprove any material which has previously proven unsatisfactory in service.
- 8. Samples of material delivered to the site or installed in place may be taken by the ENGINEER for testing. Failure of samples to meet Contract requirements shall annul previous approvals of the item tested.

1.06 SUBMITTALS

- A. Submittal Procedures are described in **Section 01 33 00**.
- B. Unless notified otherwise by the OWNER or ENGINEER, the quantities for the applicable submittals shall be as specified below:
 - 1. The original and five (5) copies of the drawings.
 - 2. Six (6) copies of manufacturers' standard schematic drawings.
 - 3. Four (4) copies of CONTRACTOR's or manufacturers' calculations and six copies of manufacturers' standard data.
 - 4. Six (6) copies of manufacturers' printed installation, assembly, erection, application, and placement instructions.
 - 5. Three of each sample item specified in the various Specification Sections (where applicable), unless otherwise specified by the ENGINEER.
 - 6. Six (6) copies of inspection reports, test reports, and certificates of compliance.
 - 7. Where submittals are submitted to the ENGINEER for information or record purposes, submit two copies.
 - 8. The original and one copy of permits and licenses and other such documents obtained.

C. Other Submittals

1. Other submittals shall be furnished upon request for the ENGINEER's approval to verify compliance of all equipment and materials with the Contract Documents. These submittals shall include in addition to drawings: catalog cuts, certifications of compliance, or any other substantiating information or samples of material items as necessary.

D. Distribution

1. The CONTRACTOR shall duplicate and distribute reproductions of shop drawings, copies of product data, and samples, which bear company stamp of approval, to job site file, record documents file, subcontractors, suppliers, and any other entities requiring information.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 33 00 – SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 GENERAL

- A. Wherever submittals are required hereunder, all such submittals by the Contractor shall be submitted to the Engineer. A Submittal is defined as any drawing, calculation, specification, product data, samples, manuals, requests for substitutes, spare parts, photographs, survey data, record drawings, bonds, or similar items required to be submitted to the TVMWD Engineer under the terms of the contract.
- B. Before issuance of Notice to Proceed, the Contractor shall submit the following submittal items to the Engineer for review:
 - 1. A Preliminary Construction Schedule indicating the starting and completion dates of the various stages of the Work. Section 01 32 16 Construction Progress Schedules.
 - 2. A preliminary schedule of Shop Drawings, Samples, and proposed substitutes or "Or Equal" submittals.
 - 3. A list of all permits and licenses the Contractor shall obtain indicating the agency required to grant the permit and the expected date of submittal for the permit and required date for receipt of the permit.
 - 4. A preliminary schedule of values (lump sum price breakdown for all of the Work which will include quantities and prices of items aggregating the Contract Price and will subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such prices shall include an appropriate amount of overhead and profit applicable to each item of work which will be confirmed in writing by the Contractor at the time of submittal.
- C. Submittals: Before the preconstruction meeting, the Contractor shall submit to the Engineer proposed Substitutes or "Or Equal" products for the Engineer's review and approval. All such submittals shall be in conformance with the requirements of Paragraph 1.04, herein.
- D. The Contractor hereby agrees that failure to submit alternative product requests within the stipulated time period shall act as a waiver of any future rights to offer such substitutes, and the Contractor hereby agrees to provide one of the specific products called for in the Contract Documents.

1.02 SECTION INCLUDES

- A. This section specifies the general methods and requirements of submissions applicable to shop drawings, product data and samples, and operations and maintenance manuals. Detailed submittal requirements will be specified in the technical Specifications sections.
- B. The term "submittal" as used herein shall be understood to include working drawings, detail design calculations, shop drawings, fabrication and installation drawings, erection drawings, lists, graphs, operating instructions, catalog sheets, data sheets, samples, and similar items.

1.03 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 01 32 16 CONSTRUCTION PROGRESS SCHEDULE
 - 2. SECTION 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES
 - 3. SECTION 01 40 00 QUALITY REQUIRMENTS
 - 4. SECTION 01 77 00 CLOSEOUT PROCEDURES

1.04 RELATED WORK

- A. Standard Drawings
- B. General Conditions
- C. Standard Specifications
- 1.05 CITED STANDARDS NONE

1.06 NOTED RESTRICTIONS

- A. All submittals shall be complete, clearly typed, and legible. Incomplete submittals will be returned without review comments and no time extensions will be granted.
- B. It is the CONTRACTOR's responsibility to review submittals made by his Suppliers and Subcontractors before transmitting them to the ENGINEER to assure proper coordination of the work and to determine that each submittal is in accordance with his desires and that there is sufficient information about materials and equipment for the ENGINEER to determine compliance with the Contract Documents. Incomplete or inadequate submittals will be returned for revisions without review.

1.07 QUALITY CONTROL

A. CONTRACTOR's Responsibilities

- 1. The CONTRACTOR shall have each submittal reviewed, stamped, and signed as reviewed and approved prior to submission, and shall be responsible for the following:
 - a. The correctness of the drawings, for shop fits and field connections, and for the results obtained by the use of such drawings.
 - b. Verification of catalog numbers, and similar data.
 - c. Determination and verification of field measurements and field construction criteria.
 - d. Checking and coordinating information in the submittal with requirements of the Work and of the Contract Documents.
 - e. Determination of accuracy and completeness of dimensions, quantities, and field conditions at the site.
 - f. Safety precautions.
 - g. Errors or omissions on submittals.

- h. Coordination and performance of work of all trades.
- i. Identification and notification to the ENGINEER of deviation(s) from Contract requirements, and Conformance with the Specifications.
- 2. A submittal cover sheet shall accompany each submittal. The submittal cover sheet shall clearly indicate the names of the Project, OWNER, ENGINEER, CONTRACTOR, and Subcontractor or supplier (if appropriate), as well as the date, submittal number and contract number. Each item included in the submittals shall be listed on the cover sheet with a description, applicable project specification section including specification section and paragraph numbers, drawing number (if appropriate), location in the WORK, quantity required, and whether the item is being submitted as a product listed in the Contract Documents or as an equivalent substitution.
- 3. The CONTRACTOR shall coordinate each submittal with the requirements of the Work, placing particular emphasis upon assuring that each submittal of one trade is compatible with other submittals of related work.
- 4. All submittals shall bear the stamp of approval and signature of CONTRACTOR as evidence that CONTRACTOR has reviewed them. CONTRACTOR's stamp shall contain the following minimum information:

PROJECT NAME:	
CONTRACTOR'S NAME:	
Date:	
Submittal No.:	
Approved By:	

- 5. The CONTRACTOR stamp and signature certify the following:
 - a. The dimensional compatibility of the product with the space in which it is intended to be used.
 - b. The review of submittals for compliance with Contract requirements.
- 6. A number shall be assigned to each submittal by the CONTRACTOR starting with No. 1 and thence numbered consecutively. Re-submittals shall be identified by the original submittal number followed by the suffix "A" for the first resubmittal, the suffix "B" for the second resubmittal, etc.
- 7. No portion of the work requiring a shop drawing, sample, or product data shall be started nor shall any materials be fabricated or installed prior to the approval or qualified approval of such item. Fabrication performed, materials purchased or on-site construction accomplished which does not conform to approved shop drawings and data shall be at the CONTRACTOR's risk. The ENGINEER will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.
- 8. Approval of drawings and associated calculations by the ENGINEER shall not relieve the CONTRACTOR from the responsibility for errors or omissions in the drawings and associated calculations, or from deviations from the Contract Documents, unless submittals containing such deviations were submitted to the ENGINEER and the deviations were specifically called to the attention of the ENGINEER in the letter of

- transmittal and within the submittal, and approved specifically by the ENGINEER as a Contract change.
- 9. Approval of the CONTRACTOR's submittal by the ENGINEER shall not relieve the CONTRACTOR of any responsibility, including responsibility for accuracy and agreement of dimensions and details.
- 10. The ENGINEER will not be liable for any expense or delay due to corrections or remedies required to accomplish conformity.
- 11. For submittal Quantities, refer to **Section 01 33 23 Shop Drawings, Product Data, and Samples**. After review by the ENGINEER, one marked up reproducible set of drawings, one copy of product data, and one sample will be returned to the CONTRACTOR.
- 12. After review, the CONTRACTOR shall distribute prints or copies of approved submittals, bearing the OWNER's or designated approval authority's stamp and signature, to the CONTRACTOR's field office, the ENGINEER's field office, and any affected and concerned subcontractors, suppliers, fabricators, or members of the CONTRACTOR's workforce.

B. Review by OWNER/ENGINEER

- 1. Submittals will be reviewed for conformance with requirements of the Contract Documents. Review of a separate item will not constitute review of an assembly in which the item functions. Review will not relieve the CONTRACTOR from CONTRACTOR's responsibility for accuracy of submittals, for conformity of submittals to requirements of Contract Documents, for compatibility of described product with other provided products and the rest of the system, or for prosecution and completion of the Contract in accordance with the Contract Documents.
- 2. The review of shop drawings, data, and samples will be general. The review shall not be construed:
 - a. As permitting any departure from the Contract requirements;
 - b. As relieving the CONTRACTOR of responsibility for any errors, including details, dimensions, and materials;
 - c. As approving departures from details furnished by the ENGINEER.
- 3. The ENGINEER will indicate its reviews of submittals and the action taken by means of its review stamp. The review stamp will be affixed by the OWNER, the action block will be marked, and the stamp will be signed and dated.
- 4. The review-stamp action-block marks will have the following meanings:
 - a. The mark REVIEWED (or "NO EXCEPTIONS TAKEN") means that the submittal appears to conform to the respective requirements of the Contract Documents; that fabrication, assembly, manufacture, installation, application, and erection of the illustrated and described product may proceed; and that the submittal need not be resubmitted.
 - b. The mark FURNISH AS CORRECTED (or "MAKE CORRECTIONS NOTED") means there are minor clarifications or changes required on the submittal, but the submittal appears to conform to the respective requirements of the Contract Documents upon incorporation of the reviewer's corrections, and that fabrication, assembly, manufacture, installation, application, and erection of the illustrated and

- described product may proceed. Submittals so marked need not be resubmitted unless the CONTRACTOR challenges the reviewer's exception.
- c. The mark REVISE AND RESUBMIT (or "AMEND AND RESUBMIT") means that the submittal is in noncompliance with the Contract Documents and must be corrected and the entire package resubmitted. Fabrication, assembly, manufacture, installation, application, and erection of the illustrated and described product may proceed after incorporation of the reviewer's corrections and verification by the ENGINEER that the reviewer's corrections have been properly incorporated in the submittal. Resubmission within the time period specified is also required if the CONTRACTOR challenges the reviewer's corrections.
- d. The mark "REJECTED" (or "REJECTED-SEE REMARKS") means that the submittal is deficient to the degree that the reviewer cannot correct the submittal with a reasonable degree of effort, and the submittal does not meet the intent of the Contract Documents. The CONTRACTOR has not made a thorough review of the submittal, and that the entire submittal package needs revision to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the Contract Documents.
- 5. Resubmittals will be handled in the same manner as first submittals. On resubmittals the CONTRACTOR shall direct specific attention, in writing, on the letter of transmittal and on resubmitted shop drawings by use of revision triangles or other similar methods, to revisions other than the corrections requested by the ENGINEER, on previous submissions. Any such revisions that are not clearly identified shall be made at the risk of the CONTRACTOR. The CONTRACTOR shall make corrections to any work done because of this type revision that is not in accordance to the Contract Documents as may be required by the ENGINEER.
- 6. Partial submittals will not be reviewed. The ENGINEER will be the only judge as to the completeness of a submittal. Submittals not complete will be returned to the CONTRACTOR, and will be considered "rejected" until resubmitted. The ENGINEER may at his option provide a list or mark the submittal directing the CONTRACTOR to the areas that are incomplete.

1.08 PERMITS

- A. Obtain all permits and licenses necessary to the prosecution of the work. Submit a copy of all permits and licenses to the Engineer within 30 days of issuance.
- B. The Contractor and all his subcontractors, vendors and service providers shall comply with the regulations as stated in each permit for the applicable portion of the work governed by the respective permit. Failure by the Contractor, its subcontractors, vendors and service providers to comply with any permit requirements may cause monetary fines or other such retribution against the TVMWD by the permit-granting agency. Permit fines or other such retribution against the TVMWD that result from the acts or negligence of the Contractor, its subcontractors, vendors and service providers shall be paid for by the Contractor by deducting from the monies due the Contractor under this Contract.

1.09 SHOP DRAWINGS

A. Wherever called for in the Contract Documents, or where required by the Engineer, the Contractor shall furnish to the Engineer for review, via email in PDF format one copy of each

shop drawing submittal. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication and installation drawings, erection drawings, lists, graphs, operating instruction, catalog sheets, data sheets, and similar items. Unless otherwise required, said Shop Drawings shall be submitted to the Engineer at a time sufficiently early to allow review of same by the Engineer, and to accommodate the rate of construction progress required under the Contract.

- B. All Shop Drawings shall be accompanied by the TVMWD Engineer's standard submittal transmittal form which will be provided to the Contractor in Word format. Any submittal not accompanied by such a form, or where all applicable items on the form are not completed, will be returned for resubmittal.
- C. Normally, a separate transmittal form shall be used for each specific items or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single transmittal form will not be permitted.
- D. Except as may otherwise be provided herein, the Engineer will return via email of each submittal to the Contractor, with its comments noted thereon, within 20 calendar days following their receipt by the Engineer. It is considered reasonable that the Contractor shall make a complete and acceptable submittal to the Engineer by the second submission of a submittal item. The TVMWD reserves the right to withhold monies due the Contractor to cover additional cost of the Engineer's review beyond the second submittal.
- E. If copies of a submittal are returned to the Contractor marked "APPROVED" or "ACCEPTED" or "NO EXCEPTIONS TAKEN," formal revision and resubmission of said submittal will not be required,
- F. If a copy of the submittal is returned to the Contractor marked "AMEND-RESUBMIT," the Contractor shall revise said submittal and shall resubmit one copy via email of said revised submittal to the Engineer.
- G. If one copy of the submittal is returned to the Contractor marked "REJECTED-RESUBMIT," the Contractor shall revise said submittal and shall resubmit one copy via email of said revised submittal to the Engineer.
- H. Fabrication of an item may be commenced only after the Engineer has reviewed the pertinent submittals and returned copies to the Contractor marked either "NO EXCEPTIONS TAKEN" or "APPROVED" or "ACCEPTED" or "MAKE CORRECTIONS NOTED" Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis of claims for extra work.
- I. All Contractor submittals shall be carefully reviewed against the contract documents by an authorized representative of the Contractor, prior to submittal to the Engineer. A letter of affidavit shall be included with each submittal stating the contract documents have been reviewed and the submitted product is correct for the project application and in strict conformance with the contract documents. The letter affidavit must be dated and signed by both the Contractor and the product manufacturer or service provider. In the case of shop drawings, each sheet shall be so dated and signed for approval. No consideration for review by the Engineer of any Contractor submittals will be made for any items which are not accompanied with an affidavit. All submittals without an affidavit will be returned to the

- Contractor without action taken by the Engineer, and any delays caused thereby shall be the total responsibility of the Contractor.
- J. The Engineer's review of Contractor submittals shall not relieve the Contractor of the entire responsibility for the correctness of details and dimensions. The Contractor shall assume all responsibility and risk for any misfits due to any errors in Contractor submittals. The Contractor shall be responsible for the dimensions and the design of adequate connections and details.

1.10 PROPOSED SUBSTITUTES OR "OR EQUAL" ITEMS

- A. For convenience in designation in the Contract Documents, any material, product, or equipment to be incorporated in the Work may be designated under a brand or trade name or the name of a manufacturer and its catalog information. The use of any substitute material, product, or equipment which is equal in quality and utility and possesses the required characteristics for the purpose intended will be permitted, subject to the following requirements:
 - 1. The burden of proof as to the quality and utility of any such substitute material, product, or equipment shall be upon the Contractor.
 - 2. The Engineer will be the sole judge as to the quality and utility of any such substitute material, product, or equipment and its decision shall be final.
- B. Wherever in the Contract Documents the name or the name and address of a manufacturer or Supplier is given for a material, product, or equipment, or if any other source of a material, product, or equipment is indicated therefore, such information is given for the convenience of the Contractor only, and no limit, restriction, or direction is indicated or intended thereby, nor is the accuracy or reliability of such information guaranteed. It shall be the responsibility of the Contractor to determine the accurate identity and location of any such manufacturer, Supplier, or other source of any material, product, or equipment called for in the Contract Documents.
- C. The Contractor may offer any material, product, or equipment which it considers equal to those specified. Unless otherwise provided by law or authorized in writing by the Engineer, the substantiation of any proposed substitute or "or-equal" material, product, or equipment must be submitted within 10 days after the submission of the Bid to substantiate substitution of "or equal items. The Contractor, at its sole expense, shall furnish data concerning items it has offered as substitute or "or-equal" to those specified. The Contractor shall provide the data required by the Engineer to determine that the quality, strength, physical, chemical, or other characteristics, including durability, finish, efficiency, dimensions, service, and suitability are such that the substitute or "or-equal" item will fulfill its intended function.
- D. The Contractor's attention is further directed to the requirement that its failure to submit data substantiating a request for a substitution of an "or equal" item within said allowed period shall be deemed to mean that the Contractor intends to furnish one of the specific brand or trade-named material, product, or equipment specified in the Contract Documents and the Contractor does hereby waive all rights to offer or use substitute materials, products, or equipment in each such case. Wherever a proposed substitute material, product, or equipment has not been submitted within said 35-day period, or wherever the submission of a proposed substitute materials, product, or equipment fails to meet the requirements of the Specifications and an acceptable resubmittal is not received by the Engineer within said 35-day

period, the Contractor shall furnish only one of the materials, products, or equipment originally- named in the Contract Documents. Approval by the Engineer of a substitute item proposed by the Contractor shall not relieve Contractor of the responsibility for full compliance with the contract Documents and for adequacy of the substituted item. The Contractor shall also be responsible for resultant changes and all additional costs which the substitution requires in its work, the work of its subcontractors and of other contractors and shall effect such changes without cost to TVMWD.

E. Should the approved substitutions result in a lowering of project cost, the TVMWD may require as a condition of approval a contract cost reduction.

1.11 SAMPLES

- A. Unless otherwise specified, whenever in the Specifications samples are required, the Contractor shall submit not less than 3 units of each such sample item or material to the Engineer for approval at no additional cost to the TVMWD.
- B. Samples, as required herein, shall be submitted for approval a minimum of 21 days prior to ordering such material for delivery to the job-site, and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delays in the Work.
- C. All samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and manufacturer's names for identification and submittal to the Engineer for approval. Upon receiving approval of the Engineer, one set of the samples will be stamped and dated by the Engineer and returned to the Contractor, one set will be retained by the Engineer, and one set of samples shall remain at the job site for reference by the Engineer and the Resident Project Representative until completion of the Work.
- D. Unless otherwise specified, all colors and textures of specified items will be selected by the Engineer from the manufacturer's standard colors and standard materials, products, or equipment lines.

1.12 TECHNICAL MANUALS

- A. The Contractor shall furnish to the Engineer 6 identical sets of technical manuals. Each set shall consist of one or more volumes, each of which shall be bound in a standard size, 3-ring, loose-leaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches. A table of contents shall be provided which indicates all equipment in the technical manuals. Three sets shall be on waterproof paper/materials.
- B. The Contractor shall include for each item of mechanical, electrical, and instrumentation equipment of the technical manuals the following.
 - 1. Complete operating instructions, including location of controls, special tools or other equipment required, related instrumentation, and other equipment needed for operation.
 - 2. Lubrication schedules, including the lubricant SAE grade and type, temperature range of lubricants, and including frequency of required lubrication.
 - 3. Preventive maintenance procedures and schedules.
 - 4. Parts lists, by generic title and identification number, complete, with exploded views of each assembly.
 - 5. Disassembly and reassembly instructions.

- 6. Name and location of nearest supplier and spare parts warehouse.
- 7. Recommended trouble-shooting and start-up procedures.
- 8. Reproducible prints of the Record Drawings, including diagrams and schematics, as required under the electrical and instrumentation portions of these specifications.
- 9. Tabulation of proper settings for all control valves and other related equipment protection devices.
- 10. Detailed test procedures to determine performance efficiency of equipment.
- C. All technical manuals shall be submitted in final form to the Engineer not later than the 75-percent of construction completion date. All discrepancies found by the Engineer in the technical manuals shall be corrected by the Contractor within five (5) days from the date of written notification by the Engineer.
- D. Incomplete or unapproved technical manuals at the 75 percent construction point shall constitute sufficient justification to withhold payment for work completed beyond that period.

1.13 SPARE PARTS LISTS

A. The Contractor shall furnish to the Engineer 5 identical sets of spare parts information for all mechanical and electrical equipment. The spare parts list shall include the current list price of each spare part. The spare parts list shall be limited to those spare parts which each manufacturer recommends be maintained by the TVMWD in inventory. Each manufacturer or supplier shall indicate the name address, and telephone number of its nearest outlet of spare parts to facilitate the TVMWD in ordering. The Contractor shall cross-reference all spare parts lists to the equipment numbers designated in the Contract Documents. The spare parts lists shall be bound in standard size, 3-ring, loose-leaf, vinyl plastic hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches.

1.14 DAILY REPORTS

A. Provide for each work shift a written Daily Report to the Engineer describing the work performed, conditions encountered, weather conditions, delays to the work, accidents or safety concerns, and any construction problems or deviations from the requirements of the Contract Documents. Show on the Daily Report an itemized breakdown of all labor, material deliveries, equipment, and subcontract labor used in performing the work. Submit the Daily Report within two days after completion of the reported work shift.

1.15 RECORD DRAWINGS

- A. General: The Contractor shall keep and maintain, at the job site, one record set of Contract Drawings. On these, it shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction.
- B. Special attention shall be given to recording the horizontal and vertical location of all buried utilities that differ from the locations indicated, or which were not indicated on the Contract Drawings. Said record drawings shall be supplemented by any detailed sketches as necessary or directed to indicate, fully, the Work as actually constructed.

- C. These master record drawings of the Contractor's representation of "as-built" conditions, including all revisions made necessary by addenda, change orders, and the like shall be maintained up-to-date during the progress of the Work.
- D. In the case of those drawings which depict the detail requirement for equipment to be assembled in the factory, the record drawings shall be updated by indicating those portions which are superseded by change order drawings or final shop drawings, and by including appropriate reference information describing the change orders by number and the shop drawings by manufacturer, drawing, and revision numbers.
- E. Record drawings prepared by the Contractor shall be accessible to the Engineer at all times during the construction period and shall be delivered to the Engineer upon completion of the work.
- F. Effect on progress Payments: Requests for partial payments will not be approved if the record drawings are not kept current. All such Record Drawings will be inspected by the Engineer each month, showing all variations between the Work as actually constructed and as originally shown on the Contract Drawings or other Contract Documents, and the TVMWD will not process monthly payment requests until such drawings are made current each month.
- G. Final Record Drawings: Upon substantial completion of the Work and prior to final acceptance by the TVMWD, the Contractor shall complete and deliver the completed set of Record Drawings to the Engineer for transmittal to the TVMWD, conforming to the construction records of the Contractor. This set of drawings shall consist of corrected plans showing the reported location of the Work. The information submitted by the Contractor and incorporated by the Engineer into the Record Drawings will be assumed to the reliable, and the Engineer will not be responsible for the accuracy of such information, nor for any errors or omissions which may appear on the Record Drawings as a result.
- H. Effect on Final Payment. Final payment will not be approved until the Contractor- prepared Final Record Drawings have been delivered to the Engineer. Said up-to- date, Record Drawings may be in the form of a set of prints with carefully plotted information overlaid in pencil.

1.16 CONSTRUCTION PHOTOGRAPHS

A. The Contractor shall provide monthly construction photographs showing the daily progress of the Work.

1.17 MEASUREMENT AND PAYMENT

A. Measurement and payment for work in this section will be considered as subsiding obligation of the Contractor and the cost thereof shall be in the applicable items listed in the Bid Schedule.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 32 19 – SUBMITTALS SCHEDULE

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section includes information regarding the submittals schedules.
- 1.02 REFERENCED SECTIONS
 - A. Related Sections are listed below:
 - 1. SECTION 01 32 16 CONSTRUCTION PROGRESS SCHEDULE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
- 1.05 QUALITY CONTROL (SUBMITTAL REQUIREMENTS)
 - A. The CONTRACTOR shall submit a completed submittal schedule and list of products for all items requiring the OWNER's review and approval within ten (10) calendar days after the effective date of Notice to Proceed. The following shall be included in the submittal:
 - 1. Submittals, including description of the item and name of manufacturer, trade name and model number.
 - 2. Specification reference.
 - 3. Intended submission/resubmission date(s).
 - 4. Order release date.
 - 5. Lead time to delivery/anticipated delivery date(s).
 - 6. Highlight any items that require expedited review to meet the project schedule.
 - B. Schedules shall be presented in a form acceptable to the OWNER in both electronic and hard copy versions and shall be updated and sent to the OWNER on a monthly basis. The CONTRACTOR shall identify all submittals that are required by the Contract Documents and determine the date on which each submittal will be submitted in conformance with the schedules specified in Section 01 32 16 Construction Progress Schedule.
 - C. Submittals involving Engineering design services, such as shoring and underpinning, excavation support structures, falsework for concrete, and load and design calculations, shall be sealed and signed by a professional ENGINEER, currently registered in the State, for the discipline involved.
 - 1. Other submittals involving Engineering design services, when specified or required by governing codes and regulations, shall be sealed and signed by a professional ENGINEER, currently registered in the State, for the discipline involved.

D. Review Period

- 1. The CONTRACTOR shall prepare submittals sufficiently in advance so that approval may be given before commencement of the related work.
- 2. Fifteen (15) calendar days shall be allowed after receipt by the OWNER for review of each submittal, including re-submittals.
- 3. The CONTRACTOR shall be responsible for determining whether or not certain governmental entities and utility districts require longer review periods. When longer review periods are required, the CONTRACTOR shall schedule the Work accordingly, so that the Work and project progress schedules are not adversely impacted.
- E. The following equipment and materials shall have the submittals provided early in the project as they are expect to have to longest lead time in procuring:
 - 1. Vertical Turbine Pump, Motor and Accessories: Submit to Engineer within 15 calendar days of NTP.
 - 2. MCC and VFD Equipment: Submit to Engineer within 45 calendar days of NTP.
 - 3. Well Building Steel Trusses: Submit to Engineer withing 45 calendar days of NTP.

F. Submittal Delivery

- 1. The CONTRACTOR shall deliver submittals by shipping them prepaid to OWNER, or by delivering them to the OWNER directly by hand.
- G. Transmittal forms shall accompany submittals and include the following information:
 - 1. The CONTRACTOR's name, address, and telephone number;
 - 2. Submittal number and date;
 - 3. Contract title and number;
 - 4. Supplier's, manufacturer's, or Subcontractor's name, address, and telephone number; and
 - 5. Subject identification including Contract Drawing and Specification reference.
- H. Changes in approved submittals will not be allowed unless those approved submittals with changes have been resubmitted and approved, in the same manner as the original submittal.
- I. Supplemental submittals initiated by the CONTRACTOR for consideration of corrective procedures shall contain sufficient data for review. Make supplemental submittals in the same manner as initial submittals.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 32 16 - CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes the scheduling of work requirements to be performed by the Contractor. The development of the schedule, monthly payment requisitions, and project status reporting requirements of the Contract shall employ computerized Critical Path Method scheduling. Prepare the CPM Schedule and all reports with the latest version of "Primavera," or equal software.

1.02 RELATED WORK

- A. Standard Drawings
- B. Standard Specifications

1.03 QUALIFICATIONS

A. Submit to TVWMD's Engineer a statement of computerized CPM qualifications verifying the Contractor's in-house staff or consultant capability to use CPM techniques required herein. Identify the individual who will perform the CPM scheduling and verify qualifications by providing a description of construction projects that the individual has successfully applied computerized CPM. List at least two projects of similar nature, scope, and value, and provide a contact person for each referenced project with current telephone, fax, email address, and mailing address information.

1.04 CPM STANDARDS

- A. CPM, as required herein, shall be interpreted to be generally as outlined in the Association of General Contractors publication, "The Use of CPM in Construction," except that either "i-j" arrow diagrams or precedence diagramming format may be utilized. In the case of conflicts between this specification and the AGC publication, this specification shall govern.
- B. Include with construction schedules a graphic network diagram and computerized construction schedule reports.
- C. The CPM network shall be in a form of a time scaled "i-j" activity-on-arrow or precedence type diagram and may be divided into a number of separate sheets with suitable match lines relating the interface points among the sheets.
- D. Indicate all construction activities and procurement in a time-scaled format using a calendar time line shown along the entire sheet length. Plot each activity arrow or node so that the beginning and completion dates of each activity are accurately represented along the calendar time line. Show all activities using the symbols that clearly distinguish between Critical Path activities, non-critical activities, and free float for each noncritical activity. Identify all activity items by their respective Activity Number, Responsibility Code, Work Duration, and their Dollar Value. All non-critical path activities shall show their total float time in scale form by utilizing a dotted line or some other graphical means.

- E. Compute the duration estimate indicated for each activity in working days and represent the single best estimate considering the scope of the activity work and resources planned for the activity.
- F. Except where otherwise provided herein, float as referenced in these documents is total float. Total float is the period of time measured by the number of working days each non-critical path activity may be delayed before it and its succeeding activities become part of the Critical Path. If a non-critical path activity is delayed beyond its float period, that activity then becomes part of the Critical Path and controls the end date of the Project. Thus, the delay of the non-critical path activity beyond its float period will cause delay to the Project itself.
- G. Duration of a single activity shall not be more than 10 calendar days on the CPM network.

1.05 CPM SCHEDULE SUBMITTALS

- A. Within 10 calendar days after the date of receipt of the Notice to Proceed, submit for review by TVWMD Engineer one hard copy and one compact disc (CD-R format) of the initial CPM Network Schedule and the Computerized Schedule Report tabulation. The CPM Schedule shall be a time-scaled network diagram of the "i-j" activity-on-arrow or precedence type. The network diagram shall describe the activities to be accomplished and their logical relationships, and show the Critical Path.
- B. The computerized schedule report tabulations shall include the following:
 - 1. Report of activities sorted by Activity Number. Correlate Activity Numbers, where practical, to the Contractor's work areas.
 - 2. Report of activities sorted by Early Start date.
 - 3. Report of activities sorted by Total Float.
 - 4. Report of activities sorted by Responsibility Code. Responsibility Codes shall be established for the Contractor, Engineer, Water Authority, subcontractors, suppliers, etc. Codes shall be identified in the Network Diagram.
 - 5. A Successor-Predecessor Report which shall identify the successor and predecessor activities for each activity and ties between schedule activities.
- C. Include sufficient detail for the identification of work components into such activities as mobilization and demobilization; clearing and grubbing; temporary erosion control installation and removal; traffic control; dewatering; shoring and bracing installation and removal; trenching, backfilling and compaction; blasting; tunneling; final grading; restoration and revegetation; pavement repair; pipe fabrication; pipe installation; pipe lining; coating of field joints; installing valves and miscellaneous piping; testing and disinfection; placing reinforcement; forming, placing and curing of concrete; masonry construction; miscellaneous metals fabrication and installation; painting and coating; installation of electrical and instrumentation equipment; and other such work.
- D. Within 5 calendar days after submittal of initial CPM Network Schedule, meet with TVWMD Engineer to review such submittal. TVWMD's Engineer's review will be limited to the submittal's conformance to the Contract requirements, and may include directions to include activities and information missing from the submittal and requests to the Contractor to clarify his schedule.

- E. Revise the initial CPM Network Schedule submittal to address all review comments received from the Engineer and resubmit the Network Diagrams and reports. TVWMD's Engineer will either (1) accept the resubmitted schedule, or (2) advise the Contractor in writing to review any part or parts of the schedule, which either do not meet the Contract requirements or are unsatisfactory for TVWMD Engineer to monitor the project's progress and status. TVWMD Engineer may accept the schedule with conditions that the first monthly CPM Schedule update be revised to correct deficiencies identified. When the CPM Schedule is accepted, it shall be considered as the "Baseline CPM Construction Schedule." The Water Authority reserves the right to require that the Contractor adjust, add to, or clarify any portion of the CPM Schedule, which may later be discovered to be insufficient for the monitoring of the work.
- F. Acceptance of the Baseline CPM Construction Schedule by TVWMD Engineer shall be a CONDITION PRECEDENT to holding the Pre-Construction Conference, mobilizing any labor, equipment and materials at the site of work, and processing any Application for Payment subsequent to the first monthly payment.
- G. By way of the Contractor assigning activity durations and proposing the sequence of the work, the Contractor agrees to utilize sufficient and necessary management and other resources to perform the work in accordance with the CPM Schedule.
- H. Submission of the Baseline CPM Construction Schedule to City Engineer shall not relieve the Contractor of his total responsibility for scheduling, sequencing, and pursuing the work to comply with the requirements of the Contract Documents, including adverse effects such as delays resulting from ill-timed work.
- I. Following the acceptance of the Contractor's Baseline CPM Construction Schedule, monitor the progress of the work and adjust the Schedule each month to reflect actual progress and any changes in planned future activities. Submit each CPM Schedule monthly update to meet all requirements as indicated herein for the original schedule submittal. Show all work activities on each update, including those already completed. Accurately show the "record" information for completed work activities by indicating when the work was actually started and completed.
- J. The CPM Schedule update submittal will be reviewed with the Contractor during monthly construction progress meetings. Subsequent to such meetings, submit on or before the fifth day of each month a revised CPM Network Diagram, revised CPM computerized tabulations, and revised Successor-Predecessor Report. Acceptance of the monthly Schedule Update submittal shall be a condition precedent to processing each monthly application for payment.
- K. Highlight or otherwise identify all changes to the Schedule. Modify any portions of the CPM Schedule, which become infeasible because of activities behind schedule or for any other valid reason.
- L. Neither the submission nor the updating of the Contractor's Schedule submittal, nor TVWMD Engineer's review or acceptance of any such Schedule shall have the effect of modifying the Contract completion date or milestone dates or the Contractor's obligations under this Contract.

1.06 PROGRESS SCHEDULES

A. Progress schedules shall represent a practical plan to complete the Work within the Contract time(s) of completion indicated, and shall convey the CONTRACTOR's intent in the manner of execution and progress of the Work.

- B. The scheduling and execution of construction in accordance with the Contract Documents are the responsibility of the CONTRACTOR. The CONTRACTOR shall involve and coordinate all Subcontractors and material suppliers in the development and updating of progress schedules.
- C. The submittal of progress schedules shall be understood to be the CONTRACTOR's representation that the progress schedule meets the requirements of the Contract Documents and that the Work will be executed in the sequence and duration indicated in the progress schedule.

D. Scheduling Format

- 1. The Project Schedule shall be computer produced by utilizing project scheduling software such as Primavera, Microsoft Project, SureTrak, Timeline or other equivalent software as approved by the ENGINEER. Project schedules shall be prepared in advance of the project pre-construction conference.
- 2. The Project Schedule shall be updated monthly and shall show Contract tasks, the percent complete, progress bars, baseline schedules, milestones, start and finish dates, and other breakdowns as required by the ENGINEER. The schedules shall show clearly the sequence of activities and shall list specifically the following activities:
 - a. Interim milestone completion dates. Phasing and staging of the Work as specified shall be prominently identified.
 - b. Submittals and the OWNER's review of submittals.
 - c. Any long lead time (over 60 days) orders for material and equipment.
 - d. Work to be performed by other contractors or agencies.
- 3. Descriptions of scheduled activities shall include sufficient detail to identify the work that is to be accomplished.
 - a. The schedule shall contain sufficient activities to clearly show the sequence and interdependencies of the Work. The schedule shall be prepared in such a way that an activity or group of activities will correspond directly with the bid item breakdown and/or the breakdown of lump sum bid items. The ENGINEER may request that additional activities be added.
 - b. Activity durations shall be expressed in whole days. Work that is to be performed by Subcontract shall be clearly defined.
 - c. Float suppression techniques, such as preferential sequencing (crew movement, equipment use, and form reuse), extended duration, imposed dates, scheduling of work not required for the Contract, and others, shall not be used to affect or limit float in the schedule. The use of constraint dates should be minimized, and must be approved by the OWNER.
- 4. A schedule showing that Work that is completed in less than the completion time specified may be found to be impractical by the ENGINEER.
- 5. A schedule showing that Work that is completed in less than the completion time specified, that is found to be practical by the ENGINEER, shall be considered to have float. The float shall be the time between the scheduled completion of the Work and the Contract completion date. Float time shall not be for the exclusive benefit of the CONTRACTOR.
- 6. A schedule found to be impractical for the preceding reasons or any other reasons shall be revised by the CONTRACTOR and resubmitted.

7. Two week look ahead schedules prepared in a format suitable to the CONTRACTOR and ENGINEER shall be prepared on a Weekly basis.

1.07 CHANGE ORDERS

- A. Incorporate approved Change Orders in the Schedule Update submittal for the next month following Change Order approval. Utilize a sub-network in the schedule depicting the changed work and its effect on other activities. Tie this sub network to the main network with the appropriate logic so that a true analysis of the Critical Path can be made.
- B. Each Change Order requiring a time impact analysis to be submitted along with the Change Order. Change Order will not be considered unless the Time Impact Analysis is submitted.

1.08 SCHEDULE REPORTS (FORMAT)

- A. Prepare Schedule Reports based on the Construction Schedule, and include the following minimum data for each activity:
 - 1. Activity Numbers and Responsibility Codes.
 - 2. Work Order Number.
 - 3. Estimated Activity Duration.
 - 4. Activity Description.
 - 5. Activity's Percent Completion.
 - 6. Early Start Date (Calendar Dated).
 - 7. Early Finish Date (Calendar Dated).
 - 8. Late Start Date (Calendar Dated).
 - 9. Late Finish Date (Calendar Dated).
 - 10. Status (Whether Critical).
 - 11. Total Float for Each Activity.
 - 12. Free Float for Each Activity.
- B. Preface each Schedule Report with the following summary data:
 - 1. Project Name.
 - 2. Contractor.
 - 3. Type of Tabulation.
 - 4. Project Duration.
 - 5. Contract Completion Date (revised to reflect time extensions).
 - 6. The Commencement Date stated in the Notice to Proceed.
 - 7. The Data Date and Plot Date of the Network Diagram.
 - 8. If an update, cite the new schedule completion date.

1.09 MEASUREMENT AND PAYMENT

A. Measurement and payment for work in this section will be considered as subsiding obligation of the Contractor and the cost thereof shall be in the applicable items listed in the Bid Schedule.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 31 19 - PROJECT MEETINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Required to enable orderly review during pre-design and pre-installation conferences and progress of Contracted Work, and to provide for systematic discussion of design and installation problems and other construction problems arisen, the ENGINEER will conduct project meetings throughout the design and construction period. Conform to the Design Scheduling Conference, Pre-Construction Scheduling Conference and Project Schedule Review Meeting.

1.02 AGENDA ITEMS

A. To the maximum extent practicable, advise the ENGINEER'S at least twenty-four (24) hours in advance of project meetings regarding items to be added to the agenda or requesting the cancellation of any Meeting.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 SECTION INCLUDES

A. Except as noted for preconstruction meeting, project meetings will be held weekly. To the maximum extent practicable, meetings will be held in CONTRACTOR'S job office at the Jobsite and/or via video teleconference. Site meetings will be held as necessary to support construction progress.

END OF SECTION

PROJECT MEETINGS 01 31 19 - 1

SECTION 01 20 00 - PRICE AND PAYMENT PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes Specifications for measurement and payment as they apply to the work, and includes provisions applicable to lump sum prices.

1.02 REFERENCED SECTIONS

A. See TVMWD Technical Specification T-01 22 00 for details on Bid Items and unit break down requirements.

1.03 LUMP-SUM MEASUREMENT

- A. The CONTRACTOR shall construct the work under a single lump sum fixed price contract. Lump-sum measurements will be for the entire item, unit of work, structure, or any combination of these described, as specified and as indicated in the Bid Schedule of the Bid Form.
- B. If the CONTRACTOR requests progress payments for lump-sum items or amounts in the Bid Schedule, such progress payments will be made in accordance with a well-balanced, detailed program of payment-apportioning, prepared by the CONTRACTOR and submitted to the OWNER for approval. Such payment-apportioning may require modifications during the Contract, as determined by the ENGINEER.
- C. Such a program for each applicable lump-sum item shall show fixed definable and measurable quantities where possible and unit prices therefore as developed and assigned by the CONTRACTOR to the different features of the work and major subdivisions thereof. The summation of extensions of quantities and unit prices and related costs shall equal the amount of the lump-sum Contract Price or lump sum bid item indicated in the Bid Schedule.
- D. Following the OWNER's approval, progress payments will be made in accordance with the CONTRACTOR's payment-apportioning program and from the approved progress schedule, reflecting the progress which occurred during the payment period as approved by the OWNER.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 14 19 – USE OF SITE

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section provides a description of how the CONTRACTOR shall use the designated site area.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE

1.04 NOTED RESTRICTIONS

- A. "Use of the Site" will be in accordance with the access agreements agreed to for each specific site/property owner that the project is worked on.
- B. The CONTRACTOR shall limit work activities to the construction site and shall restrict storage of construction materials, equipment, etc. to a site (or sites) designated by the OWNER.
- C. Holes and/or trenches shall not be left in any locations unguarded. If it is necessary to do so, the CONTRACTOR shall provide suitable protection and warning signs to prevent injury.

1.05 QUALITY CONTROL

- A. The CONTRACTOR shall assume full responsibility for protection and safekeeping of products and other items under this contract.
- B. The CONTRACTOR shall determine if there are underground wires, cables, pipelines, or other apparatus in the work area prior to excavation.
- C. The CONTRACTOR shall be liable for any damage to underground utilities caused by excavation.

1.06 CONTRACTOR'S WORK AND STORAGE AREA

- A. The ENGINEER will designate and arrange for the CONTRACTOR's use a portion of the property adjacent to the Work for its exclusive use during the term of the Contract as an office and storage and shop area for its construction operations relative to this contract.
- B. The CONTRACTOR shall be solely responsible for the security of its tools, supplies and equipment at the site.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

USE OF SITE 01 14 19 - 1

SECTION 01 14 16 - COORDINATION WITH THE OWNER

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section provides a description of how the General Construction CONTRACTOR shall coordinate construction activities with the OWNER.
 - 1. The CONTRACTOR shall develop and implement a plan to minimize the effect of construction activities on surrounding areas affected by this project.
 - 2. The CONTRACTOR shall be responsible for providing prior notice to the owners of all business and residential properties where access to the properties may be restricted.
 - 3. The CONTRACTOR shall restrict access to businesses within the affected area during normal business hours.
 - 4. The CONTRACTOR shall minimize restriction of access to residential properties to the extent practicable.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. The CONTRACTOR shall conduct its operations so as not to interfere unnecessarily with the authorized work of utility companies, other agencies, or the PWP's plant personnel. No street or access shall be closed without first obtaining permission of the proper authority.
- 1.05 QUALITY CONTROL
 - A. The CONTRACTOR shall comply with all applicable federal, state and local standards, codes, permitting and other restrictions in effect for construction activities.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 14 13 – ACCESS TO SITE

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section provides a description of the CONTRACTOR's responsibilities and restrictions related to site access.
- 1.02 CITED STANDARDS NONE
- 1.03 NOTED RESTRICTIONS
 - A. Nothing herein shall be construed to entitle the CONTRACTOR to the exclusive use of any public street, utility right-of-way or the site of the Work during the performance of the Work.
 - B. The CONTRACTOR shall complete all Work within public right-of-ways in accordance with the applicable permit(s) issued by the City of Pasadena and Los Angeles County including, but not limited to, any restrictions on work hours.
 - C. Below include anticipated work hours for reference by the CONTRACTOR. The CONTRACTOR shall confirm "actual" specific work hours with the PWP prior to performing work.
 - 1. City of Claremont
 - a. 7am 7pm
 - b. School Zones: 9am 2:30pm

1.04 HIGHWAY AND STREET LIMITATIONS

- A. The CONTRACTOR shall make its own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits and other limitations affecting transportation and ingress and egress to the site of the Work. It shall be the CONTRACTOR's responsibility to construct and maintain any haul roads required for its construction operations.
- B. Where excavation is being performed in primary streets or highways one (1) lane in each direction shall be kept open to traffic at all times unless otherwise provided or shown. Fire hydrants on or adjacent to the Work shall be kept accessible to fire-fighting equipment at all times. Temporary provisions shall be made by the CONTRACTOR to assure the use of sidewalks, access routes and the proper functioning of all gutters, sewer inlets and other drainage facilities.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

ACCESS TO SITE 01 14 13 - 1

SECTION 01 11 13 – WORK COVERED BY CONTRACT DOCUMENTS

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section provides a description of the Work Covered by the Contract Documents.
- 1.02 CITED STANDARDS NONE
- 1.03 NOTED RESTRICTIONS
 - A. For the purposes of this project, all work to be performed shall be as described in Section C Bid Forms of the associated Construction Contract, and will not be included in this section.
- 1.04 QUALITY CONTROL
 - A. Work Covered by the Contract Documents requires purchase, furnishing of all labor, material, and equipment to perform installation of all equipment and materials as necessary to complete the work as shown on the drawings, described in the Specifications, and as specified herein.
 - B. The CONTRACTOR shall be responsible for obtaining, at a minimum, the following permits:
 - 1. Encroachment and Construction Permitting for the City of Claremont
 - C. The CONTRACTOR shall include anticipated costs to obtain the necessary permits for the Work to be performed. The CONTRACTOR shall be notified so if this is the case.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 11 00 - SUMMARY OF WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Demolition and Protection in Place of Existing Features

1. The project site is located on an unimproved site with existing oak and fruit trees. Residential neighboring lots have large trees with overhanging branches requiring special care to protect in place. An existing irrigation line in the north of the lot must have service maintained throughout construction.

B. Miramar Well Site Improvements

- 1. The project involves installation of a contractor provided and installed vertical turbine pump sized with a 100 HP VFD rated motor and pump assembly. Contractor shall coordinate with the pump supplier to ensure all installation complies with pump supplier warranty requirements.
- 2. The new well will be housed inside a new well building with fieldstone cladding to match the architectural theme of the neighborhood. The building will include a climate controlled new MCC room. A future chemical disinfection room is provided with conduits for future chemical piping.
- 3. A percolation pond will be constructed for disposal of well water during well start up to dispose of an turbid water in the initial discharge. Haul routes will be strictly enforced and hours of operation of haul limited to 8:00AM to 5:00PM to reduce impacts on local residents.
- 4. Site improvements include wrought iron fencing with fieldstone cladding it's pilasters.
- 5. Site security, yard lighting, fieldstone storm swales, and landscaping are included in the site improvements.

C. Connection to Raw Water Line In Street Right-of-Way

1. TVMWD is has installed a raw water line from their other existing well and discharges to the Miramar WTP located just to the east of the project site. The project connect to the existing piping on Grand Ave and also small section interconnecting at the intersection of Miramar Ave and Grande Ave

D. Early Submittal Requirements:

- 1. The Contractor will be required to provide submittals on key long lead items early in the project in an effort minimize construction schedule. The following equipment and materials shall have the submittals provided early in the project as they are expect to have to longest lead time in procuring:
- 2. Vertical Turbine Pump, Motor and Accessories: Submit to Engineer within 15 calendar days of NTP.
- 3. MCC and VFD Equipment: Submit to Engineer within 45 calendar days of NTP.
- 4. Well Building Steel Trusses: Submit to Engineer withing 45 calendar days of NTP.

SUMMARY OF WORK 01 11 00 - 1

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SUMMARY OF WORK 01 11 00 - 2

SECTION 01 04 50 - EXISTING FACILITIES

PART 1 - GENERAL

1.01 DEFINITIONS

- A. This section describes the procedures for locating, protecting, and relocating existing underground utilities, surface improvements, and requirements to connect to existing facilities.
- B. Do not perform work that would affect any oil, gas, sewer, or water pipeline; any telephone, telegraph, or electric transmission line; any fence; or any other structure, prior to providing the owner of the improvement due notice of the beginning of work, and remove, shore, support, or otherwise protect such pipeline, transmission line, ditch, fence, or structure, or replace same.

1.02 RELATED WORK

- A. Standard Drawings
- B. Standard Specifications 01 00 00, 01 04 50, 01 32 16, 01 33 00, 02 41 13.13, 03 30 00, 03 15 16, 09 90 00, 09 96 71, 21 50 10, 23 00 00, 23 26 13, 23 31 19.13, 23 91 10, 23 91 19, 23 92 13, 23 92 17, 23 93 10, 23 93 17, 23 94 05, 23 95 13, 31 23 00, 31 23 19, 32 16 13, 33 02 22

1.03 CONDITION OF EXISTING FACILITIES

A. Neither the TVMWD nor the Design Engineers warrant the condition, size, material, and location of existing facilities.

1.04 EXISTING FACILITY LOCATION

A. The contractor shall be responsible for verifying in advance the location of all existing pipelines and subsurface utilities and structures as marked by (USA) Underground Services Alert as shown on the plans. Discrepancies shall be reported to the project engineer, prior to the fabrication of, or purchase of material and construction affected by the discrepancy.

1.05 EXISTING FACILITY DOCUMENTATION

- A. After the Notice to Proceed issued and before Work at site is started, Contractor and TVMWD shall make thorough examination of pre-existing conditions including existing buildings, structures, pipelines, roadways, and other improvements in vicinity of Work, as applicable, which might be impacted or potentially damaged by construction operations.
- B. Contractor shall take photographs and videotape to document preexisting conditions prior to the start of the work. Include public roads and improvements to adjacent private property as part of preexisting condition documentation. Three sets of dated photographs and three copies of the dated video provided on DVD shall be submitted to the TVMWD prior to the beginning of construction. The TVMWD will review, sign, and return one record copy to Contractor to be kept on file in Contractor's field office as site records.
- C. These photographs and videotapes are intended for use as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of Contractor's operations, and is for protection of Contractor and TVMWD.

D. The Contractor shall notify property owners adjacent to the site and property owners located on streets that will be closed or restricted by the Work. Notification shall be in the form of a letter, reviewed and approved by TVMWD and delivered a minimum of 15 days before construction is scheduled to commence. The Contractor shall be available to attend one community meeting to answer public questions regarding the project if requested to do so. The meeting time, date and location will be provided by TVMWD for inclusion in the notification letter.

1.06 UTILITY VERIFICATION

- A. Existing utilities have been identified and located on the Plans based on available information, including above ground utility evidence, mapping provided by utility agencies. The Contractor shall be responsible for verifying the location of all existing utilities within the entire pipe trench of the new water main. The necessary verification for existing utilities shall commence prior to constructing the new water main.
- B. The Contractor shall contact all utility owners a minimum of 72 hours in advance of any excavations to verify existing utilities and substructures. Utility verification may result in modification of the pipeline alignment or profile to avoid conflict with existing utilities that are found to be in a different location than shown on the Drawings. Minor modifications involving no increase in pipe length, number of fittings, or appurtenances shall be made at no additional cost to the TVMWD.
- C. Delays resulting from discoveries during potholing shall not justify additional time and monetary compensation to the Contractor.
- D. The Contractor shall perform exploratory excavations within the new water main pipe trench to determine the actual location, depth and required listed information in 1.06.E all utilities parallel and crossing the new water main. In the event it is required to deepen the pipe trench to lower the new water main to avoid obstructions, the contractor shall be required to verify for all utilities within the required depth of the revised pipe trench. The Contractor shall conduct exploratory excavations a minimum of two days prior to pipeline installation to provide sufficient lead time to resolve utility conflicts. Utilities that were potholed will be provided to the Contractor. The Contractor may perform additional utility verification at his discretion to ensure safety and progress of the work at no additional cost to the TVMWD.
- E. The Contractor shall provide the Engineer with the following information for the existing utilities or substructures within the pipe trench of the new pipeline:
 - 1. Horizontal location as measured from two existing features shown on the Drawings
 - 2. Depth to the top and bottom of utility from ground surface
 - 3. Size (diameter, width, and depth)
 - 4. Roundness of pipe
 - 5. Circumference
 - 6. Width
 - 7. Material
 - 8. Type of utility
 - 9. Pipeline station where the conflict is located

F. Exploratory excavations shall be backfilled with one sack cement slurry and patched to match existing pavement profile and reopened to traffic as soon as practicable after the data is obtained. If the excavation is located within an area to be resurfaced as part of the pipeline installation, the surface course of the pothole shall be temporarily patched with cold mix AC which shall be removed before the final pavement patch is installed.

1.07 PROTECTION OF EXISTING FACILITIES

- A. The Contractor's attention is directed to the possible existence of pipe and other underground improvements that may or may not be shown on the Approved Plans. Once discovered, the Contractor shall preserve and protect all such improvements whether shown on the Approved Plans or not. The Contractor shall provide and install suitable safeguards, and shall be responsible for the care and protection of all existing utilities and substructures including but not limited to: sewer and water pipe (including laterals and services), electrical and telephone conduits, gas mains and service lines, oil mains culverts, or other above-ground or belowground facilities or structures which may be encountered in or near the area of work. It shall be the responsibility of the Contractor to notify USA and each agency of jurisdiction and utility company and to make arrangements for location of facilities prior to beginning construction. In the event of damage to existing facilities during the progress of the work, such facilities shall be replaced or restored to original condition, as determined by TVMWD, at the Contractor's expense.
- B. The Contractor shall be responsible for determining in advance the location, elevation, alignment and pipe type and size of all existing pipelines to which connections are to be made (reference Section 1.05.F). Potholing to determine location will be allowed only after providing the TVMWD with three (3) day's advance notice. The contractor is required to contact Underground Service Alert (USA) at 1-800-227-2600 or 1-800-422-4133 for mark-out of all utilities in the area of the work.
- C. If the Contractor, either before commencing work or during the course of the work, finds any discrepancy between specifications or drawings and the physical conditions at the site of the work, Contractor shall promptly notify the TVMWD in writing of such discrepancy.
- D. The Contractor is to prepare a support plan for each utility crossing detailing the intended support method. The Contractor is responsible to provide shoring, underpinning, and structural support for existing utility lines and structures that become suspended or otherwise unsupported because of adjacent excavation operations. Contractor must obtain approval from the owner of the utility prior to excavation of the utility.

1.08 PROTECTION OF LANDSCAPING

- A. The Contractor shall be responsible for the protection of all trees, shrubs, fences, and other landscape items adjacent to or within the work area, unless specific removals are indicated on the Approved Plans.
- B. In the event of damage to landscape items, including the thickness of topsoil, the Contractor shall replace the damaged items in kind, in a manner satisfactory to the TVMWD.
- C. When pipelines are proposed within planted or otherwise improved areas in public or private easements, the Contractor shall restore such areas to original condition after completion of the work.

- D. When pipelines are proposed within unimproved areas, the ground surface shall be dressed smooth to the contour of the original ground and left in a neat, presentable condition, free of cleared vegetation, rubbish and other construction wastes. Rocks and clumps that cannot be readily covered by spreading shall be hauled away and disposed of by the Contractor.
- E. Unimproved areas disturbed during construction of the pipeline shall be hydro seeded in accordance with these Standard Specifications.

1.09 PUBLIC UTILITY RELOCATION

- A. In case it should be necessary to relocate or temporarily maintain the property of any public utility or any other property, and it is understood that the cost of such relocation or temporary maintenance is not required to be borne by the owner of the utility or property, the Contractor shall bear all expenses incidental to the removal or temporary maintenance of such property in a manner satisfactory to said owner. It is understood that in such cases, the utility or property owner has the option of doing such work with his or her own forces, or permitting the work to be performed by the Contractor.
- B. The right is reserved to the State, County, TVMWD, and utility owners to enter at any time upon any street, alley, right of way or easement for the purpose of making changes for maintenance or repairs to their property necessitated by the Contractor's work.

1.10 PERMITS

A. All work shall conform to the specifications and requirements of the City of Claremont, California, the County, the TVMWD having jurisdiction, and all other affected agencies involved. The Contractor shall obtain and keep a copy of all the required permits in the job site and comply with all the terms and conditions of said permits. Permits shall also include any related to the abandonment of an existing water or sewer pipe.

1.11 MEASUREMENT AND PAYMENT

A. Measurement and payment for work in this section will be considered as subsiding obligation of the Contractor and the cost thereof shall be in the applicable items listed in the Bid Schedule.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All materials used in making the connection or removing the facility from service shall conform to the applicable sections of the project.

PART 3 - EXECUTION

3.01 GENERAL CUT IN CONNECTION INFORMATION

A. Unless otherwise indicated on the Approved Plans or specifically directed by the TVMWD Engineer, all connections to existing facilities, cut-in installations, shall be performed by Contractor. All types of connections to existing water facilities shall be performed in strict accordance with the following procedures.

- The contractor shall submit a connection plan developed for all connections (including multiple connections) to the TVMWD's water system. The connection plan is to be prepared with the intent of minimizing service interruptions to TVMWD customers. The connection plan will be reviewed and approved by the TVMWD prior to proceeding with any work.
- 2. The Contractor shall furnish the required fittings, valves, and all other materials per the Approved Plans as called for in the Standard Specifications. The Contractor shall provide all equipment and labor required for the excavation and installation of the connection including but not limited to thrust blocks, thrust restraints, lights, and barricades, backfill and pavement replacement. In addition, the Contractor shall assist the TVMWD in alleviating any hardship incurred during a shutdown for connections. Emergency standby equipment or materials may be required of the Contractor by the TVMWD Engineer.

3.02 FIELD VERIFICATION OF CUT IN CONNECTION

- A. Prior to construction, Contractor shall pothole or excavate the existing pipe at the location of the proposed connection. The TVMWD Engineer shall inspect the pothole/excavation prior to Contractor's repair of trench. Contractor shall record the following information on as-built drawings:
 - 1. Pipe size, outside diameter.
 - 2. Pipe Roundness
 - 3. Pipe type such as ACP, PVC, Ductile-Iron or Steel.
 - 4. Pipe class and/or pressure rating.
 - 5. Elevation, grade, and alignment.
 - 6. Location of collars, pipe bells, fittings or couplings, if found.
 - 7. Potential conflicts with existing utilities.
- B. The recorded information shall be used by the Contractor to verify the materials submitted during the shop drawing submittal phase of the project are of the proper size and application. Contractor is responsible for verifying and demonstrating the approved materials for the connection are adequate and within product manufacturer tolerances and recommendations. This verification will be presented to the TVMWD in form of a new and separate submittal. Should the approved materials be determined inadequate by the TVMWD Engineer the Contractor shall submit new materials for review and approval.

3.03 CONNECTION TO EXISTING FACILITIES

- A. Contractor may proceed with excavation only when the all proceeding procedures (all utility verification, system shutdown and customer notifications) have been completed, materials have been approved and delivered, and a copy of the approved traffic control plan (if not included in the Approved Plans) has been supplied to the TVMWD Engineer.
 - 1. The Contractor shall saw-cut pavement, excavate and provide and install shoring and steel plating, when necessary, one day prior to the cut-in installation.
 - 2. The Contractor shall provide lights, barricades and traffic control devices in accordance with the TVMWD's Representative and as deemed necessary for the excavation by the TVMWD Engineer.

- 3. The Contractor shall de-water existing mains in full compliance with NPDES standards where cut-in installations are required and shall be done in the presence of the Engineer. The Contractor shall be prepared to deal with leaking valves and water from those valves to complete the shutdown. Only TVMWD personnel are authorized to operate existing valves. The Contractor shall be responsible for any and all damage resulting from unauthorized operation of existing TVMWD facilities.
- 4. In areas where cut-ins are to be performed the Contractor shall line the bottom of the trench with 12" to 18" of 3/4" rock and install a 12" to 16" deep sump for dewatering the trench bottom.
- 5. To facilitate the proposed connection and allow for slight adjustments in alignment, the Contractor shall leave a minimum 10' gap between the new pipe installation and the proposed connection point at the existing water main. The Contractor shall leave a gap longer than 10' if conditions warrant, or if directed by the TVMWD Engineer.
- 6. Connections shall be made with as little change as possible in the grade of the new main. If the grade of the existing pipe is below that of the new pipeline, a sufficient length of the new line shall be deepened so as to prevent the creation of any high spot or abrupt changes in grade of the new line. Where the grade of the existing pipe is above that of the new pipeline, the new line shall be laid at specified depth, except for the first joint adjacent to the connection, which shall be deflected within 75% of the allowances of the pipe manufacturer as necessary to meet the grade of the existing pipe. If sufficient change in direction cannot be obtained by the limited deflection of the first joint, a fitting of the proper angle shall be installed. Where the connection creates a high or low spot in the line, a standard air release or blow off assembly shall be installed as directed by the TVMWD Engineer.
- 7. Where connections are made to existing valves, the contractor shall furnish and install all temporary blocking, steel clamps, shackles, and anchors as required by the TVMWD, and he shall replace the valve riser box and cover and adjust the valve cover to the proper grade in accordance with these specifications. The TVMWD will operate all existing valves. All valves, existing or newly installed, shall be readily accessible at all times to the TVMWD for emergency operation.
- 8. After the Contractor has performed the cut-in operations, and the TVMWD Engineer has given approval to proceed, the Contractor shall complete the installation as shown on the Approved Plans in accordance with the Standard Specifications including, but not limited to:
 - a. Disinfecting and installing the pipe section(s) necessary to make the closure to the new system. New pipelines shall not be connected to existing facilities until new pipelines have been successfully tested and disinfected and accepted by the TVMWD.
 - b. Installing and setting the valve gate well(s) in accordance with the Standard Drawings.
 - c. Installing thrust and anchor blocks where shown in the plans in accordance with Section 03 30 00.
 - d. Completing all backfill and compaction of the trench in accordance with **Section** 31 23 00.
 - e. Repairing or replacing pavement as necessary in accordance with agency of jurisdiction requirements.

3.04 UTILITIES CROSSING WATER, RECYCLED WATER OR SEWER FACILITIES

A. Wherever new utilities cross under or over water, recycled water or sewer facilities, the minimum vertical separation shall be 12" unless otherwise approved by the TVMWD Engineer. The new pipeline shall be restrained in accordance with the Approved Plans. All new utilities crossing under or over water, recycled water or sewer facilities shall remain exposed until inspected and approved by the TVMWD's Representative. Wherever new utilities cross under or over water, recycled water or sewer facilities, backfill and compaction within the limits of the water, recycled water, or sewer facility trench width shall be in strict conformance with the backfill and compaction requirements specified herein.

3.05 HORIZONTAL SEPARATION OF UTILITIES PARALLELING WATER, RECYCLED WATER OR SEWER FACILITIES

A. Wherever new utilities parallel water, storm drain, recycled water or sewer facilities, the minimum horizontal separation shall be per the California Department of Health Services separation requirements unless otherwise approved by the TVMWD's Representative.

3.06 REMOVAL FROM SERVICE OF EXISTING MAINS AND APPURTENANCES

- A. Existing mains and appurtenances shall be removed from service at the locations shown on the plans or as directed by the engineer.
- B. Existing pipe and appurtenances removed from the ground will require backfill and repair of surface in accordance with Section 31 23 00.
- C. Removed pipe and appurtenances shall be temporarily stockpiled on the job in a location that will not disrupt traffic or be a safety hazard, disposed of in a proper manner (as determined by the TVMWD Engineer). The contractor shall remove and dispose of all removed pipe at his own expense to a landfill permitted to accept such materials.
- D. Before excavating for installing mains that are to replace existing pipes and/or services, the contractor shall make proper provisions for the maintenance and continuation of service as directed by the TVMWD Engineer unless otherwise specified.
- E. If the meter box is to be removed from an abandoned water service, the service line is to be removed and the corporation stop closed and capped. If there is no corporation stop on the service, the adapter is to be removed and a brass plug is to be installed in the service saddle.
- F. Asbestos Cement Pipe (ACP) shall be cut, removed and disposed of in a proper manner. The contractor shall be responsible for the proper manifesting of any and all ACP at an authorized disposal site.

3.07 CUTTING AND RESTORING STREET SURFACING

- A. In cutting or breaking up street surfacing, the contractor shall not use equipment that will damage adjacent pavement.
- B. All asphalt and/or Portland cement concrete surfaces shall be scored with sawing equipment of a type meeting the approval of the TVMWD; providing however, that any cement concrete base under an asphaltic mix surface will not be required to be scored by sawing. Existing paving

surfaces shall be saw cut back beyond the edges of the trenches to form neat square cuts before repaying is commenced.

- C. The Contractor is required to visit all project locations prior to bid.
- D. The Contractor will be provided additional pavement information once it becomes available.
- E. Pavement, sidewalks, curbs, or gutters removed or destroyed in connection with performance of the work shall be saw cut to the nearest score marks, if any, and shall be replaced with pavement sidewalks, curbs, or gutters of the same kind, or better by the contractor in accordance with the latest specifications, rules, and regulations and subject to the inspection of the agency having jurisdiction over the street or highway.
- F. One sack cement slurry base shall be placed beneath the restored pavement to the thickness required by the agency having to allow the restoration of the pavement.

3.08 MAINTENANCE, REMOVAL, AND RECONSTRUCTION OF UTILITIES AND OTHER FACILITIES

- A. Insofar as practicable during the progress of the work, no pipeline, conduit, sewer, culvert, storm drain, drainage channel, pole line, street lighting system, overhead wires or cables, or underground wires or cables, either main line structures or laterals and services, or any other structure or facility, shall be disturbed, but all shall be supported and protected against injury and maintained by the Contractor in good operating condition. In no case shall any such property be disturbed or removed without the approval of the Engineer as hereinafter provided. The Contractor shall be responsible for and make good all damage due to his/her operations and the provisions of this section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of backfilling.
- B. All affected traffic signal materials or equipment as a result of this improvement shall be restored or replaced by the Contractor at no cost to the TVMWD. This includes pull boxes, inductive loop detectors, detectors, lead-in wire, and interconnect cable, etc.
- C. Where a pipe fitting or portion of the pipe is to be removed near a valve, and the valve is to be left in place as a stop against main pressure, the valve shall be tied back by the Contractor to the satisfaction of the Engineer. Any damage which might result to the TVMWD's property as a result of a main break caused by inadequate restraint of the valve will be charged to the Contractor.

END OF SECTION

SECTION 01 42 13 – ABBREVIATIONS

PART 1 - GENERAL

1.01 GENERAL

A. Wherever in these Contract Documents the following abbreviations or acronyms are used, they shall have the meanings indicated as follows:

1.02 ABBREVIATIONS AND ACRONYMS:

١.٠	02 1	ADDREVIATION	S AND ACRONTMS.
	A.	AA	Aluminum Association
	B.	AAMA	Architectural Aluminum Manufacturer's Association
	C.	AASHTO	American Association of the State Highway and Transportation
			Officials
	D.	ACI	American Concrete Institute
	E.	AGC	Associated General Contractors
	F.	AGMA	American Gear Manufacturer's Association
	G.	AI	The Asphalt Institute
	H.	AIA	American Institute of Architects
	I.	AISC	American Institute of Steel Construction
	J.	AISI	American Iron and Steel Institute
	K.	AITC	American Institute of Timber Construction
	L.	AMCA	Air Moving and Conditioning Association
	M.	ANSI	American National Standards Institute, Inc.
	N.	APA	American Plywood Association
	O.	API	American Petroleum Institute
	P.	APWA	American Public Works Association
	Q.	ASA	Acoustical Society of America
	R.	ASAE	American Society of Agriculture Engineers
	S.	ASCE	American Society of Civil Engineers
	T.	ASHRAE	American Society of Heating, Refrigerating and Air Conditioning
			Engineers
	U.	ASLE	American Society of Lubricating Engineers
	V.	ASME	American Society of Mechanical Engineers
	W.	ASQC	American Society for Quality Control
	X.	ASSE	American Society of Sanitary Engineers
	Y.	ASTM	American Society for Testing and Materials
	Z.	AWPA	American Society for Preservers Association
	AA.	AWPI	American Wood Preservers Institute
	BB.	AWS	American Welding Society
	CC.	AWWA	American Water Works Association
	DD.	BHMA	Builders Hardware Manufacturer's Association
	EE.	CGA	Compressed Gas Association
	FF.	CLFMI	Chain Link Fence Manufacturer's Institute
	GG.	CMA	Concrete Masonry Association
	HH.	CRSI	Concrete Reinforcing Steel Institute

ABBREVIATIONS 01 42 13 - 1

II.	ETL	Electrical Test Laboratories
JJ.	ICBO	International Conference of Building Officials
KK.	IEEE	Institute of Electrical and Electronics Engineers
LL.	IES	Illuminating Engineering Society
MM.	IPC	Institute of Printed Circuits
NN.	IPCEA	Insulated Power Cable Engineers Association
OO.	ISA	Instrument Society of America
PP.	MBMA	Metal Building Manufacturer's Association
QQ.	NACE	National Association of Corrosion Engineers
RR.	NBS	National Bureau of Standards
SS.	NEC	National Electrical Code
TT.	NEMA	National Electrical Manufacturer's Association
UU.	NFPA	National Fire Protection Association
VV.	NFPA	National Forest Products Association
WW.	NGLI	National Lubricating Grease Institute
XX.	OSHA	Occupational Safety and Health Administration
YY.	PCA	Portland Cement Association
ZZ.	SMA	Screen Manufacturer's Association
AAA.	SMACCNA	Sheet Metal and Air Conditioning Contractors National
		Association
BBB.	SSPC	Steel Structures Painting Council
CCC.	SSPWC	Standard Specifications for Public Works Construction
DDD.	UBC	Uniform Building Code
EEE.	UL	Underwriters Laboratories, Inc.
FFF.	WCRSI	Western Concrete Reinforcing Steel Institute
GGG.		Wire Reinforcement Institute, Inc.
ННН.	WWPA	Western Wood Products Association

END OF SECTION

ABBREVIATIONS 01 42 13 - 2

SECTION 01 42 19 – REFERENCE STANDARDS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section includes details pertaining to the referenced standards used in these Specifications and their abbreviations.
- B. In these Specifications, whenever references are made to published specifications, codes, standards or other requirements, it shall be understood that only the latest published specifications, standards or requirements of the respective issuing agencies, as of the date that the work is advertised for bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes.

1.02 REFERENCED SECTIONS – NONE

1.03 CITED STANDARDS

A. The Contract Documents contain references to various standard specifications, codes, practices, and requirements for materials, equipment, work quality, installation, inspections, and tests, which references are published and issued by the organizations, societies, and associations listed in 1.05 Abbreviations by abbreviation and name. These references are hereby made a part of the Contract Documents.

1.04 NOTED RESTRICTIONS

- A. No requirements set forth herein or shown on the drawings shall be waived because of any provision of, or omission from, said standards or requirements.
- B. Whenever a referenced standard contains administrative requirements, including measurement and payment provisions, such as the standard specifications of various government entities, utility districts, and other agencies, such administrative requirements shall not apply to the Work of this Contract. References to such standards shall be applicable to the pertinent technical provisions only.

1.05 QUALITY CONTROL

- A. In case of conflict between codes, reference standards, drawings and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the ENGINEER for clarification and directions prior to ordering or providing any materials or labor. The CONTRACTOR shall bid the most stringent requirements.
- B. References in the Contract Documents to "Standard Specifications" shall mean the Manual of Standard Specifications as Published by the American Public Works Association, including all current supplements, addenda and revisions thereof.

1.06 ABBREVIATIONS

A. When an organization's abbreviation or acronym is used in the Contract Documents and throughout the Specifications, it shall be understood to mean the full name of the respective organization as shown below:

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1.	AASHTO	American Association of State Highway and Transportation Officials
2.	ACI	American Concrete Institute
3.	AFPA	American Forest and Paper Association
4.	AISC	American Institute of Steel Construction
5.	AISI	American Iron and Steel Institute
6.	ANSI	American National Standards Institute
7.	APA	American Plywood Association
8.	ASME	American Society of Mechanical ENGINEERs
9.	ASTM	American Society for Testing and Materials
10.	AWPA	American Wood Preservers Association
11.	AWPI	American Wood Preservers Institute
12.	AWS	American Welding Society
13.	AWWA	American Water Works Association
14.	CBC	California Building Code
15.	COEM	City of El Monte
16.	CRSI	Concrete Reinforcing Steel Institute
17.	EJCDC	ENGINEERs Joint Contract Documents Committee
18.	IBC Officials (ICB)	International Building Code of the International Conference of Building O)
19.	NACE	National Association of Corrosion ENGINEERs
20.	NCMA	National Concrete and Masonry Association
21.	NEC	National Electrical Code
22.	NEMA	National Electrical Manufacturers Association
23.	NFPA	National Fire Protection Association
24.	NSF	National Sanitation Foundation
25.	OSHA	Occupational Safety and Health Administration
26.	SSPC	Steel Structures Painting Council
27.	UL	Underwriters Laboratories Inc.
28.	USACE	U.S. Army Corps of ENGINEERs
29.	WIC	Woodwork Institute of California

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION – NOT USED

SECTION 01 45 16 - FIELD QUALITY CONTROL PROCEDURES

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section describes field quality control procedures to be performed by the CONTRACTOR.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. Explosives and Blasting
 - 1. The use or storage of explosives on the work or site will not be permitted.

1.05 QUALITY CONTROL

A. Chemicals

1. All chemicals used during project construction or furnished for project operation, whether soil sterilant, herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall show approval for use by either the U. S. Environmental Protection Agency or the U. S. Department of Agriculture. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer.

B. Cultural Resources

- 1. The CONTRACTOR's attention is directed to the National Historic Preservation Act of 1966 (16 U.S.C. 470) and 36 CFR 800 which provides for the preservation of potential historical architectural, archeological or cultural resources (hereinafter called "cultural resources"). If potential cultural resources are discovered during subsurface excavations at the site of construction, the following procedures shall be instituted:
 - a. The CONTRACTOR shall immediately notify the ENGINEER.
 - b. The ENGINEER will issue a Field Order directing the CONTRACTOR to cease all construction operations at the location of such potential cultural resources find.
 - c. Such Field Order shall be effective until such time as a qualified archeologist can be called to assess the value of these potential cultural resources and make recommendations to the State Historical Society Archeologist.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 DUST ABATEMENT AND RUBBISH CONTROL

A. The CONTRACTOR shall provide under the Contract all necessary measures to prevent its operation from producing dust in amounts damaging to property or causing a nuisance to the plant personnel and operations or to persons living in or occupying buildings in the vicinity.

The CONTRACTOR shall be responsible for damage resulting from any dust originating from its operations. The dust abatement measurers shall be continued throughout the length of the contract.

- B. During the progress of the work the CONTRACTOR shall keep the site of the work and other areas used by it in a neat and clean condition and free from any accumulation of rubbish.
- C. The CONTRACTOR shall dispose of all rubbish and waste materials of any nature occurring at the work site, and shall establish regular intervals of collection and disposal of such materials and waste. The CONTRACTOR shall also keep its haul roads free from dirt, rubbish and unnecessary obstructions resulting from its operations.
- D. Disposal of all rubbish and surplus materials shall be off the site of construction in accordance with local codes and ordinances governing locations and methods of disposal and in conformance with all applicable Safety Laws and Health Standards for Construction.

SECTION 01 45 16.13 – CONTRACTOR QUALITY CONTROL

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section describes CONTRACTOR Quality Control requirements.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. The CONTRACTOR shall be licensed by the State of the project, and shall maintain workers' compensation insurance, general liability insurance and a valid City business license.
 - B. They must provide the Licensing Division with their Federal Employer I.D. # and or their Social Security Number.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 51 00 – TEMPORARY UTILITIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section includes details pertaining to temporary utilities to be used by the CONTRACTOR. It shall be the CONTRACTOR's responsibility to provide equipment that is adequate for the performance of the Work under this Contract within the time specified.
- B. All equipment shall be kept in satisfactory operating condition, shall be capable of safely and efficiently performing the required Work and shall be subject to inspection and approval by the ENGINEER at any time within the duration of the Contract. All work hereunder shall conform to the applicable requirements of the OSHA Standards for Construction.

1.02 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 01 11 00 SUMMARY OF WORK
 - 2. SECTION 01 51 13 TEMPORARY ELECTRICITY
 - 3. SECTION 01 51 36 TEMPORARY WATER
 - 4. SECTION 01 77 00 CLOSEOUT PROCEDURES

1.03 CITED STANDARDS – NONE

1.04 NOTED RESTRICTIONS

- A. The CONTRACTOR shall not make connections to, or draw water from any fire hydrant or pipeline without first obtaining permission of the authority having jurisdiction over the use, and from the agency owning the electrical or water system.
- B. For each of such connection made to a water system, the CONTRACTOR shall first attach to the fire hydrant or pipeline a valve, backflow preventer, and a meter, if required by the said authority, of a size and type acceptable to said authority and agency.
- C. The OWNER'S OR ENGINEER'S telephone system shall not be used by the CONTRACTOR's work force.

1.05 QUALITY CONTROL

A. Please see the quality control requirements under the individual sub-sections.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 CLEANUP

A. Before final acceptance of work, the CONTRACTOR shall remove all materials and equipment related to temporary facilities and controls. Affected improvements shall be restored to their original condition, or better, to the satisfaction of the ENGINEER and to the agency owning the affected utility.

SECTION 01 51 13 – TEMPORARY ELECTRICITY

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section includes the CONTRACTOR's responsibilities in regard to temporary electricity. All work shall conform to the applicable requirements of the OSHA Standards for Construction.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. The CONTRACTOR shall not make connections to electrical power service without first obtaining permission of the authority having jurisdiction over the use, and from the agency owning the electrical or water system.
- 1.05 QUALITY CONTROL
 - A. Temporary Electrical Power and Lighting
 - 1. The CONTRACTOR shall connect to an existing power service to perform site work. The CONTRACTOR is responsible for providing branch wiring, feeders, connections, and distribution boxes to provide service and lighting.
 - 2. The CONTRACTOR may request the installation of temporary power poles (if necessary) in locations where electricity is required. The CONTRACTOR shall contact the utility company upon the ENGINEER's approval.
 - 3. The CONTRACTOR shall pay the costs of energy used, and shall maintain all temporary power systems required to perform the work in a safe and satisfactory manner.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

- 3.01 CLEANUP
 - A. The CONTRACTOR shall remove all materials and equipment used. Affected improvements shall be restored to their original condition, or better, to the satisfaction of the ENGINEER.

SECTION 01 51 33 – TEMPORARY TELECOMMUNICATIONS

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section includes the CONTRACTOR's responsibilities in regard to temporary telecommunications.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. The OWNER or ENGINEER's telephone system shall not be used by the CONTRACTOR's work force.
- 1.05 QUALITY CONTROL
 - A. Communications
 - 1. The CONTRACTOR shall provide and maintain at all times during the progress of the work no less than one telephone (land line or cell) in good working order, at its own field construction office.
 - 2. Each telephone shall be connected to an established exchange for toll service and with all other telephones utilized by the CONTRACTOR.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 51 36 – TEMPORARY WATER

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section includes the CONTRACTOR's responsibilities in regard to temporary water.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. The CONTRACTOR shall not make connections to, or draw water from any fire hydrant or pipeline without first obtaining permission of the authority having jurisdiction over the use, and from the agency owning the electrical or water system.
 - B. For each of such connection made to a water system, the CONTRACTOR shall first attach to the fire hydrant or pipeline a valve, backflow preventer, and a meter, if required by the said authority, of a size and type acceptable to said authority and agency.

1.05 QUALITY CONTROL

- A. Temporary Water Supply
 - 1. The CONTRACTOR shall lawfully obtain water from an existing source with adequate supply and quality suitable for all domestic and construction purposes as instructed by the ENGINEER.
 - 2. The CONTRACTOR shall be responsible for furnishing any required extension cords, hoses, etc., and all water used shall be potable water, unless noted otherwise by the ENGINEER.
 - 3. The CONTRACTOR shall pay the costs for water used for construction purposes. However, abuse of this privilege by the CONTRACTOR will warrant the OWNER the right to discontinue use of this water supply and make the CONTRACTOR responsible for supply of his/her own needs.
 - 4. Utility or plant effluent water may be used for hydraulic structures and pipeline testing as approved by the ENGINEER.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

- 3.01 CLEANUP
 - A. The CONTRACTOR shall remove all materials and equipment used. Affected improvements shall be restored to their original condition, or better, to the satisfaction of the ENGINEER.

END OF SECTION

TEMPORARY WATER 01 51 36 - 1

SECTION 01 52 00 - CONSTRUCTION FACILITIES

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section includes details pertaining to temporary construction facilities such as storage facilities, facilities for installed products, and sanitary facilities.
- 1.02 REFERENCED SECTIONS
 - A. Related Sections are listed below:
 - 1. SECTION 01 11 00 SUMMARY OF WORK
 - 2. SECTION 01 52 19 SANITARY FACILITIES
 - 3. SECTION 01 77 00 CLOSEOUT PROCEDURES
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. The CONTRACTOR shall provide temporary facilities for installed products or storage of tools, materials, and equipment. The CONTRACTOR shall provide an on-site or logistically close field office trailer for the duration of the project, complete with all necessary equipment, furnishing and utility services including telephones. The CONTRACTOR shall control traffic in the immediate area of these facilities to minimize damage, and shall construct such facilities in locations indicated or approved by the ENGINEER.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

- 3.01 CLEANUP
 - A. The CONTRACTOR is responsible for removing and disposing off-site all accumulated waste, materials, and equipment as a part of final cleanup.
 - B. The CONTRACTOR shall clean and repair any damages caused by installation or use of temporary facilities. Any existing facilities used shall be restored to its original condition.

SECTION 01 52 19 - SANITARY FACILITIES

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section includes details pertaining to temporary sanitary facilities to be used during the by the CONTRACTOR during the construction period.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. The CONTRACTOR shall provide separate sanitary facilities during the entire construction period unless noted otherwise by the OWNER or ENGINEER.
 - B. The CONTRACTOR shall provide clean and sanitary temporary toilet conveniences, washing facilities, and potable drinking water for the use of all people engaged with the work.
 - C. The CONTRACTOR shall supply sanitary facilities with toilet paper, paper towels, paper cups, and any related supplies as required.
 - D. Toilet Facilities
 - 1. Fixed or portable chemical toilets shall be provided wherever needed for the use of employees. Toilets at construction job sites shall conform to the requirements of Subpart D, Section 1926.51 of the OSHA Standards for Construction.
 - E. Sanitary and Other Organic Wastes
 - 1. The CONTRACTOR shall establish adequate and regular collection of all sanitary and organic wastes.
 - 2. All wastes and refuse from sanitary facilities provided by the CONTRACTOR or organic material wastes from any other source related to the CONTRACTOR's operations shall be disposed of in a manner satisfactory to the OWNER and in accordance with all laws and regulations pertaining thereto.
 - 3. The CONTRACTOR may install temporary piping for toilet facilities to discharge into the incoming sewer.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 55 26 - TRAFFIC CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section provides a description of the CONTRACTOR's responsibilities and restrictions related to traffic control.

1.02 REFERENCES SECTIONS

- A. Related Sections are shown below.
 - 1. SECTION 01 14 13 ACCESS TO SITE

1.03 CITED STANDARDS – NONE

1.04 NOTED RESTRICTIONS

- A. ALL CONSTRUCTION TRAFFIC shall utilize Walnut Ave for access for Treatment Plant work.
- B. Contractor shall prepare Traffic Control Plans and submitted to the City for approval to work in in all streets and at the site.

1.05 TRAFFIC CONTROL

A. For the protection of traffic in public streets and plant operating personnel at the site of the Work, the CONTRACTOR shall provide, place and maintain all necessary barricades, traffic cones, warning signs, lights and other approved safety devices. The CONTRACTOR shall take all necessary precautions for the protection of the Work and the safety of the OWNER's personnel and the public. All barricades and obstructions shall be illuminated at night.

1.06 SUBMITTALS

- A. The CONTRACTOR shall provide a written Traffic Control Plan for the ENGINEER and City for approval seven (7) days prior to beginning on respective project site. Plans and impacts to treatment plant operations and access requirements shall receive prior approval.
- B. The CONTRACTOR shall provide a Drawing of the Traffic Control Plan for the ENGINEER and PWP/County for approval 4 weeks prior to beginning on respective pipeline project sites and traffic notification shall be placed at least 2 weeks prior to the construction activity or as required by the TVMWD. Plans and impacts to water delivery/distribution shall receive prior approval.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

TRAFFIC CONTROL 01 55 26 - 1

SECTION 01 56 26 - TEMPORARY FENCING

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section provides a description of the CONTRACTOR's responsibilities related to temporary fencing.
- 1.02 REFERENCES SECTIONS
 - A. Related Sections are shown below.
 - 1. SECTION 01 14 13 ACCESS TO SITE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 TEMPROARY FENCING
 - A. The CONTRACTOR shall provide temporary fencing and/or security measures.
 - B. Temporary security measures shall obtain City's approval prior to removal of existing fencing. The CONTRACTOR shall provide the City and County with access to gate as appropriate.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 57 19 – TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section covers the CONTRACTOR'S responsibilities in regard to diversion and control of surface water runoff, dewatering of pipeline trenches and structural excavations, and other elements required for control of water if the site conditions should dictate the need.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. Prior to the CONTRACTOR performing any excavation, the CONTRACTOR shall submit his/her proposed dewatering diversion plan to the ENGINEER a minimum of 17 days prior to starting excavation, for review. The submittal shall include method, installation, and details of the proposed dewatering diversion system.

PART 2 - PRODUCTS

- 2.01 MATERIALS
 - A. Materials and equipment required for control of water shall be furnished and maintained by the CONTRACTOR, as required to perform the construction.

PART 3 - EXECUTION

- 3.01 PREPARATION
 - A. Perform all permanent construction in area free from water.
 - B. The necessary machinery, appliances and equipment shall be provided and operated to keep excavations free from water during construction, and to dispose of the water so as not to cause injury to public or private property or to cause a nuisance or a menace to the public.
 - C. During excavation, construction of structures, installation of pipelines and sewers, placing of structural and trench backfill, and the placing and setting of concrete, excavations shall be kept free of water except as specified. Surface runoff shall be controlled so as to prevent entry or collection of water in excavations.

SECTION 01 60 00 – PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes details pertaining to products, the quality of materials to be used, and appurtenances and accessories.

1.02 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 01 40 00 QUALITY REQUIREMENTS

1.03 QUALITY OF MATERIALS

- A. Materials, equipment, appliances, fixtures, and fabricated assemblies to be incorporated in the work shall be new unless indicated or specified otherwise in the Contract Documents.
- Additional quality assurance provisions for materials and equipment are specified in Section 01 40 00 Quality Requirements.

1.04 PRODUCTS

A. General

- 1. All products including but not limited to material, equipment, and systems, shall comply with the Specifications and referenced standards as minimum requirements.
- 2. Fifteen (15) days after the date established in notice to proceed, the CONTRACTOR shall submit a complete list of major products proposed for use including the name of the manufacturer and model number of each product.

B. Product Substitutions

- 1. The CONTRACTOR may submit a request for substitution for any products specified by only one manufacturer. Products specified by naming several manufacturers shall have NO substitutions allowed.
- 2. The OWNER shall only consider requests from the CONTRACTOR for substitution if the request is made within fifteen (15) after the date established in notice to proceed.
- 3. The CONTRACTOR shall document each request with complete data substantiating compliance of the proposed substitution with the Contract Documents.
- 4. Prior to requesting a product substitution, the CONTRACTOR shall do the following:
 - a. Investigate the proposed product and determine that it meets or exceeds the specified product in all respects.
 - b. Make sure that the proposed product will provide the same warranty as the specified product.
 - c. Coordinate installation and make sure that changes do not require substantial additions to the work to be performed.

- d. Waive claims for additional costs, which may subsequently become apparent.
- C. Product substitutions will not be considered when they are indicated or implied on shop drawings or product data submittals without a separate written request, or when acceptance requires substantial revision of the Contract Documents.
- D. The OWNER will determine acceptability of a proposed substitution, and will notify the CONTRACTOR of acceptance or rejection in writing within a reasonable time.
- E. The CONTRACTOR shall make only one request for substitution for each product and if the proposed substitution is rejected, the CONTRACTOR shall provide the specified product.

1.05 APPURTENANCES AND ACCESSORIES

- A. Products to be incorporated in the Work shall be furnished as complete assemblies or systems with all appurtenances and installation anchors, fasteners, and accessories as required to provide a complete and finished product installation.
- B. Installed products with moving parts shall be fully operable at proper settings and levels in accordance with the respective manufacturers' instructions and recommendations.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 66 00 – PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes details pertaining to packaging and handling, transportation and delivery, and storage and protection of the products to be used at the site.

1.02 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 01 32 16 CONSTRUCTION PROGRESS SCHEDULE

1.03 CITED STANDARDS – NONE

1.04 NOTED RESTRICTIONS

A. Products, materials and equipment not stored in a manner that will insure the maintaining of a new condition will be rejected by the ENGINEER. Such rejected products, materials and equipment shall be immediately removed from the work site.

1.05 PACKAGING AND HANDLING

- A. The CONTRACTOR shall avoid bending, scraping, or overstressing materials and equipment. Projecting parts shall be protected by blocking with wood, by providing bracing, or by other methods approved by the ENGINEER.
- B. Materials and equipment shall be protected from soiling and moisture by wrapping or by other methods approved by the ENGINEER.
- C. Small parts shall be packaged in containers such as boxes, crates, or barrels to avoid dispersal and loss. The CONTRACTOR shall firmly secure an itemized list and description of contents to such a container.

1.06 TRANSPORTATION AND DELIVERY

- A. Arrange deliveries of materials and equipment in accordance with the Project Schedule specified in **Section 01 32 16 Construction Progress Schedule**, and coordinate to avoid conflict with work and conditions at the site.
- B. Deliver materials in undamaged condition, in manufacturers' unopened containers or packaging (where applicable), dry, with identifying labels intact and legible.
- C. The CONTRACTOR shall provide the equipment and personnel to handle products by methods to prevent soiling or damage.
- D. Deliver cement, prepared dry mortar mixes, grouting material, plaster, and coloring material in original, unopened and sealed containers, bearing the brand and manufacturer's name.

E. Refer also to the individual Specifications Sections for detailed requirements as applicable.

1.07 STORAGE AND PROTECTION

- A. The receiving, storage, quality, and inventory control of equipment and materials required for the work of this Contract shall be the sole responsibility of the CONTRACTOR. Storage shall be arranged to provide easy access for inspection and identification of each shipment.
- B. Materials shall be stored in such a manner as to ensure the preservation of their quality and fitness for the work and to facilitate inspection.
- C. Sheltered, weather tight, or heated weather tight storage shall be provided as required to protect materials and equipment from weather damage and corrosion.
- D. The CONTRACTOR shall store manufactured materials in accordance with the various manufacturers' instructions. The temperature and humidity shall be maintained within the ranges required by the various manufacturers' instructions.
- E. Blocking, platforms, pallets, or skids shall be provided for materials and equipment subject to damage by contact with earth or pavement. Clearances shall be provided from adjacent surfaces for stored materials requiring natural ventilation.
- F. Packaged materials shall be stored in their original unbroken packages or containers. Protect materials and equipment from damage and corrosion during warehousing operations.
- G. For exterior storage of fabricated products, the products shall be placed on sloped supports aboveground. Products subject to deteriorations shall be covered with impervious sheet covering and ventilation shall be provided to avoid condensation.
- H. Loose granular materials shall be stored on solid surfaces in a well-drained area to prevent mixing with foreign matter.
- I. Perform periodic inspections of stored materials to assure that materials are maintained under specified conditions, and are free from damage or deterioration.
- J. Fabricated structural components shall be stored on supports above ground and in a manner to prevent accumulation of water and warping. Products subject to deterioration from atmospheric conditions shall be covered in a manner that will provide adequate ventilation to avoid condensation.
- K. Continue protection of materials and equipment from damage and corrosion after installation until final acceptance of the work. Refer also to the individual Specifications Sections for detailed requirements, as applicable.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 01 71 13 – MOBILIZATION

PART 1 - GENERAL

1.01 GENERAL

- A. Mobilization shall include the obtaining of all permits; moving onto the site of all equipment; furnishing and erecting temporary buildings and other construction facilities; all as required for the proper performance and completion of the Work. Mobilization shall include, but not be limited to, the following principal items:
 - 1. Moving on to the Owner's site of all equipment required for first month operations.
 - 2. Installing temporary construction power, wiring and lighting facilities.
 - 3. Establishing fire protection equipment and instructing designated personnel in the operation of such apparatus.
 - 4. Providing field office trailer for the CONTRACTOR complete with furnishings and utility services. Owner will furnish the temporary power and water for the CONTRACTOR's field offices. CONTRACTOR to furnish and install necessary piping, wiring and disconnects.
 - 5. Providing all on-site CONTRACTOR communication facilities.
 - 6. Providing on-site CONTRACTOR's sanitary facilities.
 - 7. Arranging and setting up the CONTRACTOR's work and storage yard.
 - 8. Obtaining all required permits.
 - 9. Posting all OSHA required notices and establishment of safety programs.
 - 10. Have CONTRACTOR's superintendent at the jobsite full time.
 - 11. Submittal of Construction Schedule.
 - 12. Install Owner furnished project sign.

END OF SECTION

MOBILIZATION 01 71 13 - 1

SECTION 01 71 18 – SITE ACCESS AND STORAGE

PART 1 - GENERAL

1.01 HIGHWAY AND STREET LIMITATIONS

- A. The CONTRACTOR shall make its own investigation of the condition of available public and private roads and of clearances, restrictions, bridge load limits and other limitations affecting transportation and ingress and egress to the site of the Work. It shall be the CONTRACTOR's responsibility to construct and maintain any haul roads required for its construction operations.
- B. Nothing herein shall be construed to entitle the CONTRACTOR to the exclusive use of any public street, utility right-of-way or the site of the Work during the performance of the Work hereunder. The CONTRACTOR shall conduct its operations so as not to interfere unnecessarily with the authorized work of utility companies, other agencies, or the Owner's plant personnel. No street or access shall be closed without first obtaining permission of the Engineer or proper governmental authority. Where excavation is being performed in primary streets or highways one (1) lane in each direction shall be kept open to traffic at all times unless otherwise provided or shown. Fire hydrants on or adjacent to the Work shall be kept accessible to fire-fighting equipment at all times. Temporary provisions shall be made by the CONTRACTOR to assure the use of sidewalks, access routes and the proper functioning of all gutters, sewer inlets and other drainage facilities.
- C. <u>Traffic Control</u>: For the protection of traffic in public streets and plant operating personnel at the site of the Work, the CONTRACTOR shall provide, place and maintain all necessary barricades, traffic cones, warning signs, lights and other approved safety devices. The CONTRACTOR shall take all necessary precautions for the protection of the Work and the safety of the Owner's personnel and the public. All barricades and obstructions shall be illuminated at night.

1.02 CONTRACTOR'S WORK AND STORAGE AREA

A. The CONTRACTOR is solely responsible to designate and arrange for its use any addition property required for project execution. The property associated to the Work is assigned for the CONTRACTOR'S exclusive use during the term of the Contract as an office, storage and shop area for its construction operations relative to this contract as is reasonable. Access to the Wadsworth well site shall be maintained at all time to PWP personnel. CONTRACTOR shall be solely responsible for the security of its tools, supplies and equipment at the site.

SECTION 01 71 23.16 – CONSTRUCTION SURVEYING

PART 1 - GENERAL

- 1.01 THE REQUIREMENT
 - A. Permanent Survey Markers
 - B. The CONTRACTOR shall be responsible for the preservation of survey monuments and bench marks except as noted herein. At least two (2) working days before the start of construction, the CONTRACTOR shall submit acceptable preconstruction survey tie notes to the OWNER'S office. These survey tie notes will be for all survey markers or bench marks that may be lost or disturbed due to construction. Lost or disturbed monuments shall be replaced at the CONTRACTOR'S expense by a California licensed land surveyor or registered civil ENGINEER authorized to practice land surveying. Post construction survey monument ties acceptable to the OWNER shall be submitted to the OWNER'S office before the completion of The ENGINEER will reestablish the monuments and bench marks where survey services are provided by the ENGINEER, providing the CONTRACTOR protects the preconstruction reference points. In this case, where the monuments are to be removed or damaged by the CONTRACTOR, the CONTRACTOR shall notify the ENGINEER in writing seven (7) calendar days before starting the Work.
 - C. All site work such as conflicts with existing utilities, additional subsurface investigation, and surveying shall be included in this section.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. It is not the responsibility of the OWNER to maintain the most accurate and most recent record DRAWINGS. The OWNER is not responsible for any costs of the items disturbed or damaged by the CONTRACTOR's operation.
 - B. The CONTRACTOR will not be permitted to use existing sewer systems (if any) as drain lines for the construction work. The CONTRACTOR shall be responsible for all surface water runoff and/or groundwater tributary to the pipeline and/or trenches constructed and shall supply the necessary dewatering and pumping equipment for handling those flows during construction.
 - C. Existing Utility Lines
 - 1. The CONTRACTOR is responsible for locating any possible existing underground utilities in order to properly complete site work. The CONTRACTOR shall contact the OWNER or ENGINEER immediately upon discovery of additional utilities in the area prior to starting and during the performance of the work.
 - 2. Water, sewer, gas, power and telephone service to buildings shall be maintained with a minimum of interruption throughout the construction of the contract work. No such service shall be intentionally interrupted without the approval of the respective utility

- company concerned, and without first giving due warning to the occupants of said dwelling or business establishment.
- 3. The CONTRACTOR shall avoid disturbance and/or displacement of existing utilities and shall provide all temporary and permanent supports and other required protection.

D. Existing Power Lines

- 1. If the proposed work is in close proximity to overhead and underground power lines which could be hazardous to construction personnel and/or other persons, the CONTRACTOR shall properly protect the wires, pole supports, or other power line appurtenances to avoid disturbances to those facilities.
- 2. The CONTRACTOR shall also operate all machinery and conduct all other construction activities in a manner, which will assure protection of all construction personnel and other persons against the described hazard.

E. Existing Gas Lines

- 1. The CONTRACTOR shall avoid disturbance and/or displacement of underground gas lines and their associated facilities and shall provide all temporary and permanent supports required to protect and prevent exposure to construction personnel and/or other persons.
- 2. If gas lines are exposed during construction and leakage is detected, the CONTRACTOR shall suspend all construction work in those areas immediately. The OWNER of the pipeline shall be immediately advised of the condition, and construction shall not resume until all repairs have been properly completed.

F. Landscaping, Existing Trees, and Vegetation

- 1. The CONTRACTOR shall protect existing trees, shrubbery, and other vegetation that is to remain in place against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials, excess foot or vehicular traffic, or improper parking of vehicles on vegetation. Temporary fences, barricades or guards are to be provided as required to protect trees and vegetation to be left standing.
- 2. Trees and other vegetation to remain within limits of contract work shall be watered as required to maintain their health during course of construction operations.
- 3. Protection shall be provided for roots over 1-1/2" diameter cut during construction operations. Coat cut faces with a wound paint formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
- 4. The CONTRACTOR shall repair or replace trees and vegetation that will remain, which are damaged by construction operations, in a manner acceptable to the ENGINEER and property OWNER if work is performed on private property. The ENGINEER may employ an Arborist to repair damages to trees and shrubs at the CONTRACTOR's expense when deemed necessary.

G. Existing Valves and/or Other Existing System Appurtenances

1. The CONTRACTOR shall not operate existing system valves, hydrants or other appurtenances at any time. If the existing items described are required to accommodate

construction, the CONTRACTOR shall provide the OWNER with an advance notice and shall receive approval from the OWNER before use of the existing appurtenances.

1.05 QUALITY CONTROL

- A. The CONTRACTOR shall conduct all work in accordance with the applicable rules and regulations of specified governing agencies, and in accordance with the laws, rules, and/or regulations of all other authorities having jurisdiction over the required construction work. Any required permits shall be obtained and paid for by the CONTRACTOR (including all city permit fees and charges).
- B. The CONTRACTOR shall determine the exact location of existing structures, underground piping, or conduit which would be in the vicinity or possibly affected by the CONTRACTOR's operation.
- C. The CONTRACTOR shall relocate existing items or mark these existing items if removal is not required, and shall protect any underground facility.
- D. The CONTRACTOR shall schedule and coordinate all construction activities and shall cooperate with the OWNER's operating personnel to provide a minimum of interruptions to the operations of other present facilities.

E. Property Restoration

- 1. CONTRACTOR shall restore landscaping to original condition.
- 2. The CONTRACTOR shall assume <u>all responsibility</u> and <u>liability</u> for property damages, bodily injury, or financial losses and interruptions of service that may result from his/her construction activities which affect structures, facilities, water lines, gas lines, power lines, electric conduits, sewer lines, telephone lines, cable TV lines, and all service facilities connected thereto.
- 3. The CONTRACTOR shall be responsible for the relocation, repairing, reconstruction, and re-installation of damaged or disturbed items due to his/her construction activities.
- 4. Damaged or disturbed items shall be re-installed or restored to their original condition as soon as possible and prior to completion of work. Restoration shall be approved by the authority having jurisdiction over the disturbed items. There shall be no extra cost to the OWNER.
- 5. Items not specifically stated in the Specifications that are removed, damaged, destroyed, or defaced due to neglect or carelessness on the part of the CONTRACTOR shall be repaired or replaced by the CONTRACTOR if determined so by the ENGINEER.

1.06 SUBMITTALS

A. Record DRAWINGS

1. The CONTRACTOR is responsible for maintaining accurate record DRAWINGS, also known as "As-Built" DRAWINGS. Record DRAWINGS shall consist of <u>red lined</u> marked Contract DRAWINGS and shall be available to the OWNER or ENGINEER at any time upon request. The record DRAWINGS shall be delivered to the OWNER upon completion of the project.

- 2. Record drawing mark-ups are defined as design DRAWINGS whether provided by the Company, the CONTRACTOR, or others, upon which the CONTRACTOR has recorded all variations or changes between the work as built and observed by the CONTRACTOR, and the work as shown in the design DRAWINGS provided at the time of award or approval by the Company.
- 3. The CONTRACTOR shall keep one <u>up-to-date record copy</u> of all DRAWINGS for all deviations or modifications in location or elevation of any underground installation from that shown on the Contract DRAWINGS.
- 4. All As-Built drawing mark-ups submitted by the CONTRACTOR shall be provided on the latest issue "Approved for Construction," "D" size paper.
- 5. The As-Built DRAWINGS shall include, but not be limited to, the following: location of all underground pipes, fittings, valves, stub-outs, plugs, and service lines, as constructed.
- 6. As-Built mark-ups provided by the CONTRACTOR shall include final well locations, pipeline routings and the lateral and vertical extent of trench excavation. All locations and elevations shall be identified by qualified survey crews and tied to the California Coordinate System NAD 83 in feet. Survey shall be in accordance with the respective pipeline and well installation Specifications.
- 7. As-Built DRAWINGS kept by the CONTRACTOR are considered as part of the work such that any application for payment, approved percentage of completion, etc., is contingent upon the As-Built DRAWINGS being up-to-date with that portion of the construction.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Replacement in Kind

1. Except as indicated on the DRAWINGS or as specifically authorized by the utility OWNER, reconstruct utilities with new material of the same size, type, and original quality as that removed.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Replace in kind improvements that are cut, removed, damaged, or otherwise disturbed by the construction.
- B. Where utilities are parallel to or cross the pipeline trench but do not conflict with the permanent work to be constructed, follow the procedures given below and as indicated on the DRAWINGS. Notify the utility OWNER 48 hours in advance of the crossing construction and coordinate the construction schedule with the utility OWNER's requirements.
- C. Determine the true location and depth of utilities and service connections which may be affected by or affect the work. Determine the type, material, and condition of these utilities. The CONTRACTOR shall pothole all utilities, except those listed in the contract documents as already being potholed, prior to submitting pipe laying DRAWINGS. The CONTRACTOR shall submit a set of potholing plans to the OWNER prior to submitting laying diagrams. In

addition, the CONTRACTOR shall expose all utilities at least 500 lineal feet in advance of the start of pipeline excavation.

3.02 PROCEDURES

A. Protect in Place: Protect utilities in place, unless abandoned, and maintain the utility in service, unless otherwise specified on the DRAWINGS or in the Specifications.

B. Adjacent Existing Underground Utilities

- 1. Whenever possible, environmental piping should be laid at least 10 feet, horizontally, from any existing or proposed water mains. If local conditions prevent a lateral separation of 10 feet, environmental piping may be laid closer than 10 feet to a water main as long as one of the following are performed:
 - a. It is laid in a separate trench.
 - b. It is laid in the same trench with the water main located at one side of a bench of undisturbed earth.
 - c. In either case (a or b) the elevation of the top (crown) of the environmental pipe line is at least 18" below the bottom (invert) of the water main.
- 2. Whenever the environmental pipeline must cross under existing water mains, pipeline shall be laid at such an elevation that the top of the pipeline is at least 18" below the bottom of the water main.
- 3. Where significant utility conflicts are to be encountered, each pipeline shall be installed with a steel casing pipe at all such locations.
- 4. CONTRACTOR shall provide temporary support for all pipelines crossing the proposed trench. All pipelines 18 inches in diameter or larger crossing over the proposed water main with less than 4 feet of clearance shall have a temporary support. CONTRACTOR shall submit DRAWINGS of his method of temporary support to the ENGINEER for review. All pipelines less than 18 inches in diameter and crossing over the proposed water main with less than 2 feet of clearance shall be protected by pouring one (1) sack of sand/cement slurry from the top of the water main to the bottom of the crossing pipeline.

C. Lines and Grades for Water Lines and Underground Electrical Conduit

- 1. The CONTRACTOR shall employ a competent survey crew, approved by the ENGINEER, to lay out the work from the initial points of instruction as given by the ENGINEER. They shall set all offset stakes, set, test, and check all elevations and levels and other parts of the construction as the work progresses.
- 2. The CONTRACTOR shall furnish all flagging, nails, spikes, stakes, paint, and marking devices required for the survey and layout work. The CONTRACTOR shall also furnish personnel to assist the ENGINEER in checking the survey and layout work if required throughout the entire Contract period.
- 3. The ENGINEER will not provide surveying services to the CONTRACTOR. The CONTRACTOR shall retain the services of a qualified instrument man to perform the required survey work.
- 4. The CONTRACTOR shall furnish personnel to assist the ENGINEER for checking grades and locating existing facilities if requested.

- 5. The CONTRACTOR shall be responsible for protecting and safeguarding all benchmarks established by the ENGINEER and all existing property stakes, pins, monuments, etc. Any benchmarks, property stakes, pins, or monuments disturbed during construction activities shall be re-established and replaced by the CONTRACTOR's survey crew at no additional cost to the OWNER.
- 6. Property corner markers, boundary monuments, etc., disturbed or moved shall be restored, in conformance with the property deed description by a licensed land surveyor. Restoration of the markers or monuments shall be certified by said surveyor on a map prepared and stamped by him which shows the work accomplished. One copy of the map will be given to the property OWNER and one copy given to the ENGINEER.

D. Abandoned Utilities

1. Cut and Plug Ends: Cut abandoned utility lines (conduits) and plug the ends with brick and mortar or concrete plug. Plug utility lines with an 8-inch wall of brick and mortar or 8-inch concrete plug from the cut end of the pipe. Remove and dispose of abandoned utilities within the trench excavation.

E. Temporary Relocations

- 1. The CONTRACTOR, with the approval of the ENGINEER, shall remove items, which would interfere with his/her pipe installation operations, and shall re-install these items after construction is complete.
- 2. The CONTRACTOR shall disassemble items and store items for later reinstallation, as required. The CONTRACTOR shall disassemble the items carefully and store them in a safe location, and in a manner to prevent damage. Any damage to the items, as a result of the CONTRACTOR's neglect during removal, disassembly, storage, and/or reinstallation shall be replaced or repaired to the satisfaction of the ENGINEER at the CONTRACTOR's expense.

3.03 TESTING – NONE

3.04 CLEANUP

- A. Immediately after all construction operations have been completed, the CONTRACTOR shall thoroughly clean the area of all excess materials, debris, plant and equipment for which he or she is responsible. The CONTRACTOR shall also restore grounds, lawns, driveways, streets, roadways, pipes, drain lines, banks, ditches, and all other areas to their original condition and to the satisfaction of the ENGINEER and shall leave the premises in a neat and operable condition.
- B. Cleanup and restoration operations must be completed within a reasonable time following installation of any particular section of pipeline.

SECTION 01 71 31 – PROTECTION OF EXISTING FACILITIES

PART 1 - GENERAL

1.01 GENERAL

- A. The Contractor shall protect all existing utilities, piping and improvements not designated for removal and shall restore damaged or temporarily relocated utilities, piping and improvements to a condition equal to or better than they were prior to such damage or temporary relocation.
- B. The Contractor shall verify the exact locations and depths of all underground piping and utilities shown and not shown and shall make exploratory excavations of all piping and utilities that may interfere with the Work. It shall be the Contractor's responsibility to ascertain the actual location of all existing utilities, piping and other improvements that will be encountered in its construction operations and to see that such utilities or other improvements are adequately protected from damage due to such operations.
- C. <u>Maintaining in Service</u>: All pipelines, electrical, power, telephone, communication cables, gas and water mains shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the Engineer are made with the Owner. Where the proper completion of the Work requires the temporary or permanent removal and/or relocation of an existing utility or other improvement the Contractor, after necessary scheduling and approval, shall remove and, without unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to the Engineer and the Owner of the facility. In all cases of such temporary removal or relocation, the Work shall be accomplished by the Contractor in a manner that will restore or replace the utility or improvement to a new condition meeting the specification requirements.
- D. All repairs to a damaged utility or improvement are subject to inspection and approval by an authorized representative of the improvement owner before being concealed by backfill or other work.

1.02 RIGHTS-OF-WAY

A. The Contractor shall not do any work or enter upon the rights-of-way of any oil, gas, sewer or water pipeline; any telephone or electric transmission line; any fence; or any other structure, until notified by the Engineer that the Owner has secured authority to do so. After authority has been obtained, the Contractor shall give the governing utility proper advanced notice of its intention to begin work.

1.03 RESTORATION OF PAVEMENT AND SIDEWALKS

A. All paved areas and sidewalks not designated for replacement, cut or damaged during construction shall be replaced with similar materials and of equal thickness to match the

existing adjacent undisturbed areas unless otherwise noted. All sidewalks and pavements which are subject to partial removal shall be neatly saw-cut in straight lines.

1.04 UNDERGROUND UTILITIES NOT SHOWN OR INDICATED

A. If the Contractor damages existing utilities, piping or improvements that are not shown or the location of which was not made known to the Contractor prior to excavation and the damage was not due to failure of the Contractor to exercise reasonable care the Contractor shall immediately notify the Engineer. If directed by the Engineer repairs shall be made by the Contractor under the provisions for changes and extra work contained in Articles 13, 14 and 15 of the General Conditions.

1.05 NOTIFICATION BY THE CONTRACTOR:

A. Prior to any excavation in the vicinity of any existing underground facilities, including water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications or telecommunication cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way, the Contractor shall notify the respective authorities representing the owners or agencies responsible for such facilities not less than three (3) working days prior to excavation so that a representative can be present during such work if they are required to do so.

SECTION 01 71 37 – TRAFFIC REGULATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope: Provide operation and maintenance equipment, services, personnel, traffic control and protective devices, as required to expedite vehicular traffic flow in the areas designated for improvements as shown on the drawings.

1.02 REFERENCES

- A. ANSI D6.1: Manual on Uniform Traffic Control Devices for Streets and Highways.
- B. ATSSA: American Traffic Safety Services Association.

1.03 QUALITY ASSURANCE

A. All work within any highway right-of-way shall be performed in accordance with applicable safety regulations contained in the "Manual on Uniform Traffic Control Devices."

1.04 FLAGGERS

A. Flaggers to be knowledgeable of ANSI D6.1.

PART 2 - PRODUCTS

2.01 SIGNS, TAGS, SIGNALING AND BARRICADES

A. Signs, Tags and signaling and barricade devices shall comply with ANSI D6.1

PART 3 - EXECUTION

3.01 PREPARATION

- A. Notify the Engineer of areas to be rendered impassable or otherwise obstructed due to construction operations so routing of emergency vehicles and Owner's operations vehicles can be coordinated.
- B. Notify City of all scheduled disruptions to traffic flow at least 24 hours prior to initiating proposed action.

3.02 TRAFFIC CONTROL DEVICES AND SIGNS

A. Provide and operate traffic control devices and directional signs to direct and maintain an orderly flow of traffic in all areas under Contractor's control, or affected by Contractor's operations.

TRAFFIC REGULATION 01 71 37 - 1

- B. Mount traffic control and directional signs on barricades or posts at the following locations:
 - 1. Changes of direction of a roadway and at each crossroad
 - 2. Detours
 - 3. Parking areas
- C. Spacing and configuration of all construction signs shall conform to ANSI D6.1.

END OF SECTION

TRAFFIC REGULATION 01 71 37 - 2

SECTION 01 71 39 – DETOUR CONSTRUCTION AND FACILITIES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Detouring pedestrian and vehicular traffic includes but is not necessarily limited to:
 - 1. Regulating pedestrian and vehicular traffic in and around the perimeter of the work site.
 - 2. Maintaining the right of access of the public to private property unless closure is contemplated.
 - 3. Notifying public of intended closures of access to private properties.
 - 4. Maintaining existing services.

1.02 RELATED WORK

A. Any specific traffic control provisions listed on the project drawings or in the special provisions, or requested by engineer.

1.03 ACCESS RIGHTS OF PUBLIC

- A. Consider the access rights of the public at all times. Cause <u>no</u> unnecessary inconvenience.
- B. Provide and maintain safe and adequate pedestrian and vehicular access to fire hydrants, commercial and industrial establishments, churches, schools, parking lots, service stations, motels, fire and police stations, hospitals and establishments of similar nature. Access to these facilities shall be continuous and unobstructed.
- C. Maintain vehicular access to residential driveways to the property line except when necessary construction precludes such access for reasonable periods of time. If backfill has been completed to such extent that safe access may be provided and the street is opened to local traffic, immediately clear the street and driveways and provide and maintain access. Provide temporary drive approaches at all times except when concrete is being placed or cured.
- D. Non-compliance with the details of Section 1.03 will result I liquidated damages being assessed per the requirements of these Specifications.

1.04 MAINTAINING EXISTING SERVICES

- A. Cooperate with the various parties involved in the delivery of mail and the collection and removal of trash and garbage to maintain existing schedules for these services.
- B. Ensure that no interruption occurs in mail delivery, trash and garbage collection. This shall include the Contractor's responsibility to pick up scheduled garbage collection and haul to nearest point of suitable access as determined by the agency.

- C. Facilitate the garbage or trash pick up in the following manner:
 - 1. If operations interfere with garbage or trash pick up operations, notify all affected residents and business ahead of time by written notice. Inform them in the notice not to put out their garbage or trash for pick up at the appointed time and tell them another time will be set up to collect their garbage or trash. It will be collected when unrestricted vehicular access is assured for all the affected area residents and businesses. Deliver a copy of the notice to the Engineer for approval before it is delivered to the affected citizens.

1.05 NOTICE OR CLOSURE

- A. At least 48 hours in advance in closing, or partially closing, or of any re-opening any street, alley, or other public thorough-fare, notify emergency services corporations, Police, Fire, Traffic and Engineering Departments.
- B. Notify in writing all abutting property owners at least two (2) days prior to excavation in front of said abutting properties. Deliver a copy of the notice to the Engineer for approval before it is delivered to the affected citizens.
- C. In open streets, no intersection, driveway, or parking entrance shall be blocked more than one (1) working day. No intersection shall remain closed to vehicular traffic overnight.

1.06 REFERENCES

- A. Federal High Way Administration Manual on Uniform Traffic Control Devices.
- B. Caltrans Traffic Control Manual.

PART 2 - PRODUCTS

2.01 TEMPORARY TRAFFIC CONTROL DEVICES

A. All warning signs, warning lights, barricades, lights, temporary signals and other protective devices shall be in accordance with 2016 Work Area Traffic Control Handbook.

PART 3 - EXECUTION

3.01 GENERAL TRAFFIC REGULATIONS

A. Unless provided for otherwise in this section, regulate all pedestrian and vehicular traffic in and adjacent to the work site in accordance with 2016 Work Area Traffic Control Handbook standards and the manual of Uniform Traffic Control Devices.

3.02 TRENCH EXCAVATIONS

A. Any excavation left open during hours of darkness shall be protected with flashing light barricades, as required by OSHA.

3.03 CONSTRUCTION OPERATIONS

- A. The Contractor shall provide for two-way traffic through construction operations, except where conditions warrant, as determined by the Engineer, one-way traffic will be allowed. One-way traffic provisions shall apply when fresh bituminous material is being placed, when half-width pavement is being laid, or when necessary due to construction operations. The contractor shall furnish adequately trained flagmen, warning signs and warning lights, and if necessary, pilot cars for the safe control of traffic. During suspension of work, two-way traffic shall be provided.
- B. The contractor shall erect warning signs in advance of any place on the project where operations interfere with the use of the road by traffic, and at all intermediate points where the new work crosses or coincides with an existing road. Such warning signs shall be constructed and erected in accordance with the plans.

3.04 BARRICADES

A. Furnish, place and maintain all safety devices, danger signs, barricades, etc., required for all pedestrian and traffic control in accordance with the requirements specified in the Manual of Uniform Traffic Control Devices.

3.05 FLAGGING

A. Flagging personnel shall be considerate to motorists, and project a safe, professional image while flagging. Flaggers shall refrain from using abusive language while on the job.

SECTION 01 75 13 – CHECKOUT PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section describes the Checkout Procedures to be performed by the CONTRACTOR. Equipment testing and plant startup are required for satisfactory completion of the contract and shall be scheduled and completed within the contract time.

1.02 REFERENCED SECTIONS

- A. Division 26 Electrical
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL

A. Equipment Testing

- 1. The CONTRACTOR shall provide the services of an experienced and authorized representative of the manufacturer of each item of equipment indicated in the equipment schedules that shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation.
- 2. The CONTRACTOR shall have the manufacturer's representative revisit the Work site as often as necessary until any and all problems are corrected.
- 3. The CONTRACTOR shall require that each manufacturer's representative furnish to the ENGINEER a written report addressed to the City certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts and has been operated satisfactorily under full-load conditions.
- 4. The CONTRACTOR shall be responsible for scheduling all operations testing. The CONTRACTOR shall furnish all personnel, power, water, chemicals, fuel, oil, grease and all other necessary equipment, facilities and services required for conducting the tests.
- 5. The CONTRACTOR is advised that the ENGINEER and operating personnel will witness operations testing and that the manufacturer's representative shall be required to instruct the operating personnel in correct operation and maintenance procedures.
- 6. This instruction shall be scheduled with the OWNER / ENGINEER at least ten (10) days in advance and shall be provided while the equipment is fully operational. The CONTRACTOR shall have previously furnished the technical manuals required under Sections 01 33 00 Submittal Procedures and 01 78 23 Operation and Maintenance Data.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION – NOT USED

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes requirements for closeout procedures, final cleaning, and project record documents.

1.02 REFERENCED SECTIONS

A. Related Sections are listed below:

- 1. SECTION 01 78 23 OPERATION AND MAINTENANCE DATA
- 2. SECTION 01 78 39 PROJECT RECORD DOCUMENTS
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL

A. Closeout Procedures

1. The CONTRACTOR shall make all repairs and replacements promptly upon receipt of written order from the OWNER / ENGINEER. If the CONTRACTOR fails to make such repairs or replacements promptly the OWNER / ENGINEER reserves the right to do the Work and the CONTRACTOR and his/her surety shall be liable to the OWNER for the cost thereof. Replacement of earth fill, backfill or resurfacing where it has settled below the required finish elevations shall be considered as part of such required repair work.

B. Final Cleaning

- 1. Final cleaning shall be executed prior to the final inspection.
- 2. The CONTRACTOR shall clean the site, sweep paved area, and clean any other surfaces.
- 3. Waste and surplus materials, rubbish and construction facilities shall be removed from the project and from the site.

C. Project Record Documents

- 1. Documents shall be stored separate from those used for construction.
- 2. The CONTRACTOR shall keep documents current and shall not conceal any work until required information has been recorded.
- 3. At Contract Closeout, the CONTRACTOR shall submit documents with a transmittal letter containing the date, project title, CONTRACTOR's name and address, list of documents, and the signature of the CONTRACTOR.

1.06 SUBMITTALS

- A. When the CONTRACTOR considers his/her work has reached final completion, the CONTRACTOR shall submit a certification that states that the Contract Documents have been reviewed, work has been inspected, and that the work is complete in accordance with the Contract Documents and is ready for the OWNER's inspection. The inspection shall include start-up and testing of all installed equipment.
- B. The request shall be made in writing, addressed to the ENGINEER, at least seven days in advance of the requested date of the final inspection.
- C. In addition to submittals required by the Conditions of the Contract, the CONTRACTOR shall provide submittals required by governing authorities, and shall submit a final statement of accounting giving the total adjusted contract sum, previous payments, and the sum remaining due.
- D. The OWNER will issue a final change order reflecting approved adjustments to the contract sum not previously made by change order.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 FINAL CLEANUP

A. The CONTRACTOR shall promptly remove, from the vicinity of the completed work, all rubbish, unused materials, concrete forms, construction equipment and temporary structures and facilities used during construction. Final acceptance of the Work by the ENGINEER will be withheld until the CONTRACTOR has satisfactorily complied with the requirements for final cleanup of the project site.

SECTION 01 78 23 – OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section includes the CONTRACTOR's requirements in regard to the facility's Operation and Maintenance Data. The CONTRACTOR has overall responsibility to obtain the necessary data from and compile the data as set forth in this specification, including items or equipment purchased by the OWNER and delivered to the CONTRACTOR for installation.
- B. The Operating and Maintenance (O&M) Manual is prepared to provide a ready reference to all important pieces of mechanical and electrical equipment installed on the project. It is also to provide the necessary operating and maintenance data for use by service personnel. It is also to provide information required for checking equipment performance or for planning of plant expansion or redesign.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. The O&M Manuals will be submitted in three-ring binder with insert labels in the cover and spine identifying the project and device name. Stick-on, taped or pasted labels are not acceptable.
 - B. Equipment will not be accepted until approval and submittal of final O&M manuals.
- 1.05 QUALITY CONTROL
 - A. Operation and Maintenance (O&M) Manual
 - 1. For the O&M Manual, the Contractor shall provide, at a minimum, the following:
 - a. A comprehensive and applicable operating and maintenance manual.
 - b. Nameplate data including equipment identification number (as identified on the Drawings), model number, serial number, operating range, and power supply.
 - c. Manufacturer's instruction, description of system operation, start-up data, and troubleshooting lists.
 - d. Manufacturer's instructions, calibration schedule and instructions, lubrication schedule, and type and cleaning procedures.
 - e. Electrical wiring diagram and schematic.
 - f. Complete parts list identifying material of construction, and the manufacturer's recommended repair parts listing.
 - g. Name, address and phone number for manufacturer, sales representative and nearest parts warehouse.

- B. All information included shall be legible and sufficiently marked to indicate the exact size, model, type, etc., of equipment furnished and installed.
- C. The number of binders (or "volumes") required will depend on the amount of information to be catalogued.

1.06 SUBMITTALS

- A. The CONTRACTOR shall submit all approved O&M technical manuals to the ENGINEER. The ENGINEER will then prepare the O&M Manual.
- B. Manuals from the CONTRACTOR shall contain descriptive drawings and data which identify equipment installed at the project and detail the procedures and parts required to maintain and repair the equipment. Copies of approved submittals shall be included for all equipment.
- C. The ENGINEER submittals shall include the following:
 - 1. Two sets of the draft O&M manual shall be submitted for review.
 - 2. Four sets of the final O&M manual and an electronic copy on portable media drive(s) shall be submitted to the following:
 - a. Three sets and portable media drive(s) to the OWNER
 - b. One set for the ENGINEER
 - 3. The manuals will be submitted in a three-ring binder with insert labels in the cover and spine identifying the project and device name. Stick-on, taped or pasted labels are not acceptable.
 - 4. The quantities of drawings, manufacturer's literature, or other data required for these manuals are in addition to those otherwise required for normal distribution for approval during the construction period.
- D. Equipment will not be accepted until approval and submittal of final O&M manuals.

PART 2 - PRODUCTS

2.01 O&M MANUAL COMPONENTS

A. Page Size

1. All pages shall be standard 8-1/2" x 11" size or approximate multiples (preferably 17" x 11") folded to 8-1/2 x 11 inch manila pockets, which shall have standard three-ring side punching for insertion in the binders. The equipment name, drawing description and number shall be written on the face of each manila pocket.

B. Drawings

1. All drawings larger than 8-1/2" x 11" shall be folded and inserted in individual 8-1/2" x 11" manila pockets, which shall have standard three-ring side punching for insertion in the binders. The equipment name, drawing description and number shall be written on the face of each manila pocket.

C. Binders

- 1. Binders shall be Buckram binders with block lettering for sheet size 8-1/2" x 11" with 2" to 3-1/2" expandable metal capacity as required for the project. The number of binders, however, shall be based on not filling them beyond 4".
- D. The following information shall appear on the front cover and backbone of both the Well and Treatment Plant O&M Manuals, as applicable:
 - 1. "Operation and Maintenance Manual."
 - 2. Project Name (and volume number if more than one volume).
 - 3. OWNER's name.
 - 4. ENGINEER's name.
 - 5. General CONTRACTOR's name.
- E. Item 5 need not be printed on the backbone.
- F. Contents and Indexing:
 - 1. Manuals shall contain descriptions of the building systems in sufficient detail to adequately indicate the type of systems installed and the basic details of their operation.
 - 2. All purchased equipment data shall be used to designate the sections. Within each section additional indexing of component parts may be required.
 - 3. Operation and Maintenance Manuals shall contain to the fullest extent all possible information pertinent to the equipment. The arrangement and type of information to be filed shall be as follows:
 - a. Copy of purchase order change (if any).
 - b. Outline drawings, special construction details, "as built" electrical wiring and control diagrams for all major and supplementary systems.
 - c. Manufacturer's test or calculated performance data and certified test curves.
 - d. Installation, operating, and maintenance instructions, including a complete parts list and sectional drawing with parts identification numbers. Mark with model, size and plan number.
 - e. Manufacturer's brochure marked to indicate exact equipment purchased.

 Brochures on component parts supplied by a manufacturer with his equipment, but not manufactured directly by him, shall also be included.
 - f. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols.
 - g. Written warranties.
 - h. Include a Table of Contents. The contents shall be divided with tabbed index dividers into the following suggested parts:
 - 1) Building and System Descriptions
 - 2) Purchased Equipment Data
 - 3) Test Reports and Valve Charts

- 4) Start-Up and Operation
- 5) Preventative Maintenance Recommendations
- i. A copy of the approved submittals for each piece of equipment, and a copy of all testing, adjusting and balancing reports, and wiring diagrams marked with model and size and plan symbol.
- j. Operating and Maintenance Manuals data for Part I shall be obtained directly from the mechanical and electrical consultants. (Allow consultant preparation cost.)
- k. The index shall contain the name and address of the manufacturer and, if different, where replacement and repair parts may be obtained.

PART 3 - EXECUTION - NOT USED

SECTION 01 78 39 – PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section includes the CONTRACTOR's requirements in regard to the project record documents.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. Prior to requesting final payment, the CONTRACTOR shall obtain and submit the following items to the OWNER or ENGINEER:
 - 1. Manufacturers' representatives' installation, testing and startup reports.
 - 2. Keying.
 - 3. Maintenance stock items, spare parts and special tools.
 - 4. Completed record drawings (also known as "As Built" drawings).
 - 5. Certificates of inspection and acceptance by local governing agencies having jurisdiction.
 - 6. Releases from all parties who are entitled to claims against the subject project, property or improvement pursuant to the provisions of law.
 - B. Record Drawings
 - 1. The Record drawings shall be kept current with the work and shall be subject to inspection by the ENGINEER at any time.
 - 2. Prior to acceptance of the work, the CONTRACTOR shall submit the record prints to the ENGINEER.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 02 01 00 – MAINTENANCE OF EXISTING CONDITIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section includes a description of how the General Construction CONTRACTOR (CONTRACTOR) shall address the construction practices that relate to items at the site at the commencement of work.
- B. All site work such as conflicts with existing utilities, additional subsurface investigation, and surveying shall be included in this section.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. It is not the responsibility of the OWNER to maintain the most accurate and most recent record DRAWINGS. The OWNER is not responsible for any costs of the items disturbed or damaged by the CONTRACTOR's operation.
 - B. If interruptions to TVMWD's operations results from damage to existing underground/above-ground utilities, restoration of utility service shall be completed AS SOON AS POSSIBLE by the CONTRACTOR and shall be included as part of the project's costs.
 - C. The CONTRACTOR will not be permitted to use existing sewer systems (if any) as drain lines for the construction work. The CONTRACTOR shall be responsible for all surface water runoff and/or groundwater tributary to the pipeline and/or trenches constructed and shall supply the necessary dewatering and pumping equipment for handling those flows during construction.
 - D. Existing Utility Lines
 - 1. The CONTRACTOR is responsible for locating any possible existing underground utilities in order to properly complete site work. The CONTRACTOR shall contact the OWNER or ENGINEER immediately upon discovery of additional utilities in the area prior to starting and during the performance of the work.
 - Water, sewer, gas, power and telephone service to buildings shall be maintained with a minimum of interruption throughout the construction of the contract work. No such service shall be intentionally interrupted without the approval of the respective utility company concerned, and without first giving due warning to the occupants of said dwelling or business establishment.
 - 3. The CONTRACTOR shall avoid disturbance and/or displacement of existing utilities and shall provide all temporary and permanent supports and other required protection.

E. Existing Power Lines

1. If the proposed work is in close proximity to overhead and underground power lines which could be hazardous to construction personnel and/or other persons, the

- CONTRACTOR shall properly protect the wires, pole supports, or other power line appurtenances to avoid disturbances to those facilities.
- 2. The CONTRACTOR shall also operate all machinery and conduct all other construction activities in a manner, which will assure protection of all construction personnel and other persons against the described hazard.

F. Existing Gas Lines

- 1. The CONTRACTOR shall avoid disturbance and/or displacement of underground gas lines and their associated facilities and shall provide all temporary and permanent supports required to protect and prevent exposure to construction personnel and/or other persons.
- 2. If gas lines are exposed during construction and leakage is detected, the CONTRACTOR shall suspend all construction work in those areas immediately. The OWNER of the pipeline shall be immediately advised of the condition, and construction shall not resume until all repairs have been properly completed.

G. Landscaping, Existing Trees, and Vegetation

- 1. The CONTRACTOR shall protect existing trees, shrubbery, and other vegetation that is to remain in place against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials, excess foot or vehicular traffic, or improper parking of vehicles on vegetation. Temporary fences, barricades or guards are to be provided as required to protect trees and vegetation to be left standing.
- 2. Trees and other vegetation to remain within limits of contract work shall be watered as required to maintain their health during course of construction operations.
- 3. Protection shall be provided for roots over 1-1/2" diameter cut during construction operations. Coat cut faces with a wound paint formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
- 4. The CONTRACTOR shall repair or replace trees and vegetation that will remain, which are damaged by construction operations, in a manner acceptable to the ENGINEER and property OWNER if work is performed on private property. The ENGINEER may employ an Arborist to repair damages to trees and shrubs at the CONTRACTOR's expense when deemed necessary.

H. Existing Valves and/or Other Existing System Appurtenances

1. The CONTRACTOR shall not operate existing system valves, hydrants or other appurtenances at any time. If the existing items described are required to accommodate construction, the CONTRACTOR shall provide the OWNER with an advance notice and shall receive approval from the OWNER before use of the existing appurtenances.

1.05 QUALITY CONTROL

A. The CONTRACTOR shall conduct all work in accordance with the applicable rules and regulations of specified governing agencies, and in accordance with the laws, rules, and/or regulations of all other authorities having jurisdiction over the required construction work. Any

- required permits shall be obtained and paid for by the CONTRACTOR (including all <u>city</u> permit fees and charges).
- B. The CONTRACTOR shall determine the exact location of existing structures, underground piping, or conduit which would be in the vicinity or possibly affected by the CONTRACTOR's operation.
- C. The CONTRACTOR shall relocate existing items or mark these existing items if removal is not required, and shall protect any underground facility.
- D. The CONTRACTOR shall schedule and coordinate all construction activities and shall cooperate with the OWNER's operating personnel to provide a minimum of interruptions to the operations of other present facilities.

E. Property Restoration

- 1. CONTRACTOR shall restore landscaping to original condition.
- 2. The CONTRACTOR shall assume <u>all responsibility</u> and <u>liability</u> for property damages, bodily injury, or financial losses and interruptions of service that may result from his/her construction activities which affect structures, facilities, water lines, gas lines, power lines, electric conduits, sewer lines, telephone lines, cable TV lines, and all service facilities connected thereto.
- 3. The CONTRACTOR shall be responsible for the relocation, repairing, reconstruction, and re-installation of damaged or disturbed items due to his/her construction activities.
- 4. Damaged or disturbed items shall be re-installed or restored to their original condition as soon as possible and prior to completion of work. Restoration shall be approved by the authority having jurisdiction over the disturbed items. There shall be no extra cost to the OWNER.
- 5. Items not specifically stated in the Specifications that are removed, damaged, destroyed, or defaced due to neglect or carelessness on the part of the CONTRACTOR shall be repaired or replaced by the CONTRACTOR if determined so by the ENGINEER.

1.06 SUBMITTALS

A. Record DRAWINGS

- 1. The CONTRACTOR is responsible for maintaining accurate record DRAWINGS, also known as "As-Built" DRAWINGS. Record DRAWINGS shall consist of red lined marked Contract DRAWINGS and shall be available to the OWNER or ENGINEER at any time upon request. The record DRAWINGS shall be delivered to the OWNER upon completion of the project.
- 2. Record drawing mark-ups are defined as design DRAWINGS whether provided by the Company, the CONTRACTOR, or others, upon which the CONTRACTOR has recorded all variations or changes between the work as built and observed by the CONTRACTOR, and the work as shown in the design DRAWINGS provided at the time of award or approval by the Company.
- 3. The CONTRACTOR shall keep one <u>up-to-date record copy</u> of all DRAWINGS for all deviations or modifications in location or elevation of any underground installation from that shown on the Contract DRAWINGS.

- 4. All As-Built drawing mark-ups submitted by the CONTRACTOR shall be provided on the latest issue "Approved for Construction," "D" size paper.
- 5. The As-Built DRAWINGS shall include, but not be limited to, the following: location of all underground pipes, fittings, valves, stub-outs, plugs, and service lines, as constructed.
- 6. As-Built mark-ups provided by the CONTRACTOR shall include final well locations, pipeline routings and the lateral and vertical extent of trench excavation. All locations and elevations shall be identified by qualified survey crews and tied to the California Coordinate System NAD 83 in feet. Survey shall be in accordance with the respective pipeline and well installation Specifications.
- 7. As-Built DRAWINGS kept by the CONTRACTOR are considered as part of the work such that any application for payment, approved percentage of completion, etc., is contingent upon the As-Built DRAWINGS being up-to-date with that portion of the construction.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Replacement in Kind

1. Except as indicated on the DRAWINGS or as specifically authorized by the utility OWNER, reconstruct utilities with new material of the same size, type, and original quality as that removed.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Replace in kind improvements that are cut, removed, damaged, or otherwise disturbed by the construction.
- B. Where utilities are parallel to or cross the pipeline trench but do not conflict with the permanent work to be constructed, follow the procedures given below and as indicated on the DRAWINGS. Notify the utility OWNER 48 hours in advance of the crossing construction and coordinate the construction schedule with the utility OWNER's requirements.
- C. Determine the true location and depth of utilities and service connections which may be affected by or affect the work. Determine the type, material, and condition of these utilities. The CONTRACTOR shall pothole all utilities, except those listed in the contract documents as already being potholed, prior to submitting pipe laying DRAWINGS. The CONTRACTOR shall submit a set of potholing plans to the OWNER prior to submitting laying diagrams. In addition, the CONTRACTOR shall expose all utilities at least 500 lineal feet in advance of the start of pipeline excavation.

3.02 PROCEDURES

A. Protect in Place: Protect utilities in place, unless abandoned, and maintain the utility in service, unless otherwise specified on the DRAWINGS or in the Specifications.

B. Adjacent Existing Underground Utilities

- 1. Whenever possible, environmental piping should be laid at least 10 feet, horizontally, from any existing or proposed water mains. If local conditions prevent a lateral separation of 10 feet, environmental piping may be laid closer than 10 feet to a water main as long as one of the following are performed:
 - a. It is laid in a separate trench.
 - b. It is laid in the same trench with the water main located at one side of a bench of undisturbed earth.
 - c. In either case (a or b) the elevation of the top (crown) of the environmental pipe line is at least 18" below the bottom (invert) of the water main.
- 2. Whenever the environmental pipeline must cross under existing water mains, pipeline shall be laid at such an elevation that the top of the pipeline is at least 18" below the bottom of the water main.
- 3. Where significant utility conflicts are to be encountered, each pipeline shall be installed with a steel casing pipe at all such locations.
- 4. CONTRACTOR shall provide temporary support for all pipelines crossing the proposed trench. All pipelines 18 inches in diameter or larger crossing over the proposed water main with less than 4 feet of clearance shall have a temporary support. CONTRACTOR shall submit DRAWINGS of his method of temporary support to the ENGINEER for review. All pipelines less than 18 inches in diameter and crossing over the proposed water main with less than 2 feet of clearance shall be protected by pouring one (1) sack of sand/cement slurry from the top of the water main to the bottom of the crossing pipeline.

C. Lines and Grades for Water Lines and Underground Electrical Conduit

- 1. The CONTRACTOR shall employ a competent survey crew, approved by the ENGINEER, to lay out the work from the initial points of instruction as given by the ENGINEER. They shall set all offset stakes, set, test, and check all elevations and levels and other parts of the construction as the work progresses.
- 2. The CONTRACTOR shall furnish all flagging, nails, spikes, stakes, paint, and marking devices required for the survey and layout work. The CONTRACTOR shall also furnish personnel to assist the ENGINEER in checking the survey and layout work if required throughout the entire Contract period.
- 3. The ENGINEER will not provide surveying services to the CONTRACTOR. The CONTRACTOR shall retain the services of a qualified instrument man to perform the required survey work.
- 4. The CONTRACTOR shall furnish personnel to assist the ENGINEER for checking grades and locating existing facilities if requested.
- 5. The CONTRACTOR shall be responsible for protecting and safeguarding all benchmarks established by the ENGINEER and all existing property stakes, pins, monuments, etc. Any benchmarks, property stakes, pins, or monuments disturbed during construction activities shall be re-established and replaced by the CONTRACTOR's survey crew at no additional cost to the OWNER.
- 6. Property corner markers, boundary monuments, etc., disturbed or moved shall be restored, in conformance with the property deed description by a licensed land surveyor. Restoration of the markers or monuments shall be certified by said surveyor on a map

prepared and stamped by him which shows the work accomplished. One copy of the map will be given to the property OWNER and one copy given to the ENGINEER.

D. Abandoned Utilities

1. Cut and Plug Ends: Cut abandoned utility lines (conduits) and plug the ends with brick and mortar or concrete plug. Plug utility lines with an 8-inch wall of brick and mortar or 8-inch concrete plug from the cut end of the pipe. Remove and dispose of abandoned utilities within the trench excavation.

E. Temporary Relocations

- 1. The CONTRACTOR, with the approval of the ENGINEER, shall remove items, which would interfere with his/her pipe installation operations, and shall re-install these items after construction is complete.
- 2. The CONTRACTOR shall disassemble items and store items for later reinstallation, as required. The CONTRACTOR shall disassemble the items carefully and store them in a safe location, and in a manner to prevent damage. Any damage to the items, as a result of the CONTRACTOR's neglect during removal, disassembly, storage, and/or reinstallation shall be replaced or repaired to the satisfaction of the ENGINEER at the CONTRACTOR's expense.

3.03 TESTING – NONE

3.04 CLEANUP

- A. Immediately after all construction operations have been completed, the CONTRACTOR shall thoroughly clean the area of all excess materials, debris, plant and equipment for which he or she is responsible. The CONTRACTOR shall also restore grounds, lawns, driveways, streets, roadways, pipes, drain lines, banks, ditches, and all other areas to their original condition and to the satisfaction of the ENGINEER and shall leave the premises in a neat and operable condition.
- B. Cleanup and restoration operations must be completed within a reasonable time following installation of any particular section of pipeline.

SECTION 02 05 00 – COMMON WORK RESULTS FOR EXISTING CONDITIONS

PART 1 - GENERAL

- 1.01 GENERAL CONDITIONS
 - A. The General Conditions apply to all sections of this specification, which shall be done as shown on the plans and as specified, and shall be properly coordinated with work in other Specifications.
 - B. The DRAWINGS and these Specifications are complementary to each other; what is called for by one shall be as binding as if called for by both. If there is any conflict between what is shown on the DRAWINGS and what is written in the Specifications, the details described on the DRAWINGS shall take precedence and the CONTRACTOR shall communicate the conflicts to the ENGINEER in a timely manner.
 - C. Safety
 - 1. The CONTRACTOR shall be familiar with, and shall at all times conform to, the regulations of the "OSHA General Industry Occupational Safety and Health Standards," "OSHA Safety and Health Regulations for Construction," and other applicable state and municipal standards and regulations.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS
 - A. Standards listed as "Reference Standards" in the various sections of these contract documents are hereby incorporated into these Specifications by reference.
 - B. Referenced documents shall include all revisions, amendments, supplements, or addenda issued on or before the date of advertising for bids.
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL NONE

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

SECTION 02 10 70 – RESTORATION OF IMPROVEMENTS

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

- A. It shall be the responsibility of the Contractor to reconstruct any and all existing improvements along the project unless the drawings or the Engineer specifically state otherwise. Items to be reconstructed include but are not limited to the following:
 - 1. Relocation of mailboxes, street signs, water meters, and utility boxes as required.
 - 2. Reconstruction of existing fences in kind, including posts, wires, concrete curb walls, rails, slats, gates, etc.
 - 3. Relocation of existing trees, and shrubbery as indicated.
 - 4. Reconstruction of improvements damaged during the construction of the project.

1.02 PROTECTION

A. Ensure safe passage of persons around area of reconstruction. Conduct operations to prevent injury to adjacent buildings, structures, other facilities and improvements, and persons. Provide flaggers, barricades, warning lights, etc., as required to properly identify construction areas.

1.03 DAMAGES

A. Promptly repair damages caused to adjacent facilities by reconstruction operations at no cost to the owner of damaged facilities and the project owner. Proper care shall be taken to retain and protect all items specifically labeled as being retained and protected.

1.04 UTILITY SERVICE DISRUPTION

A. The contractor shall notify and receive approval from the appropriate utility company and affected property owners at least 24 hours in advance of all requited disruption of services.

1.05 CONSTRUCTION CONSIDERATIONS

A. The Contractor shall be considerate of the adjacent property owners during construction. Disruptions to services and property access ways shall be minimized. Clean-up of construction areas shall be performed daily. Storage of Contractor owned equipment shall not be allowed on private property without written permission of property owners. All construction debris shall be removed from the job site and disposed of in a safe and lawful manner.

1.06 DOCUMENTATION OF EXISTING IMPROVEMENTS

A. It shall be the responsibility of the Contractor to properly document the state and dimensions of existing improvements that are to be reconstructed prior to removal of that improvement. This may be done through the means of photographs, sketches, detailed drawings, or written text.

PART 2 - PRODUCTS

2.01 SALVAGEABLE ITEMS

A. Insofar as it is practicable, existing improvements should be salvaged and reused during reconstruction operations. It is the intent to replace in kind all existing improvements to be reconstructed.

2.02 NON-SALVAGEABLE ITEMS

A. When it is not practical or safe to reuse existing materials the Contractor shall supply new materials that match existing or adjacent improvements. All new material must be approved by the individual property owners and the project owner before they are used for reconstruction purposed.

PART 3 - EXECUTION

3.01 GENERAL

A. All items to be reconstructed shall reconstructed to match the original improvements and to the satisfaction of the affected property owners. Workmanship and quality of materials shall meet or exceed industry standards for the items being reconstructed.

3.02 TREES AND SHRUBS

- A. Care shall be taken when removing existing trees to avoid damaging the root system. Excavate pits, beds and trenches with vertical sides and with bottom of excavation slightly raised at center to provide drainage. Set root balls on a layer of compacted planting soil mixture, plumb and in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades. Backfill in layers and work each layer to settle backfill and eliminate voids and air pockets. Guy and stake trees and shrubs immediately after planting.
- B. The Contractor shall be responsible to water and maintain trees and shrubs relocated until project close-out.

SECTION 02 41 16.13 – BUILDING DEMOLITION

PART 1 - GENERAL

1.01 REQUIREMENT

- A. The Contractor shall provide demolition and removal of existing structural materials and piping, electrical gear and equipment in accordance with the requirements of the Contract Documents. The Contractor shall conduct demolition operations so that existing facilities to remain and new work will not be damaged or disturbed.
- B. It is vital that the existing Miramar treatment plant system remain in operation at all times. Any proposed shut-down of any one of the system facilities shall be coordinated and approved by the Owner.
- C. If during demolition operations the Contractor becomes aware of any asbestos, hazardous waste or toxic material at the Work site to which the Contractor or any subcontractor, supplier or Owner's personnel may be exposed the Contractor shall immediately notify the Owner and the Engineer in writing. The Contractor shall not perform any work in connection therewith prior to receipt of special written instructions from the Owner through the Engineer.
- D. The Contractor shall repair or replace without cost to the Owner and to the satisfaction of the Engineer existing facilities disturbed or damaged during demolition and removal operations.
- E. Immediately upon removal the Contractor shall legally dispose of demolished items not to be salvaged. The Contractor shall not allow demolished items not to be salvaged to accumulate at the Work site. No demolished items shall be sold while on the Owner's property.
- F. The Owner reserves the right to salvage any of the existing materials or equipment. The Contractor, upon being notified by the Engineer or the Owner, shall salvage and relocate to an Owner designated, on-site storage area any materials or equipment the Owner desires to keep. The cost for such salvage shall be included under the contract.
- G. The Contractor shall patch and seal abandoned openings and holes left as a result of removal and demolition to match existing surrounding structure. Openings in concrete shall be patched with non-shrink grout and if necessary grouted openings in floors shall be supported in a manner approved by the Engineer. Large openings shall be supported by 1/4-inch minimum galvanized sheet metal bolted to the structure underneath the opening.

SECTION 03 05 00 – COMMON WORK RESULTS FOR CONCRETE

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. The General Conditions apply to all work of this specification, which shall be done as shown on the plans, and as specified, and shall be properly coordinated with work in other Specifications.
- B. The DRAWINGS and these specifications are complementary to each other; what is called for by one shall be as binding as if called for by both. If there is any conflict between what is shown on the DRAWINGS and what is written in the specifications, the details described on the DRAWINGS shall take precedence and the CONTRACTOR shall communicate the conflicts to the ENGINEER in a timely manner.

C. Safety

1. The CONTRACTOR shall be familiar with, and shall at all times conform to, the regulations of the "OSHA General Industry Occupational Safety and Health Standards," "OSHA Safety and Health Regulations for Construction," and other applicable state and municipal standards and regulations.

1.02 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 01 33 00 SUBMITTAL PROCEDURES

1.03 CITED STANDARDS

- A. All concrete work shall conform to the requirements of the following standard specifications, of the latest revisions, as applicable:
 - 1. ASTM C31 / C31M 09 Standard Practice for Making and Curing Concrete Test Specimens in the Field
 - 2. ASTM C39 / C39M 05e2 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 - 3. ASTM C143 / C143M 08 Standard Test Method for Slump of Hydraulic-Cement Concrete
 - 4. ASTM C172 08 Standard Practice for Sampling Freshly Mixed Concrete
 - 5. ACI 318-11 Building Code Requirements for Structural Concrete and Commentary

1.04 NOTED RESTRICTIONS

A. Compaction testing results shall be made available to OWNER or its representative.

1.05 QUALITY CONTROL

- A. Any change in configuration or design of the concrete foundations or structural elements which is required to accommodate any construction procedure or operation shall be done only on approval of, and at no additional cost to, the OWNER.
- B. The CONTRACTOR shall accompany any request for a design change in the concrete work with design calculations, prepared by a qualified registered professional ENGINEER, which shall show the effect of the proposed changes on the elements to be revised and on all supporting elements.
- C. The CONTRACTOR shall adhere to any applicable part of the specifications in this division as it relates to the work to be done.
- D. CONTRACTOR shall apply all drawing notes to unlisted concrete mix designs.

1.06 SUBMITTALS

A. The CONTRACTOR shall submit manufacturer's catalog data and descriptive literature for form ties, spreaders, corner formers, form coatings and curing compound, bond breakers, joint sealant, backing rod, joint filler, epoxy bonding compound, and color additive.

PART 2 - PRODUCTS

2.01 CONCRETE AND RELATED COMPONENTS

- A. All concrete, grout, and all ingredients including water shall be as approved by the ENGINEER.
- B. All concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, and water so proportioned and mixed as to produce a plastic, workable mixture in accordance with all requirements of these Specifications and suitable to the specific conditions of placement. The proportions of materials shall be such as to secure the lowest water/cement ratio which is consistent with good workability, a plastic, cohesive mixture, and one which is within the specified slump range. The proportion of fine and coarse aggregate shall be such as not to produce harshness in placing or honeycombing in the structures.

PART 3 - EXECUTION

3.01 PREPARATION

A. Workmanship and Methods

- 1. Concrete work, including detailing of reinforcing, shall be in accordance with the best standard practices as set forth in the ACI Building Code, Manuals, and Recommended Practices.
- 2. All concrete materials shall be so delivered, stored, and handled as to prevent damage to the materials and the inclusion of foreign substances. Packaged materials shall be delivered and stored in original containers until ready for use. Material containers or materials showing evidence of water or other damage shall be rejected.

3.02 INSTALLATION

A. Concrete work shall be constructed as a monolith as feasible. Every part of the work concrete and grout of homogeneous structure, when hardened, shall have the required strength, watertightness, and resistance to weathering.

B. Watertightness of Concrete Work

- 1. It is recognized that some surface hairline cracks and crazing will develop in the concrete surfaces. Construction, contraction, and expansion joints shall be positioned in structures, and curing methods shall be specified, for the purpose of reducing the number and size of these expected cracks (due to the normal expansion and contraction expected from the specified concrete mixes).
- 2. Cracks which develop in walls or slabs shall be repaired, and cracks which show any signs of leakage shall be repaired until all leakage is stopped. Visible cracks, other than hairline cracks and crazing, shall be pressure grouted with low viscosity epoxy as specified herein.
- 3. Epoxy Injection System shall be used for walls and overhead slabs of passageways or occupied spaces, the outside of which are exposed to weather or may be washed down and are not specified to receive a separate waterproof membrane; and other similar surfaces not specified to receive a separate waterproof membrane.
- 4. Walls or slabs, as above, that leak or sweat because of porosity or cracks too small for successful pressure grouting, shall be sealed on the water or weather side by coatings of a surface sealant system, as specified elsewhere herein.
- 5. Grouting or sealing as specified above shall be continued until the structure is watertight and shall remain watertight for not less than one year after final acceptance or date of final repair, whichever occurs later in time.

C. Joints and Bonding

- 1. The locations of contraction, construction, and other joints are indicated on the DRAWINGS and/or specified herein. Where not specified or indicated otherwise, all slabs and walls shall have construction joints at intervals no greater than 30 feet. There shall not be less than 14 days between placement of concrete in adjacent concrete wall placements.
- 2. At construction joints, the concrete in place shall be thoroughly cleaned of laitance, grease, oil, mud, dirt, curing compounds, mortar droppings, or other objectionable matter by means of heavy sandblasting, after which the surfaces shall be washed just prior to the succeeding concrete placement. Immediately prior to resuming concrete placing operations, a bed of grout not less than ½ inch in thickness nor more than 1 inch in thickness shall be thoroughly spread over the horizontal joint surfaces.

3. Keyways

- a. Material for keyways shall be steel, plastic or lumber treated with form release coating, applied in accordance with the manufacturer's published instructions.
- 4. Construction joints shall be washed free of sawdust, chips, and other debris after forms are built and immediately before the concrete placement. Should formwork confine sawdust, chips, or other loose matter in such manner that it is impossible to remove them by flushing with water, a vacuum cleaner shall be used for their removal, after which the

- cleaned surfaces shall be flushed with water. A cleanout hole shall be provided at the base of each wall and column for inspection and cleaning.
- 5. The CONTRACTOR shall schedule the placing of concrete in such a manner as to complete any single placing operation to a construction, contraction, or expansion joint. Special care shall be taken to insure that concrete is well consolidated around and against waterstops and that waterstops are secured in the proper position.
- 6. In any case where it is necessary to repair concrete by bonding mortar or new concrete to concrete which has reached its initial set, the surface of the set concrete shall first be coated with epoxy bonding agent.

D. Measurements of Materials

1. Materials shall be measured by weighing unless other methods are specifically authorized in writing by the ENGINEER. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. Cement shall be weighed separately. The accuracy of all weighing devices shall be such that successive quantities of the individual item can be measured to within 1% of the desired amount of that item. Cement in unbroken standard packages (sack) need not be weighed, but bulk cement and fractional packages shall be weighed. The mixing water shall be measured by volume or by weight. The water measuring device shall be capable of control of water quantities to accuracy of 1% of the desired amount. All measuring or weighing devices shall be subject to review and acceptance by the ENGINEER, and shall bear a valid seal of the Sealer of Weights and Measures having jurisdiction.

E. Concrete Proportions and Consistency

- 1. The concrete shall be of such consistency and composition that it can be worked readily into the corners and angles of the forms and around the reinforcement without excessive vibration and without permitting the materials to segregate or free water to collect on the surface.
- 2. The ratio of coarse aggregate to fine aggregate shall be no less than 1.0 or more than 2.0 for all concrete with the exception of Class CE.
- 3. The CONTRACTOR shall prevent unnecessary or haphazard changes in consistency of the concrete. Aggregate shall be obtained from a source which shall provide uniform quality, moisture content, and grading during any single day's operation. Aggregate shall be delivered to the mixing site and handled in such a manner that variations in moisture content will not interfere with the steady production of concrete of the specified degree of uniformity and slump.
- 4. The concrete mix water to cement ratio, minimum cement content, and slump range shall conform to the values specified in Table A below.

TABLE A					
Туре	Max. W/C ratio	Min. Cement Factor	28-day Strength	Max. Slump (in)	
Class AA	0.42	6 3/4	4500 psi	3 ± 1	
Class A	0.45	6	4000 psi	3 ± 1	
Class C	0.59	5	2800 psi	3 ± 1	
Class CE	0.6	4.5	2500 psi	4 ± 1	

- 5. The CONTRACTOR shall control and adjust the concrete batch weights so as to secure the maximum yield and shall also maintain the proportions of the concrete mix within the specified limits.
- 6. If designated by the ENGINEER, the mixture shall be modified within the limits set forth in these specifications.

F. Concrete Mixes

1. Prior to placement of concrete, the CONTRACTOR shall mix design calculations for the concrete mix he proposes to use for each class of concrete. The concrete mix shall be proportioned based on the required average compressive strength f'cr defined in the following sections.

G. Required Average Compressive Strength

- 1. The required average compressive strength, f'cr for the selection of concrete proportion for the mix design, for each class of concrete, shall be determined using the calculated standard deviation and its corresponding specified compressive strength f'c, in accordance with ACI 318, Part 3, Chapter 5.
- 2. Where the CONTRACTOR has a test record of at least 30 consecutive tests that span a period of no less than 45 calendar days, a standard deviation shall be established as described in ACI 318, Part 3, Chapter 5 and as modified herein. Test records from which the standard deviation is calculated shall represent materials and conditions similar to the materials, quality control procedures, and conditions expected to apply in the preparation of concrete for the work. Changes in materials and proportions within the test records shall be more restricted than those for the work. The specified compressive strength fc of concrete used in the test records shall be within 1,000 psi of that specified for the Work.
- 3. The CONTRACTOR shall include the test records with the mix design submittal.
- 4. Where the CONTRACTOR does not have a test record for calculation of standard deviation meeting requirements specified herein, the required average compressive strength f'cr shall be determined from Table B.

TABLE B			
Specified Compress Strength f'c (psi)	Required Avg. Compressive Strength f'cr (psi)		
Less than 3,000	f'c + 1,000		
3,000 to 5,000	f'c + 1,200		
Over 5,000	f'c + 1,400		

H. Enforcement of Strength Requirement

- 1. Concrete is expected to reach a higher compressive strength than that which is indicated in Table B as the specified compressive strength fc. The strength level of the concrete will be considered acceptable if all of the following conditions are satisfied.
 - a. The averages of all sets of three consecutive strength test results shall be greater or equal to specified compressive strength f'c. No individual strength test (average of two cylinders) shall fall below specified compressive strength f'c by more than 500 psi.

b. Whenever one, or both, of the two conditions stated above is not satisfied, the CONTRACTOR shall provide additional curing of the affected portion followed by cores taken in accordance with ASTM C 42 and ACI 318. If the additional curing does not bring the average of three cores taken in the affected area to at least the specified compressive strength f'c, all concrete in the affected area shall be designated as defective. The ENGINEER may require the CONTRACTOR to strengthen the defective concrete by means of additional concrete, additional reinforcing steel, or replacement of the defective concrete, all at the CONTRACTOR's expense.

3.03 TESTING OF CONCRETE

- A. During the progress of construction, the ENGINEER will have tests made to determine whether the concrete, as being produced, complies with the requirements specified herein. These tests shall be made in accordance with ASTM C 31, ASTM C 39, and ASTM C 172. Test cylinders will be made and delivered to the laboratory by the ENGINEER and the testing expense will be borne by the OWNER.
- B. Not less than three cylinder specimens, 6" D x 12" L, will be tested for each 150 yd³ of each class of concrete with a minimum of three specimens for each class of concrete placed and not less than three specimens for each half day's placement. One cylinder will be broken at 7 days and two at 28 days.
- C. The CONTRACTOR shall test the slump of concrete using a slump cone in accordance with the requirements of ASTM C 143. The CONTRACTOR shall provide the test equipment. Concrete that does not meet the specification requirements as to slump shall not be used and shall be removed. The CONTRACTOR shall test the slump at the beginning of each placement, as often as necessary to keep the slump within the specified range, and when requested to do so by the OWNER.
- D. The CONTRACTOR shall make provisions for and furnish all concrete for the test specimens, and provide manual assistance to the OWNER in preparing said specimens. The CONTRACTOR shall be responsible for the care of and providing curing conditions for the test specimens in accordance with ASTM C 31.

3.04 TESTS FOR WATERTIGHTNESS

- 1. All concrete structures which are designed or intended to hold water shall be tested for water tightness in the following manner:
- 2. After the structure has been completed, all drain valves and other valves or openings into the tanks shall be closed and all stop plank openings, etc., shall be sealed or plugged so as to be made watertight. Any leaking valves shall be conditioned or repaired so that they are watertight.
- 3. The basin shall then be filled with water to the approximate average flow line and left to stand for 24 hours to permit the concrete to absorb any moisture, after which time the basin level shall be brought up to the average flow line and readings shall be taken by means of a hook gage as to the exact depth of water in the basin. The basin shall stand thus for 24 hours and a reading shall then be taken.
- 4. At the beginning of the test, a flat pan shall be floated in the basin containing approximately 1 in. depth of water. The exact depth of the water in the pan shall be

- measured. At the conclusion of the test the amount of water that has been lost or gained by the pan shall be determined in a similar manner in order to determine the amount of precipitation or evaporation from the surface of the tank or basin to be tested.
- 5. The maximum allowable loss for the basin that will be permitted will be 0.25% of the volume of the water in the basin. However, any damp places, leaks or other locations indicating seepage shall be repaired. All structures requiring water tests shall not be backfilled until after the test has been completed so that the locations of any or all points where leakage may occur will be visible.

SECTION 03 06 30 – SCHEDULES FOR CAST-IN-PLACE CONCRETE

Item	No.	Ref. Drawing No.	Size (ft.)	Exposure Class	Strength (28 day)
Well Building Foundation	1	S-4	32'-0"x26'-8"	F0, S0, W2, C1	5,000 psi
Misc Access Drives and Pads		See Structural Plans	Varies	F0, S3, W2, C1	5,000 psi

SECTION 03 11 00 - CONCRETE FORMING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes a description of how the General Construction CONTRACTOR (CONTRACTOR) shall address the construction practices that relate to concrete forming.

1.02 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 03 30 00 CAST-IN-PLACE CONCRETE

1.03 CITED STANDARDS

- A. All concrete forming shall conform to the requirements of the following standard specifications, of the latest revisions, as applicable:
 - 1. ACI International 347 Guide to Formwork for Concrete
 - 2. APA PS1 (1995) Construction and Industrial Plywood (APA V995)
 - 3. ASTM C31/C31M-06 Standard Practice for Making and Curing Concrete Test Specimens in the Field
 - 4. ASTM C39/C39M-05e1 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

1.04 NOTED RESTRICTIONS

A. Failure of any supporting surface either due to surface texture, deflection or form collapse shall be the responsibility of the CONTRACTOR.

1.05 QUALITY CONTROL

- A. Forming systems shall be performed by manufacturers with a minimum of 5 years of experience. Forms for all exposed concrete shall be carefully built to produce the contour and design indicated. Care shall be taken to assure that all form joints are truly vertical or horizontal. No sloping joints will be accepted.
- B. Formwork shall be designed as a complete system with consideration given to the effects of cementitious materials and mixture additives such as fly ash, cement type, plasticizers, accelerators, retarders, air entrainment, and others. The adequacy of formwork design and construction shall be monitored prior to and during concrete placement.
- C. Formwork shall be designed for anticipated live and dead loads, and shall comply with the tolerances specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

1.06 SUBMITTALS

- A. The CONTRACTOR shall submit, manufacturer's catalog data and descriptive literature for form ties, spreaders, corner formers, form coatings and curing compound, bond breakers, joint sealant, backing rod, joint filler, epoxy bonding compound, and color additive to the ENGINEER.
- B. The shop DRAWINGS and data submitted shall include the type, size, quantity, and strength of all materials of which the forms are made, the plan for jointing of facing panels, details affecting the appearance, and the assumed design values and loading conditions.
- C. Manufacturer's literature shall be submitted for plywood, concrete form hard board, form accessories, prefabricated forms, form coating, and form-lining materials.

PART 2 - PRODUCTS

2.01 FORMS AND FORM LINERS

- A. All forms and form liners shall be fabricated as defined in ACI 347. Forms shall conform to the shape, lines, grades and dimensions of the concrete as called for on the DRAWINGS. All lumber used for forms shall be thoroughly cleaned and free from dirt, debris, concrete, etc. and treated with an approved form oil. Lumber used in forms for exposed surfaces shall be dressed to a uniform thickness and shall be free from loose knots or other defects.
- B. For a smooth, hard, and dense finish, a sufficient number of forms shall be provided so that the work may be completed rapidly and present a uniform appearance in form patterns and finish.
- C. For unexposed surfaces and rough work, undressed lumber free of nails and clean of hardened concrete or other foreign material may be used. Lumber once used in forms shall have nails withdrawn, and surfaces to be in contact with concrete shall be thoroughly cleaned before being used again.
- D. Form sheathing for exposed surfaces may be composed of tongue and groove lumber, shiplap, plywood, concrete form board, or steel. Steel lining on wood lagging will not be permitted. Tongue and groove shiplap when used shall conform to the American Lumber Standards for No. 2 boards.
- E. Forms and form liners for this project shall be fabricated with a Class A or B Finish. Plywood used for sheathing or lining shall be Grade B-B exterior or better as described in the Commercial Standards of the Douglas Fir Plywood Association. The forms used shall produce a concrete surface with "abrupt" irregularities less than 1/4 in. and gradual irregularities less than 1/2 in. in 5 ft.
- F. Forms shall be sufficiently tight to prevent leakage of mortar. They shall be properly braced or tied together so as to maintain the desired position and shape during and after placing concrete and so they will not tremble or distort in a high wind.

2.02 FORM COATINGS

- A. Forms for exposed or painted surfaces shall be coated with approved form oil before the form or reinforcement is placed in final position. Forms for unexposed surfaces may be wet with water in lieu of coating immediately before placing concrete in hot weather.
- B. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

2.03 KEYWAYS AND INSERTS (WHERE NECESSARY)

A. Material for keyways shall be steel, plastic, or lumber treated with form coating, applied according to label directions. Pipes, anchor bolts, steps, reglets, castings, and other inserts shall be encased in the concrete. Dovetail anchors or ties shall be used in conjunction with the slots or inserts for the various materials as may be necessary for the required work.

PART 3 - EXECUTION

3.01 PREPARATION AND INSTALLATION

A. Form Construction

- 1. The CONTRACTOR shall continuously monitor the alignment and stability of the forms during all phases to assure the finished product will meet the required surface class (or classes) specified in Part 2 of this section above.
- 2. When forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be re-used if there is any evidence of defects which would impair the quality of the resulting concrete surface. All surfaces of used forms shall be cleaned of mortar and any other foreign material before reuse.

B. Chamfering

- 1. Where not otherwise indicated on the DRAWINGS, all external angles of walkways, slabs, walls, beams, columns, and openings shall have a 3/4" bevel formed by utilizing a true dimensioned wood or solid plastic chamfer strip and external angles of walkways, walls, and slabs at expansion, contraction, and construction joints shall be a 1/2" bevel formed by utilizing a true dimensioned wood or solid plastic chamfer strip. Reentrant angles may be left square. Level strips shall be installed at the top of all wall concrete placements to maintain a true line at all horizontal construction joints.
- 2. Chamfered joints shall not be permitted where earth or rock fill is placed in contact with concrete surfaces. Chamfered joints shall be terminated 12" (30 cm) outside the limit of the earth or rock fill so that the end of the chamfers will be clearly visible.

C. Bracing and Alignment of Forms

- 1. All formwork shall be securely braced, supported, tied down, or otherwise held in place to prevent any movement of formwork.
- 2. When a second lift is placed on hardened concrete, special precautions shall be taken in the form work at the top of the old lift and bottom of the new lift to prevent spreading, vertical or horizontal displacement of forms; and to prevent grout "bleeding" on finished

- concrete surfaces. Pipe stubs, anchor bolts, and other embedded items shall be set in the forms where required.
- 3. No concrete shall be placed until all forms have been thoroughly checked by the CONTRACTOR for alignment, level, strength, and to assure accurate location of all mechanical and electrical inserts or other embedded items. All cracks, openings, or offsets at joints in the formwork which are 1/16 inch or larger shall be closed by tightening the forms or by filling with an acceptable crack filler.

D. Tolerances

- 1. It shall be the responsibility of the CONTRACTOR to comply with the intent of these specifications, but it is also recognized that there will be occasions when some deviation will occur or be required. It shall therefore be agreed that the maximum deviation from true line and grade shall not exceed the tolerances listed below at the time of acceptance of the project.
- 2. All tolerances shall comply with ACI 117-81 (paragraphs 2.0 2.2, and paragraphs 4.0 4.5). All slabs shall be uniformly sloped to drain when a slope is indicated. Slabs which are indicated to be level shall have a maximum deviation of ¹/₈" in 10 feet without any apparent changes in grade.
- 3. All inserts shall be set to the tolerances required for the proper installation and operation of the equipment or systems to which the insert pertains. The following shall be considered maximum tolerances.

Item	Max Tolerance (in)		
Sleeves and inserts	+/- 1/8"		
Projected ends of anchor bolts	+/- 1/4"		
Anchor bolt setting	+/- 1/16"		

E. Removal of Forms

1. The CONTRACTOR shall remove forms in such a manner as to insure the complete safety of the structure. All forms supporting concrete and shoring shall remain in place as follows:

Form Type	Duration Period in Place		
Vertical Forms	24 hours min		
Sides of footings	24 hours min		
Vertical sides of beams, girders, etc.	48 hours min		
Slabs, beams, and girders	Until concrete reaches the specified strength or until shoring is installed		
Shoring for slabs, beams, girders	Until concrete reaches the specified strength		
Wall bracing	Until concrete beams and slabs laterally supporting the wall reaches the specified strength		

- 2. No form or form support shall be removed from the formed surface for at least 24 hours. In case the CONTRACTOR shall remove any form before the above conditions have been met, the concrete elements may be condemned even though there is no apparent defect
- 3. Factors related to form removal include ambient temperature, concrete lift heights, the type and amount of concrete admixture, and type and amount of cementitious material in the concrete. The CONTRACTOR is responsible for considering all of the applicable factors and for leaving the forms in place until it is safe to remove them.
- 4. Where forms support more than one element, the forms shall not be removed until the form removal criteria are met by all supported elements.

F. Control Cylinders

- 1. Evidence that the concrete has gained sufficient strength to permit removal of forms shall be determined by tests on control cylinders.
- 2. Control cylinders shall be stored in the structure or as near the structure as possible so they receive the same curing conditions and protection methods as given to the portions of the structure they represent.
- 3. Control cylinders shall be removed from the molds at an age of no more than 24 hours. All control cylinders shall be in accordance with ASTM C 31/C 31M and ASTM C 39/C 39M.

G. Form Ties

- 1. After the forms and the tapered ties are removed from the wall, tapered tie holes shall be plugged. Tie holes shall be heavy blasted, cleaned, and then shall have a rubber plug driven into each of the tapered tie holes with a steel rod. The steel rod shall be located in a cylindrical recess, made in the plug, during driving. At no time shall plugs be driven on the flat area outside the cylindrical recess. The rubber plug shall be sized so that after it is driven into the tapered tie hole, the plug will be located near the center of the wall.
- 2. After installing plugs in the tapered tie holes, the tie holes shall be coated with epoxy bonding agent and filled with dry-pack mortar with a dry consistency and with a mix of one part of Portland cement to one part of plaster sand. The amount of water to be added to the cement-sand mix shall be such that the mortar can be driven into the holes and will compact properly. The dry-pack mortar shall be heavily compacted in the holes and shall be placed in layers with a thickness not exceeding the tie hole diameter. Admixtures or additives shall not be used in the dry-pack mortar.
- 3. The wall surfaces in the area of the dry-packed tie holes shall be covered with a minimum of 10 mils of epoxy gel. The epoxy gel coating on the wall surface shall extend a minimum of 2 inches past the dry-pack mortar filled tie hole. The finish surfaces shall be free from sand streaks or other voids.

3.02 TESTING

A. Forms and embedded items shall be inspected in sufficient time prior to each concrete placement by the CONTRACTOR. The results of each inspection shall be reported to the ENGINEER.

CONCRETE FORMING 03 11 00 - 5

B. Tests for water tightness shall be as described in Section 3.04 of **03 05 00 Common Work Results for Concrete**.

END OF SECTION

CONCRETE FORMING 03 11 00 - 6

SECTION 03 13 00 – CONCRETE FORMWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes materials and installation of concrete forms.

1.02 RELATED SPECIFICATION SECTIONS

- A. Reinforcing Steel: 03 21 00.
- B. Cast-In-Place Concrete: 03 30 00.
- C. Concrete Finishing: 03 35 00.
- D. Concrete Curing: 03 39 00.
- E. Painting and Coating: 09 90 00.

1.03 SUBMITTALS

- A. Shop drawings shall be submitted in accordance with Section 01 33 00 and the following.
- B. Submit manufacturer's literature for form ties, spreaders, corner form, form coating, and bond breakers.

PART 2 - PRODUCTS

2.01 FORM CONSTRUCTION AND DESIGN

- A. <u>General:</u> Forms shall be designed according to the applicable portions of ACI347, "Recommended Practice for Concrete Formwork," and all applicable regulations and codes. All concrete shall be formed unless specified otherwise.
- B. <u>Observation Points:</u> Form windows or stage forms shall be provided to allow observation at all times before concrete is poured. Formwork and placement design shall be such as to limit free fall of concrete to 4 feet.
- C. Notification: NONE

2.02 CLASSES OF FORMS

- A. <u>Class I Forms:</u> Smooth-surface plywood ¾-inch minimum thickness shall be used for straight surfaces and ½-inch minimum thickness for curved surfaces.
- B. <u>Class II Forms:</u> Forms shall be made of plywood in good condition, metal, or smooth-planed boards free from large or loose knots with tongue and groove or ship lap joints. Forms shall be oiled.

C. <u>Application:</u> Class II forms shall be used for exterior concrete surfaces which are 1 foot or more below finished grade. Class I forms shall be used for all other surfaces.

2.03 FORM MATERIAL

- A. <u>General:</u> Forms shall be made of plywood, lumber, or steel of sufficient strength and surface smoothness to produce the specified finish. Joints, gaps, and apertures in forms shall be taped, gasketed, plugged and/or caulked so that the joint will remain watertight and withstand placing pressures without bulging outward or creating surface irregularities.
- B. <u>Lumber:</u> Lumber used in form construction shall be standard grade Douglas fir, S4S Standard Grading and Dressing Rules No. 16, West Coast Lumber Inspection Bureau. Boards in contact with concrete shall be 6 inches or more in width.
- C. <u>Plywood:</u> Plywood used in form construction shall be Grade B-B, Class 1 plyform, mill-oiled, and sanded on both sides in conformance with U.S. Product Standard PS-1.

2.04 FORM TIES

- A. <u>General:</u> Form ties shall be located on exposed surfaces in a uniform pattern or as indicated on the drawings. Form ties shall be constructed so that the tie remains embedded in the wall except for a removable portion at each end. Form ties shall have conical or spherical type inserts with a maximum diameter of 1 inch. Form ties shall be constructed so that no metal is within 1 inch of the concrete surface when the forms, inserts, and tie ends are removed. Wire ties shall not be used. Ties shall withstand all pressures and limit deflection of forms to acceptable limits.
- B. <u>Flat Bar Ties:</u> Flat bar ties for panel forms shall have plastic or rubber inserts having a minimum depth of 1-inch and sufficient dimensions to permit patching of the tie hole.
- C. <u>Ties with Integral Waterstops</u>: Ties for water-holding structures or dry structures with access, such as basement access shafts or pipe galleries that are below finish grade shall have an integral steel waterstop that is tightly and continuously welded to the tie. The waterstop shall be at least two times larger in area than the tie cross-sectional area and shall be oriented perpendicular to the tie and symmetrical about the center of the tie. Ties shall be constructed to provide a positive means of preventing rotation or disturbance of the center portion of the tie during removal of the ends.
- D. <u>Tapered Form Ties:</u> Tapered form ties shall be tapered through-bolts at least 1 inch in diameter at smallest end, or through-bolts that utilize a removable tapered sleeve of the same minimum size.

2.05 BOND BREAKER

A. Bond breaker shall be a nonstaining type which will provide a positive bond prevention, such as Williams Tilt-Up Compound, as manufactured by Williams Distributors, Inc., Seattle, Washington; Silcoseal 77, as manufactured by SCA Construction Supply Division, Superior Concrete Accessories, Franklin Park, Illinois; or approved equal.

2.06 FORM RELEASE AGENT

- A. Form release agent shall effectively prevent absorption of moisture and prevent bond with the concrete. Agent shall be nonstaining and nontoxic after 30 days.
- B. For steel forms, release agent shall prevent discoloration of the concrete due to rust.

PART 3 - EXECUTION

3.01 FORM TOLERANCES

- A. <u>Rejected Work:</u> Failure of the forms to produce the specified concrete surface and surface tolerance shall be grounds for rejection of the concrete work. Rejected work shall be repaired or replaced at no additional cost to the OWNER.
- B. <u>Allowable Tolerances:</u> The following table indicates tolerances or allowable variations from dimensions or positions of structural concrete work:

	Maximum Tolerance
Sleeves and inserts	1/4" - 1/4"
Projected ends of anchors	1/4" - 0.0"
Anchor bolt setting	1/4" - 1/4"
Finished concrete, all locations	1/4" - 1/4", 10 feet
Finished concrete, total length	+1"

- C. The planes or axes from which the above tolerances are to be measured shall be as follows:
 - 1. Sleeves and inserts: Centerline of sleeve or insert.
 - 2. Projected ends of anchors: Plane perpendicular to the end of the anchor as located on the drawings.
 - 3. Anchor bolt setting: Centerline of anchor bolt.
 - 4. Finish concrete: The concrete surface as located on the drawings.
 - 5. Where equipment is to be installed, the manufacturer's tolerances shall be complied with if more stringent than the above.

3.02 FORM SURFACE PREPARATION

- A. <u>Cleaning:</u> Form surfaces to be in contact with the concrete shall be cleaned of all previous concrete, dirt, and other surface contaminants prior to preparation by the applicable method below.
- B. <u>Release Agent:</u> Wood surfaces and steel surfaces in contact with the concrete shall be coated with a release agent prior to form installation. Release agent shall be submitted to and approved by the ENGINEER prior to construction. For water storage facilities, a non-hazardous mineral oil type release agent shall be used.

3.03 CHAMFERS

- A. <u>General Dimensions:</u> 3/4-inch bevels shall be formed at concrete edges except those on top of walls and elevated slabs and beams. Edges at top of walls, slabs, and beams shall be rounded to a 3/4-inch radius.
- B. <u>Exterior Corners:</u> Exterior corners in concrete members shall be provided with 3/4-inch chamfers. Reentrant corners in concrete members shall not have fillets, unless otherwise shown on the drawings.

3.04 FORM PLACEMENT

- A. <u>General:</u> Forms shall be provided with adequate means for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. The forms shall be tight and braced in order to prevent movement and the loss of mortar and fines during placing and vibration of the concrete.
- B. <u>Inspection Openings:</u> Cleanout and inspection openings shall be provided at the bottom of each lift of forms. There shall be one 12-inch-wide by 18-inch- high opening every 7 feet at the bottom of each lift of forms.
- C. <u>Allowable Embedment of Form Tie in Concrete:</u> No part of any form-tying device other than metal shall be embedded in the concrete.
- D. <u>Taper Tie Orientation:</u> The large end of taper ties shall be located on the "wet" side of the wall.
- E. <u>Prevention of Spalling:</u> Only form or form-tying methods which do not cause spalling of the concrete upon form stripping or tie removal shall be allowed.
- F. Non-formed Concrete: Surfaces of concrete members shall be formed except where placement of the concrete against the ground is shown on the drawings. The dimensions of concrete members shown on the drawings shall apply to formed surfaces, except where otherwise indicated. At least 2 inches of concrete shall be added where concrete is placed against trimmed undisturbed ground in lieu of forms. Placement of concrete against the ground shall be limited to footings and only where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing.

3.05 FORM REUSE

A. Only forms which maintain a uniform surface texture on exposed concrete surfaces shall be used. Light sanding shall be applied between uses to obtain uniform texture. Unused tie rod holes with corks, shaved flush, and sandpapered on the concrete surface side. Other than filling tie rod holes, forms shall not be patched except in the case of Class II forms. Metal patching discs shall not be used on Class I forms.

3.06 FORM REMOVAL AND TIMING

A. <u>Protection of Concrete Surfaces:</u> Means shall be provided for removing forms without injury to the surface of the finished concrete.

B. <u>Form Placement Duration:</u> Forms and shoring for elevated structural slabs or beams shall remain in place until the concrete has reached a compressive strength equal to the specified 28-day compressive strength as determined by test cylinders. Supports shall not be removed and reshored. The following table indicates the minimum allowable time after the last cast concrete is placed before forms, shoring, or wall bracing shall be removed:

Sides of footings and encasements	24 hours
Walls not supporting load	48 hours
Vertical sides of beams, girders, and similar members	48 hours
Slabs, beams, and girders	10 days (forms only)
Shoring for slab, beams, and girders	Until concrete strength reaches specified 28-day strength
Wall bracing	Until top or roof slab concrete reaches 2,500 psi

C. <u>Form Placement Duration in Cold Weather:</u> Forms shall not be removed from concrete which has been placed with outside air temperature below 50° F without first determining if the concrete has properly set without regard for time. Heavy loading shall not be applied to green concrete. Immediately after forms are removed, the surface of the concrete shall be carefully examined and any irregularities in the surface shall be repaired and finished as specified.

3.07 FORMED OPENINGS

A. Openings shall be of sufficient size to permit final alignment of the items within it without deflection or offsets of any kind and to allow space for packing where the items pass through the wall to ensure watertightness around openings so formed. Openings shall be provided with continuous keyways with waterstops where required, and a slight flare to facilitate grouting and the escape of entrained air during grouting. Formed openings shall be provided with reinforcement as indicated in the typical structural details. Reinforcing shall be at least 2-inches clear from the opening.

3.08 EMBEDDED ITEMS_

A. Anchor bolts and other embedded items shall be set accurately and held securely in position in the forms until the concrete is placed and set. All special castings, channels, or other metal parts that are to be embedded in the concrete shall be checked prior to and again after concreting. All nailing blocks, plugs, and strips necessary for the attachment of trim, finish, and similar work shall be checked prior to concreting.

3.09 PIPES AND WALL SPOOLS CAST IN CONCRETE

- A. <u>Fittings Cast in Formed Concrete Structures:</u> Wall spools, wall flanges, and wall anchors shall be installed before placing concrete. Wall spools or anchors shall not be welded, tied, or otherwise connected to the reinforcing steel.
- B. <u>Pipe Encasement:</u> Pipe and fabricated fittings to be encased in concrete shall be supported on concrete piers or pedestals. Concrete supports shall be carried to firm foundations so that no settlement occurs during construction.

END OF SECTION

SECTION 03 15 13 – WATERSTOPS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section includes a description of how the General Construction CONTRACTOR (CONTRACTOR) shall proceed to furnish all material, equipment, labor, services, etc., to complete and install waterstops that shall provide a lasting, watertight, bond to fresh and cured concrete surfaces, and vertical, horizontal, and sloping cast-in-place concrete joints.
- B. Waterstop shall be installed in concrete joints where indicated on the DRAWINGS.

1.02 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 07 90 00 JOINT PROTECTION

1.03 CITED STANDARDS

- A. All waterstops shall conform to the requirements of the following standard specifications, of the latest revisions, as applicable:
 - 1. International Federal Specifications SS-S-210A "Sealing Compound for Expansion Joints" (1975)
 - 2. U.S. Army Corps of ENGINEERs (USACE) COE CRD-C 572 Specifications for Polyvinylchloride Waterstops (1974)

1.04 NOTED RESTRICTIONS

A. Split-leg waterstops will not be permitted.

1.05 QUALITY CONTROL

A. Waterstops shall meet or exceed all requirements of Federal Specifications SS-S-210A.

1.06 SUBMITTALS

A. Shop DRAWINGS

1. The CONTRACTOR shall submit DRAWINGS showing the locations of all joints that are to receive waterstops and the methods of supporting the waterstops in the forms without creating displacement due to pressure from concrete placement.

B. Product Data

1. The CONTRACTOR shall submit the Manufacturer's product data of the proposed waterstops for review by the ENGINEER.

C. Samples

1. The CONTRACTOR shall also submit a 12-inch long sample of a typical waterstop.

D. Certificates

1. The CONTRACTOR shall submit a certificate of compliance stating that the waterstops, joint filler, and sealant materials to be used conform to the requirements specified.

1.07 DELIVERY AND STORAGE

- A. Materials delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. The waterstops shall be stored out of direct sunlight.
- B. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Waterstop shall be polyvinyl chloride and shall be manufactured by:
 - 1. Burke Concrete Accessories Inc.;
 - 2. Greenstreak Plastic Products Division of Western Textile Products Company;
 - 3. Kirkhill Rubber Company; Williams Products Inc.; or equal.
- B. Waterstops shall be manufactured by such a process that they will be dense, homogenous, and free from holes and other imperfections. The cross-section of the waterstop shall be uniform and symmetrical along its entire length.
- C. The waterstops and the codes they shall conform to are described below:
 - 1. Polyvinylchloride waterstops shall conform to COE CRD-C 572.
- D. Material for PVC waterstops shall be of an elastomeric plastic compound, the basic resin of which shall be polyvinyl chloride.
- E. Preformed Plastic Adhesive Waterstops (recommended where applicable)
 - 1. Preformed plastic adhesive waterstops are recommended where applicable and shall be single-component, self-sealing strip applied plastic waterstops extruded in a "rope" form between two "quick-release" papers.
 - 2. Preformed Plastic Adhesive Waterstop shall have an indefinite shelf life and shall contain no solvents, irritating fumes, or obnoxious odor.
 - 3. The waterstop shall be a single-component, self-sealing plastic adhesive type. It shall also have non-oxidizing, non-evaporating, non-expanding, non-shrinking and with water, chemical and saturated hydrogen sulfide resistant characteristics.
- F. Unless otherwise specified or indicated on the DRAWINGS, polyvinyl chloride waterstop shall be 6-inch flat ribbed, centered, at construction and contraction joints, and 9-inch wide ribbed with a 1-inch diameter hollow center bulb centered at expansion joints. The waterstop shall be manufactured from virgin polyvinyl chloride plastic compound and shall not contain any scrap or reclaimed material.

G. The CONTRACTOR shall submit samples, prints, and complete physical property data covering the waterstop. The CONTRACTOR shall submit written certifications that all of the material supplied on this project meets or exceeds the physical property requirements of the current U.S. Army Corps of ENGINEERs Specification No. CRD-C572 and shall submit laboratory test reports indicating that the average properties of all the materials and finished waterstops conform to the following:

TEST	LIMIT	TEST METHOD
Specific gravity - not less than	1.35	ASTM D 792
Type A shore durometer hardness	70 to 80	ASTM D 2240
Tensile strength - not less than	2,250 psi	ASTM D 638
Ultimate elongation - not less than	350 percent	ASTM D 638
Alkali extraction, 7 day weight change between	-0.1 percent to +0.25 percent	CRD-C-572
Low temperature brittle point - not more than	-35 degrees F	ASTM D 746
Water absorption - 24 hours - not more than	0.15 percent	ASTM D 570
Accelerated extraction tensile - not less than	1,500 psi	ASTM D 412
Stiffness in flexure - not less than	750 psi	ASTM D 747
Tear resistance - not less than	350 lbs/in	ASTM D 624

- 1. 6-inch waterstop shall weigh not less than 130 pounds per 100 linear feet.
- 2. 9-inch waterstop shall weigh not less than 220 pounds per 100 linear feet.
- 3. Thickness shall be 3/8-inch. Center bulb shall be 1-inch nominal outside diameter. Allowable tolerances are width plus or minus 3/16-inch; thickness plus or minus 1/32-inch.

PART 3 - EXECUTION

3.01 PREPARATION

A. The CONTRACTOR shall review the manufacturer's specifications and recommendations prior to installation.

3.02 INSTALLATION

A. Waterstop shall be installed so that all joints are watertight. All joints such as unions, crosses, ells and tees for polyvinyl chloride waterstop shall be field welded with thermostatically controlled equipment recommended by the waterstop manufacturer. The CONTRACTOR shall demonstrate the ability to weld acceptable joints in the polyvinyl chloride waterstop before installing waterstop in the forms. Quality of welded joints will be subject to the approval of the OWNER.

- B. Exposed waterstops shall be protected during applications of form release agents to avoid being coated.
- C. The CONTRACTOR shall protect exposed projecting edges and ends of partially embedded waterstops from damage.
- D. If splices are to be used, they shall be made by certified trained personal using equipment and procedures approved by the ENGINEER.
- E. Waterstops in the walls shall be carried into lower slabs and shall join the waterstops in the slabs with appropriate types of fittings. All joints in water bearing structures shall have waterstops, whether indicated on the DRAWINGS or not. All waterstops shall be continuous. Waterstops shall be set accurately to the position and line indicated on the DRAWINGS. Edges shall be held and securely fixed in position at intervals of not more than 12 inches so that they will not move during the placing of concrete. No nails shall be driven through waterstops in the vicinity of construction joints. Wires at not more than 12 inches on centers near the outer bulbs shall be used to tie the waterstops into position. Special clips may be used in lieu of wires, at the CONTRACTOR's option. Waterstops shall be terminated 3 inches from the top of finished surfaces of walls and slabs unless otherwise specified or indicated on the DRAWINGS.

F. Preformed Plastic Adhesive Waterstop Installation

- 1. Installation for preformed plastic adhesive waterstops shall be a prime, peel, place, and pour procedure.
- 2. Joint surfaces shall be clean and dry before priming and just prior to placing of the sealing strips. If conditions are damp or cold, the joint surface shall be flashed with a direct flame to warm and dry the surface. The sealing strips shall be dipped in warm water to soften the material to achieve maximum bond to the concrete surface.
- 3. The CONTRACTOR shall strip the protective paper wrapper from one side only of the waterstop material then press waterstop material strip firmly against primed surface throughout length and width of strip.
- 4. The CONTRACTOR shall then join the strips together with a 1" overlap to form a continuous waterstop. The CONTRACTOR shall remove the remaining protective paper when ready to install forms and pour concrete.

3.03 TESTING – NONE

3.04 CLEANUP

- A. The CONTRACTOR shall immediately remove all spots, smears, stains, residues, and adhesives, etc. which result from the work.
- B. Upon completion of the work, the CONTRACTOR shall properly dispose of (away from the site unless specified otherwise) all debris, trash, containers, residue, remnants, and scraps which results from the work.

END OF SECTION

SECTION 03 15 13.13 – LINK-SEAL FLOOR AND WALL PENETRATION SEALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes the CONTRACTOR's responsibilities regarding watertight seals for all concrete penetrations for pipe and conduit.

1.02 REFERENCED SECTIONS

- A. Related Sections are shown below.
 - 1. DIVISION 40 PROCESS INTEGRATION
 - 2. DIVISION 26 ELECTRICAL

1.03 CITED STANDARDS

A. All work specified herein shall conform to or exceed the applicable requirements of the referenced standards. Wherever the provisions of said publication are in conflict with the requirements specified herein, the more stringent requirement shall apply.

1.04 NOTED RESTRICTIONS

A. Link-Seal Modular Seals are specifically designed as hydrostatic and/or fire-rated seals and are not considered to be pipe supports. When appropriate, Link-Seal Modular Seals should be used with proper pipe supports on both ends.

1.05 QUALITY CONTROL

- A. Each individual link shall be conspicuously and permanently identified with the name of the manufacturer and model number. Manufacturers other than the above-named company wishing to quote equipment in this section shall submit detail DRAWINGS of their proposed equipment and suitable evidence of a minimum of 25 years of experience and results to the ENGINEER to obtain written approval to quote at least ten (10) days prior to bid opening.
- B. Link-Seal® Modular Seal components and systems shall be domestically manufactured at a plant with a current ISO-9001:2000 registration. Copy of ISO-9001:2000 registrations shall be a submittal item.

1.06 SUBMITTALS

- A. The CONTRACTOR shall submit DRAWINGS showing the locations of all penetrations that are to receive the specified seals.
- B. The CONTRACTOR shall submit the Manufacturer's product data of the proposed seals for review by the ENGINEER.
- C. The CONTRACTOR shall submit a certificate of compliance stating that the seals to be used conform to the requirements specified.

1.07 DELIVERY AND STORAGE

A. Materials delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. The seals shall be stored out of direct sunlight.

PART 2 - PRODUCTS

2.01 LINK-SEAL® MODULAR SEAL ASSEMBLY

- A. The CONTRACTOR shall furnish and install a complete Link-Seal® modular seal assembly, manufactured by PSI-Thunderline/Link-Seal® located at 6525 Goforth Street, Houston, TX 77021. For clarification, complete assembly is defined as a combined:
 - 1. Wall or floor opening (i.e. steel sleeve, Thermoplastic (HDPE) sleeve, cored hole or formed hole). The opening size and/or type shall be selected according to information found in the most recent Link-Seal® modular seal catalog.
 - 2. Sufficient quantity and type of Link-Seal® modular seals required to effectively provide a hydrostatic and/or fire-rated seal.

2.02 LINK-SEAL® MODULAR SEAL RUBBER LINKS

- A. Shall be modular, mechanical type, consisting of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening. The elastomeric element shall be sized and selected per manufacturer's sizing procedure and have the following properties as designated by ASTM. Coloration shall be throughout elastomer for positive field inspection. Each link shall have a permanent identification of the size and manufacturer's name molded into it.
 - 1. For Standard Service Applications (Pipe) = Model C -40
 - a. to $+250^{\circ}$ F (-40 to $+121^{\circ}$ C)
 - b. EPDM = ATSM D2000 M3 BA510
 - c. Color = Black
 - 2. For Thin Walled Pipe Applications (Conduit) = Model L
 - a. $-40 \text{ to } +250^{\circ}\text{F} (-40 \text{ to } +121^{\circ}\text{C})$
 - b. EPDM = ATSM D2000 M3 BA510
 - c. Color = Blue

2.03 LINK-SEAL® MODULAR SEAL PRESSURE PLATES

- A. Link-Seal® modular seal pressure plates shall be molded of glass reinforced Nylon Polymer with the following properties:
 - 1. Izod Impact Notched = 2.05ft-lb/in. per ASTM D-256
 - 2. Flexural Strength @ Yield = 30,750 psi per ASTM D-790
 - 3. Flexural Modulus = 1,124,000 psi per ASTM D-790
 - 4. Elongation Break = 11.07% per ASTM D-638
 - 5. Specific Gravity = 1.38 per ASTM D-792

- B. Models LS200, 275, 300, and 315 shall incorporate the most current Link-Seal® Modular Seal design modifications and shall include an integrally molded compression assist boss on the top (bolt entry side) of the pressure plate, which permits increased compressive loading of the rubber sealing element.
- C. Models 315, 325, 340, 360, 400, 410, 425, 475, 500, 525, 575, and 600 shall incorporate an integral recess known as a "Hex Nut Interlock" designed to accommodate commercially available fasteners to insure proper thread engagement for the class and service of metal hardware.
- D. All pressure plates shall have a permanent identification of the manufacturer's name molded into it.

2.04 LINK-SEAL® MODULAR SEAL HARDWARE

A. All fasteners shall be sized according to latest Link-Seal® modular seal technical data. Bolts, flange hex nuts shall be 316 Stainless Steel per ASTM F593-95, with 85,000 psi average tensile strength.

2.05 WALL OPENING

- A. Century-Line® Sleeves for openings to 24.81" diameter.
 - 1. Where pipes must pass through walls and floors of new structures, unless otherwise shown or specified, install molded non-metallic high density polyethylene Model CS Century-Line® sleeves as manufactured by PSI Thunderline/Link-Seal®. Model CS sleeves shall have integrally formed hollow water stop sized having a minimum of four inches larger than the outside diameter of the sleeve itself and allowing 1/2" movement between wall forms to resist pour forces. Each sleeve assembly shall have end caps manufactured of the same material as the sleeve itself and installed at exposed ends of the sleeve so as to prevent deformation during the initial concrete pour. End caps shall remain in place to protect the opening from residual debris and rodent entry prior to pipe insertion.

PART 3 - EXECUTION

3.01 PREPARATION

A. The CONTRACTOR shall assure that the proper-sized sleeve with protective covers, is in place as detailed on the DRAWINGS, prior to pouring concrete floors, slabs, etc., and shall follow manufacturer's recommendations during installation.

3.02 INSTALLATION

A. The CONTRACTOR shall install the seal between the pipe and sleeve in accordance with manufacturer's recommendations.

3.03 TESTING – NONE

END OF SECTION

SECTION 03 15 15 – MISCELLANEOUS JOINT AND CRACK FILLERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes a description of how the General Construction CONTRACTOR (CONTRACTOR) shall proceed to furnish all material, equipment, labor, services, etc., to complete and install miscellaneous joint and crack filler compounds.

1.02 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 03 15 13 WATERSTOPS
- 1.03 CITED STANDARDS NOT USED
- 1.04 NOTED RESTRICTIONS NOT USED
- 1.05 QUALITY CONTROL NOT USED
- 1.06 SUBMITTALS

A. Shop DRAWINGS

- 1. The CONTRACTOR shall submit DRAWINGS showing the locations of all joints that are to receive these materials.
- 2. The CONTRACTOR shall submit DRAWINGS showing the location of filled cracks and materials used.

PART 2 - PRODUCTS

2.01 JOINT MATERIALS

A. Preformed Expansion Joint Material

- 1. Preformed expansion joint material shall be sponge rubber or bituminous fiber types as specified herein. Specific type to be used in any application shall be as indicated on the DRAWINGS. The CONTRACTOR shall submit sufficient information on each type of material to the OWNER for review to determine conformance of the material to these Specifications.
- 2. Thicknesses and dimensions of the materials shall be as indicated on the DRAWINGS or as required according to the way it is used. Expansion joint strips shall be fastened to concrete, masonry, or forms with adhesive. No nailing will be permitted, nor shall expansion joint strips be placed without fastening.

B. Synthetic Sponge Rubber Expansion Joint Material

1. Synthetic sponge rubber expansion joint material shall be Cementone Code 3329 as manufactured by W. R. Grace and Company; neoprene sponge rubber expansion joint as manufactured by Burke Concrete Accessories Inc.; or equal.

C. Bituminous Fiber Expansion Joint Material

1. Bituminous fiber expansion joint material shall be Cone Fiber Expansion Joint Fillers Code 1390 as manufactured by W. R. Grace and company; Burke Fiber Expansion Joint; or equal.

2.02 SYNTHETIC SPONGE RUBBER FILLER

- A. Synthetic sponge rubber filler shall be an expanded closed-cell sponge rubber backer rod manufactured from a synthetic polymer neoprene base; or a resilient closed-cell polyethylene foam backer rod. The synthetic sponge rubber filler shall have characteristics suitable for the application intended, including the following:
 - 1. Necessary strength for supporting the sealing compound during application.
 - 2. Sufficient resiliency to prevent significant load transfer across the joint.
 - 3. Resistance to the environmental conditions of the installation.
 - 4. No bonding to the sealing compound.
 - 5. A cellular structure that shall prevent wicking or absorption of water.
 - 6. Compatibility with other materials in the joint, and acceptance by the manufacturer of the sealing compound.
- B. The size of the synthetic sponge rubber filler shall be 25 percent greater than the nominal joint width.
- C. Acceptable products include No. 750.3 Ropax Rod Stock manufactured by the Presstite Division of Interchemical Corporation; Rubatex-Cord manufactured by the Rubatex Corporation; or equal.
- D. Surface preparation and installation of the synthetic sponge rubber filler shall be as recommended by the manufacturer in published instructions. The synthetic sponge rubber filler shall not be stretched beyond its normal length during installation.

2.03 CAULKING, JOINTS AND SEALING

A. General

- 1. Expansion, contraction, and construction joints shall be constructed as indicated on the DRAWINGS, and materials used shall be as specified herein.
- 2. Pipe and conduit shall be installed in structures as indicated on the DRAWINGS, and shall be sealed with the materials specified herein. Doors, windows, louvers, and other items installed in or over concrete openings shall be caulked inside and out with the materials specified herein.

B. Caulking

- 1. All caulking where indicated on the DRAWINGS or as specified, except for masonry construction and where specified otherwise, shall be done with synthetic rubber sealing compound. Caulking shall be completed prior to painting.
- C. Synthetic Rubber Sealing Compound

- 1. Synthetic rubber sealing compound shall be a multi-part polyurethane designed for continuous submerged condition in water or sewage and exposed to direct sunlight in a dry condition. Synthetic rubber sealing compound shall be PRC 270 as manufactured by Products Research and Chemical Company; Elastothane 227R as manufactured by Pacific Polymers Inc.; or equal. Sealing compound shall comply with Federal Specification TT-S-00227e, Type I (pourable grade) and Type II (non-sag), Class A, and the following requirements.
- 2. Polyurethane sealant shall have the following properties determined at 75 degrees F and 50 percent relative humidity:
 - a. Base polyurethane rubber
 - b. Solids not less than 97 percent
 - c. Application Time not less than 2 hours
 - d. Cure Time not more than 3 days
 - e. Tack Free Time 24 hours
 - f. Ultimate Hardness 35 plus or minus 5 (Shore A)
 - g. Tensile Strength (ASTM D 412) 300 pounds per square inch minimum
 - h. Ultimate Elongation not less than 550 percent (ASTM D 412)
 - i. Tear Resistance not less than 85 pounds per inch (ASTM D 624 Die C)
 - j. Color shall be gray to match concrete, unless otherwise indicated, and the temperature service range shall be 50 degrees F to 200 degrees F.
 - k. Polyurethane sealant shall be a compound designed to cure at room temperature to a firm, highly resilient rubber.

2.04 EPOXY MATERIALS

A. All epoxy materials shall be new and shall be used within the shelf life limitations set forth by the manufacturer.

B. Epoxy

- 1. Epoxy shall be a water-insensitive two-part type low viscosity epoxy adhesive material containing 100 percent solids and shall meet or exceed the following characteristics when tested in accordance with the standards specified:
 - a. ASTM D 638, Tensile Strength: 9,000 psi at 14 days and 77 degrees F cure.
 - b. ASTM D 790, Flexure Strength: 12,000 psi at 14 days and 77 degrees F cure.
 - c. ASTM D 695, Compressive Strength: 16,000 psi at 24 hours and 77 degrees F cure.
 - d. Bond Strength: Concrete shall fail before failure of the epoxy.
 - e. Gel Time In A 5-Mil Film: 4 hours maximum at 77 degrees F.
 - f. ASTM D 638, Elongation: 1 percent minimum at 14 days and 77 degrees F.

2. For dry and damp concrete, the epoxy shall be Sikadur Hi-Mod LV as manufactured by the Sika Chemical Corporation; Adhesive Engineering Company Concressive No. 1380; or equal.

C. Epoxy Gel

 Epoxy gel shall be Sikadur Hi-Mod Gel manufactured by Sika Chemical Corporation; Concressive No. 1438 manufactured by Adhesive Engineering Company; or equal. Epoxy gel shall be used for vertical or overhead work, or where a high viscosity epoxy is required. Epoxy gel for vertical or overhead work may be used for horizontal work. All mixing, installing, and curing of epoxy shall conform to the manufacturer's published instructions.

D. Epoxy Bonding Agent

1. Epoxy bonding agent shall be Concressive No. 1001 LPL as manufactured by Adhesive Engineering; Sikadur Hi-Mod as manufactured by Sika Chemical Corporation; or equal. This material shall be applied in accordance with the manufacturer's published instructions. Bonding agent will not be required for filling form tie holes or for normal finishing and patching of similar sized small defects.

2.05 EXPANDED POLYSTYRENE

- A. When expanded polystyrene joint filler is indicated on the DRAWINGS or specified, the filler shall be placed in correct position before concrete is placed against the filler. Holes and joints in the filler shall be filled with caulking to prevent the passage of mortar or concrete from one side of the joint to the other.
- B. Expanded polystyrene shall be a commercially available polystyrene board. Expanded polystyrene shall have a flexural strength of 35 pounds per square inch, minimum, determined in accordance with ASTM C 203, and a compressive yield strength of between 16 and 40 pounds per square inch, at 5 percent compression.
- C. When indicated on the DRAWINGS, surface of expanded polystyrene shall be faced with hardboard. Hardboard shall be 1/8-inch minimum thickness, conforming to Federal Specification LLL-B-810, any type. Other facing materials may be used provided they furnish equivalent protection. All boards shall be held in place by nails, waterproof adhesive, or other means approved by the OWNER.

PART 3 - EXECUTION

3.01 CAULKING

- A. Concrete must be thoroughly cured prior to caulking. All surfaces to be caulked shall be dry, clean, and free of dirt, grease, curing compounds, and other residue which might interfere with adhesion of the caulking compound.
- B. Concrete, masonry, wood, and steel surfaces shall be cleaned and primed in strict accordance with the manufacturer's recommendations prior to caulking. Synthetic sponge rubber filler materials may be used as backing for caulking, if acceptable to the OWNER. Filler material, when used, shall be compressible and untreated.

- C. Caulking shall be applied with a pneumatic caulking gun. Nozzles of the proper shape and size shall be used for the application intended. A continuous bond shall be maintained between the caulking and the sides of the joint to eliminate gaps, bubbles, or voids and to fill the joint in a continuous operation without layering of the compound. All joints and seams shall be caulked by experienced applicators in a neat workmanlike manner.
- D. No caulking shall be applied when the temperature exceeds 120 degrees F to avoid sponging or bubbling of compound. To hasten curing of the compound when used on wide joints subject to movement, the CONTRACTOR shall apply heat with infra-red lamps or other convenient means.
- E. Excess caulking shall be removed by soaking and scrubbing before caulking has cured with Chem Seal CS9900; equivalent product of Products Research and Chemical Corporation; or equal. Excess cured material shall be removed by sanding with No. 80 grit sandpaper.

3.02 SYNTHETIC RUBBER SEALING COMPOUND

- A. All surfaces to which synthetic rubber must bond shall be dry and free of dust, dirt, and other foreign residue, heavy sandblasted caulking groove to provide a sound surface, and shall be primed with the manufacturer's recommended primer for the particular surface.
- B. Application shall be in strict accordance with the manufacturer's published instructions. Application shall be by means of a pneumatic caulking tool or other acceptable method.
- C. All packages shall be code dated. No material shall be more than six months old when used. Material shall have been kept at temperatures lower than 80 degrees F at all times.

3.03 EPOXY INJECTION SYSTEM

- A. Where epoxy injection is required to repair cracks in concrete material, information on the epoxy injection system shall be submitted.
- B. Adequate surface seal shall be applied to the crack or joint to prevent escape of the epoxy. Entry points shall be established at a distance along the seal not less than the thickness of the cracked member
- C. A 100 percent solid epoxy adhesive as specified above shall be forced into the crack at the first port with sufficient pressure to advance the epoxy to the adjacent port. The original port shall be sealed and entry shifted to the port at which the epoxy appears. This manner of port-to-port injection shall be continued until each joint has been injected for its entire length.
- D. Before processing, the space in the vicinity of a crack location receiving epoxy shall have been swept and left in a generally clean condition. All joints receiving epoxy under this section shall be cleaned free from dirt, laitance, and other loose matter.
- E. Pump unit used for injection shall be a positive displacement type with interlock to provide an in-line mixing and metering system for the two component epoxy. The pressure hoses and injection nozzle shall be of such a design as to allow proper mixing of the two components of epoxy. The presence of a standby injection unit may be required.

- F. For small amounts, or where excessive grout pressure developed by a pump unit might further damage the structure, premixed material and a hand caulking gun may be used if acceptable to the OWNER.
- G. Seal all ports, including adjacent locations where epoxy seepage occurs, as necessary to prevent drips or run out. Any condition other than normal shall be reported to the OWNER. Solvents may not be used to thin the epoxy system introduced into the cracks or joints. All work under this Specification shall be performed and conducted in a neat orderly manner.

END OF SECTION

SECTION 03 21 00 - REINFORCING STEEL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes a description of how the General Construction CONTRACTOR (CONTRACTOR) shall proceed to furnish all material, equipment, labor, services, etc., to provide steel reinforcing bars for concrete reinforcement.

1.02 CITED STANDARDS

- A. All reinforcing steel shall conform to the requirements of the following standard specifications, of the latest revisions, as applicable:
 - 1. ACI 315 Details and Detailing of Concrete Reinforcement
 - 2. ACI 318 Building Code Requirements for Structural Concrete
 - 3. ASTM A82 / A82M 07 Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
 - 4. ASTM A185 / A185M 07 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
 - 5. ASTM A370 Test Methods and Definitions for Mechanical Testing of Steel Products

1.03 NOTED RESTRICTIONS – NONE

1.04 QUALITY CONTROL

A. The CONTRACTOR shall receive approval from the ENGINEER prior to movement or rearrangement of reinforcement bars if any adjustments need to be made in order to avoid interference with other embedded items.

1.05 SUBMITTALS

A. The CONTRACTOR shall be wholly and completely responsible for the accuracy of the lists and for furnishing and placing reinforcing steel in accordance with the details shown on the plans and as specified. Calculated weights of the bars shall be as specified in ACI 318. Detailing of the reinforcing steel shall be in accordance with ACI 315.

B. Product Data

1. The CONTRACTOR shall submit the Manufacturer's product data for reinforcement materials and accessories.

C. Certificates

 The CONTRACTOR shall also submit a certificate of compliance stating that the grades and properties of the reinforcing steel are in conformance with ASTM A370, and any other applicable ASTM Standards.

1.06 DELIVERY AND STORAGE

A. Reinforcing bars shall be delivered in bundles limited to one size and length of bar, securely tied and identified with plastic tags including the mill, heat number, and grade and size of the bars. The bars shall be placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants that could cause an impaired bond with concrete.

PART 2 - PRODUCTS

2.01 REINFORCEMENT BARS

- A. Reinforcing bars shall conform to the requirements of the "Standard Specifications for Deformed Billet Steel Bars for Concrete Reinforcement" (ANSI/ ASTM A615). Reinforcing bars shall be Grade 60.
- B. Bars shall be delivered bundled and tagged with identifying tags, and shall be of new material, of the quality specified, free from excessive rust or scale or any defects affecting its usefulness.
- C. Bars shall be cut and bent in accordance with the provisions of ACI 315 and ACI 318. All bars shall be bent cold. Bars shall be free from defects and kinks and from bends not indicated on the DRAWINGS. Reinforcing bars shall be welded where indicated on the DRAWINGS or acceptable to the OWNER. Welding shall be performed in accordance with AWS D1.4 "Structural Welding Code-Reinforcing Steel.

2.02 FABRICATION

A. Reinforcement shall be accurately formed to the dimensions indicated on the DRAWINGS. All bars shall be bent cold. Diameter of bend measured on inside of bar, other than for stirrups and ties in sizes No. 3 through No. 5, shall not be less than specified in Table 3E-1. Inside diameter of bends for stirrups and ties shall not be less than 4 bar diameters for No. 5 bar and smaller. For bars larger than No. 5, diameter of bend shall comply with Table 3E-1 shown on the next page.

Table 3E-1 – Min. Diameters of Bend		
Bar Size Minimum Diamete		
Nos. 3 through 8	6 Bar Diameters	
Nos. 9, 10, and 11	8 Bar Diameters	
Nos. 14 and 18	10 Bar Diameters	

B. Metal reinforcement shall not be straightened or re-bent in a manner that will injure the material. Bars with kinks, or bends not shown on the DRAWINGS, shall not be used. Heating of the reinforcement or welding to the reinforcement shall not be permitted.

2.03 BAR SUPPORTS

A. Bar supports shall be hot-dip galvanized steel, shall conform to ACI 315, and shall be furnished in sufficient number to prevent sagging and to support loads during construction. Bar supports, where used in slabs which will be exposed to view, shall be equipped with plastic tips. Reinforcing for concrete placed on the ground shall be supported by standard manufactured

- chairs, with steel plates for resting on the ground. No use shall be made of brick, broken concrete masonry units, spalls, rocks, or similar material for supporting reinforcing steel.
- B. The CONTRACTOR shall submit samples of all chairs he proposes to use along with a letter stating where each type chair will be used. No concrete shall be placed until this prior acceptance has been obtained.

2.04 WELDED WIRE FABRIC

- A. Welded wire fabric shall be in accordance with ASTM A185. All necessary wiring, spacing chairs, or supports shall be installed to keep the welded wire fabric in place while concrete is being placed. The welded wire fabric shall be bent as shown or required to fit the work. Welded wire fabric shall be rolled or otherwise straightened to make a perfectly flat sheet before placing in the Work. Welded wire fabric shall be lap spliced as indicated on the DRAWINGS. If the lap splice length is not indicated on the DRAWINGS, the welded wire fabric shall be spliced in accordance with ACI 318.
- B. Welded wire fabric may be used in place of reinforcing bars if accepted by the OWNER. The welded wire fabric shall be furnished in flat sheet form. The cross-sectional area per linear foot of wire fabric shall be not less than the cross-sectional area per linear foot of reinforcing bars indicated on the DRAWINGS.

2.05 SPIRAL REINFORCEMENT

A. Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A 82.

2.06 ACCESSORIES

- A. The CONTRACTOR shall furnish and install all accessories including necessary chairs or bolsters, concrete blocks (dobies), tie wires, supports, spacers and other devices to position reinforcement during concrete placement.
- B. Wire bar supports shall be made of plain cold-drawn steel wire with pre-molded, gray-colored, plastic tips to the legs of the support. The plastic shall have a thickness of 1/8" or greater at points of contact with formwork and extend upward on the wire a minimum of ½". Wire sizes and geometric dimensions shall be made in accordance with Table II of the latest edition of CRSI Manual of Standard Practice.
- C. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Where the concrete blocks are used on concrete surfaces exposed to view, the color and texture of the concrete blocks shall match that required for the finished surface. Wire ties shall be embedded in concrete block bar supports.
- D. The wire tie shall be 16-gauge or heavier, black annealed.

2.07 MECHANICAL COUPLERS

A. Mechanical couplers shall be provided where shown and where approved by the ENGINEER. The couplers shall develop a tensile strength which exceeds one hundred and fifty percent (150%) of the yield strength of the reinforcement bars being spliced at each splice.

PART 3 - EXECUTION

- 3.01 PREPARATION NONE
- 3.02 INSTALLATION (PLACING REINFORCEMENT)
 - A. Metal reinforcement shall be placed in accordance with ANSI/ACI 318, except as otherwise noted herein and accurately positioned in accordance with the information on the DRAWINGS. Protective concrete cover shall be as required in ANSI/ACI 318. Reinforcement shall be secured against displacement by using annealed iron wire-ties or suitable clips at intersections, and shall be supported by concrete or metal supports, spacers, or metal hangers.
 - B. Bars at lap splices shall be in contact with each other and the bars shall be fastened together with tie wire. When it is necessary to splice reinforcement at points other than shown on the DRAWINGS, the character of the splice shall be determined by the ENGINEER. The overlap in splices in reinforcing steel shall be as specified in accordance with ACI 318. Lap splices for masonry, shall be in accordance with the Uniform Building Code.
 - C. Bars shall be fastened securely in place with annealed steel wire ties. Bars shall be tied sufficiently often to prevent shifting. There shall be at least three ties in each bar length (does not apply to dowel laps or to bars shorter than 4 ft, unless necessary for rigidity). Slab bars shall be tied at every intersection around the periphery of the slab. Wall bars and slab bar intersections other than around the periphery shall be tied at not less than every fourth intersection, but at not greater than the following maximum spacings:

Maximum Spacing		
Bar No.	Slab Bars, (in)	Wall Bars, (in)
Bars No. 5 and smaller	60	48
Bars No. 6 through No. 9	96	60
Bars No. 10 and No. 11	120	96

Note: The above tying requirements do not apply to reinforcement for masonry.

- D. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
- E. Placing Tolerances shall be within the limits specified in ACI 318, except where in conflict with the requirements of The Building Code. Where reinforcement in beams or girders is placed in two (2) or more layers, the clear distance between layers shall be not less than 1".
- F. Bars may need to be moved to avoid interference with other reinforcement steel, conduits or embedded items. If bars are moved enough to exceed the above tolerances, the resulting arrangement of bars shall be as acceptable by the ENGINEER. Additional bars may be

- necessary to prevent cracking or provide additional reinforcement in this case and shall be provided by the CONTRACTOR at its own expense.
- G. Metal reinforcement before being positioned, shall be free from loose mill and rust scale, and from coatings including ice that destroy or reduce the bond. Where there is delay in depositing concrete, reinforcement shall be re-inspected and cleaned when necessary.
- H. All laps of wire mesh shall be one width of wire spacing, and adjoining sheets shall be securely tied together with No. 14 tie-wire, one tie for each 2 running feet. At laps, wires shall be staggered and tied in such a manner that they cannot slip.
- I. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than three (3) feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

3.03 TESTING – NONE

END OF SECTION

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 REQUIREMENT

- The Contractor shall furnish all materials for concrete and shall construct, form, batch, place, A. cure, protect, repair and do all work required to produce finished concrete that meets or exceeds the requirements of the Contract Documents.
- В. The following types of concrete shall be covered in this Section:
 - Structural Concrete: Concrete to be used in all cases except where noted otherwise in the 1. Contract Documents.
 - 2. Sitework Concrete: Concrete to be used for curbs, gutters, sidewalks, fence and guard post embedment, underground duct bank encasement and thrust blocks.

1.02 **RELATED WORK**

- Section 01 33 00 Submittal Procedures A.
- В. Section 03 11 00 - Concrete Forming
- C. Section 03 21 13 – Galvanized Reinforcing Steel
- D. Section 03 16 10 - Joints in Concrete

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Codes:

The Building Code, as referenced herein, shall be the latest edition of the California 1. Building Standards Code (CBC), Title 24, California Code of Regulations.

В. Commercial Standards:

ACI 214-77	Recommended Practice for Evaluation of Strength Test Results of Concrete.
ACI 301-79	Specifications for Structural Concrete for Buildings.
ACI 315-80	Details and Detailing of Concrete Reinforcement.
ACI 347-88	Recommended Practice for Concrete Formwork.
ASTM C 156-80a	Test Method for Water Retention by Concrete Curing Materials.
ASTM C 31-84	Methods of Making and Curing Concrete Test Specimens in the Field.
ASTM C 33-84	Specification for Concrete Aggregates.

ASTM C 39-83b	Test Method for Compressive Strength of Cylindrical Concrete Specimens.
ASTM C 94-83	Specification for Ready-Mixed Concrete.
ASTM C 114-83b	Method for Chemical Analysis of Hydraulic Cement.
ASTM C 136-84a	Method for Sieve Analysis for Fine and Coarse Aggregate.
ASTM C 143-78	Test Method for Slump of Portland Cement Concrete.
ASTM C 150-84	Specification for Portland Cement.
ASTM C 157-80	Test Method for Length Change of Hardened Cement Mortar and Concrete.
ASTM C 192-81	Method of Making and Curing Concrete Test Specimens in the Laboratory.
ASTM C 260-77	Specification for Air-Entraining Admixtures for Concrete.
ASTM C 494-82	Specification for Chemical Admixtures for Concrete.
ASTM C 618-85	Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement.

1.04 SUBMITTALS

- A. Mix Designs: Before placing any concrete, the Contractor shall submit to the Engineer, for review, the complete details of all concrete mix designs which he proposes to use including proportions and gradations of all materials for each class and type of concrete specified herein. The mix designs shall be designed by a certified testing laboratory acceptable to the Engineer. The mix design submittal shall also include test results from at least one (1) trial batch of each class and type concrete. From each trial batch six (6) 6-inch X 12-inch test cylinders shall be cast in accordance with ASTM C 31. Three (3) of these cylinders shall be compression tested in accordance with ASTM C 39 at 7-days and the other three (3) at 28-days. Test results shall include full information on each cylinder as to mix and slump in accordance with ASTM 143. Three (3) drying shrinkage specimens shall also be cast and tested in accordance with ASTM C 157 on each type of structural concrete (4,000 psi) mix design. All costs for such mix design including mix design tests shall be borne by the Contractor.
- B. If fly ash concrete is proposed by the concrete supplier, the Contractor shall submit to the Engineer for review the design mix for fly ash concrete together with the design mix for Portland Cement (non-fly ash) concrete as specified in this Section. The Contractor shall furnish a Certificate of Compliance signed by the supplier identifying the type of fly ash and stating that the fly ash complies with ASTM C 618 and these specifications, together with all supporting test data including a certified chemical and physical analysis report prior to the use of the fly ash the sample represents. The supporting data shall also contain test results confirming that the fly ash in combination with the cement and water to be used meets all strength requirements and is compatible with air-entraining agents and other admixtures.

- C. When a water-reducing admixture is to be used, the Contractor shall furnish mix designs for concrete both with and without the admixture.
- D. <u>Delivery Tickets</u>: Where ready-mix concrete is used, the Contractor shall provide certified weighmaster delivery tickets at the time of delivery of each load of concrete. Each certificate shall show the total quantities, weight of cement, sand, each class of aggregate, admixtures and the amounts of water in the aggregate and added at the batching plant as well as the amount of water allowed to be added at the site for the specific design mix. Each certificate shall also state the mix number, total yield in cubic yards, the time the batch was dispatched and when it arrived on the job.
- E. Submit certified cement mill test reports including the total alkali content.

1.05 QUALITY ASSURANCE

- A. Mix design tests on component materials and for compressive strength and shrinkage of concrete shall be performed as specified herein. The mix shall not at any time be changed without approval of the Engineer, except that at all times the batching of fine aggregate shall be adjusted to compensate for the moisture content. Satisfactory means shall be provided at the batching plant for checking the moisture content of the fine aggregate. The details of concrete mixes submitted for approval shall include information on the correction of the batching for varying moisture contents of the fine aggregate. To avoid unnecessary or haphazard changes in consistency, the aggregate shall be obtained from a source which will ensure a uniform quality.
- B. During the progress of construction, the Owner will have tests made to determine whether the concrete, as being produced, complies with the standards of quality specified herein. These tests will be made in accordance with ASTM C 31, ASTM C 39, ASTM 179 and ASTM C 157. The testing expense during construction, except for the trial batch or mix design testing, will be borne by the Owner. Four (4) cylinder specimens will be cast and tested for each 50-cubic yards of concrete placed. One (1) test cylinder will be tested at 7-days and two (2) at 28-days. The remaining cylinders will be held to verify test results if needed. The costs of additional tests, including non-destructive tests and core drilling, needed to verify or investigate the quality of concrete that is questionable as to meeting the specification shall be borne by the Contractor.
- C. Concrete for testing shall be supplied by the Contractor at no cost to the Owner, and the Contractor shall provide assistance to the Engineer in obtaining samples and disposal and cleanup of excess material.

D. Evaluation and Acceptance of Concrete:

- 1. Concrete is expected to reach a higher compressive strength than that which is indicated in Paragraph 2.05, B., as compressive strength. The strength level of the concrete will be considered satisfactory if the average strength of the two (2) 28-day specimens equals or exceeds the required strength and no individual specimen strength falls below the required strength by more than 500 psi. Where an individual strength test falls below the required strength by more than 500 psi, the Engineer shall have the right to ask for cores taken in accordance with ASTM C 42 and ACI 318, all at the Contractors expense.
- 2. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.

- 3. All concrete which fails to meet the ACI requirements and these specifications, is subject to removal and replacement at the cost of the Contractor.
- E. <u>Shrinkage Tests</u>: Additional shrinkage tests will be made by the Engineer during construction to ensure continued compliance with these specifications.
- F. Ready-mix concrete shall conform to the requirements of ASTM C 94.
- G. The Engineer shall have access to and have the right to inspect all batch plants, cement mills and supply facilities providing products under these specifications. Batch plants shall have current certificates that all scales have been tested and are certified within the tolerances as set forth in the National Bureau of Standards Handbook No. 44.
- H. Construction Tolerances: The Contractor shall set and maintain concrete forms and perform finishing operations so as to ensure that the completed work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades or dimensions shown. Where tolerances are not stated in these specifications, permissible deviations will be in accordance with ACI 347. The following construction tolerances are hereby established and apply to finished walls and slab unless otherwise shown:

Structural Component	<u>Tolerance</u>
Variation of the constructed linear outline from the established position in plan.	In 10-feet: 1/4-inch; In 20-feet or more: 1/2-inch.
Variation from the level or from the grades shown.	In 10-feet: 1/4-inch; In 20-feet or more: 1/2-inch.
Variation from the plumb.	In 10-feet: 1/4-inch; In 20-feet or more: 1/2-inch.
Variation in the thickness of slabs and walls.	Plus 1/4-inch; Plus 1/2-inch.
Variation in the locations and sizes of slab and wall openings.	Plus or minus 1/4-inch.

PART 2 - PRODUCTS

2.01 CONCRETE MATERIALS

A. Except as otherwise specified, all cement shall be standard brand Portland Cement conforming to ASTM C 150 for Type II, low alkali. Portland Cement shall contain not more than 0.60 percent total alkalies. The term "alkalies" is defined as the sum sodium oxide (Na₂O), potassium oxide (K₂O), calculated as sodium oxide (.658 K₂O). Only one (1) brand of cement shall be used for exposed concrete in any individual structure. The cement shall be suitably protected from exposure to moisture until used. Certified mill test reports for each shipment of cement to be used shall be submitted to the Engineer. Mill test reports shall include the alkali content.

- B. Water shall be potable, clean and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purpose of this Section only, if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids (over 1000 mg/l TDS) shall not be used.
- C. All concrete aggregates shall be obtained from pits acceptable to the Engineer, shall be non-reactive, sound, uniformly graded and free of deleterious material in excess of allowable limits specified. Combined aggregates shall be well graded from coarse to fine sizes, and be uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Lightweight sand for fine aggregate will not be permitted. Aggregates shall conform to ASTM C 33.
 - 1. <u>Coarse Aggregate</u>: Coarse aggregate shall consist of gravel, crushed gravel or crushed stone made up of clean, hard, durable particles free from calcareous coatings, organic matter or other foreign substances. Thin or elongated pieces having a length greater than four (4) times the average thickness shall not exceed fifteen percent (15%) by weight. Deleterious substances shall not be present in excess of the following percentages by weight, and in no case shall the total of all deleterious substances exceed one and one-half percent (1.5%):

Soft Fragments	1.5%
Shale	1.5%
Coal and Lignite	0.25%
Clay Lumps	0.25%
Materials Finer than No. 200 Sieve	0.50%

^{*}Except that when material finer than No. 200 sieve consists of crusher dust, the maximum amount maybe 1%.

- a. Except as otherwise specified or approved in writing by the Engineer, coarse aggregate shall be graded as specified in ASTM C 33, size No. 57.
- Fine Aggregate: Fine aggregate for concrete or mortar shall consist of clean, natural sand or a combination of natural and manufactured sands that are hard and durable.
 Deleterious substances shall not be present in excess of the following percentages by weight of contaminating substances. In no case shall the total exceed three percent (3%):

Removed by Decantation (Dirt, Silt, Etc.)	3%
Shale	1%
Clay Lumps	1%

- a. Fine aggregate shall not contain strong alkali nor organic matter which gives a color darker than a standard color when tested in accordance with ASTM C 40. Fine aggregate shall have a fineness modulus not less than 2.50 nor greater than 3.00. Except as otherwise specified, fine aggregate shall be graded from coarse to fine in accordance with the requirements of ASTM C 33.
- D. Admixtures of any type, except as otherwise specified, shall not be used unless written authorization has been obtained from the Engineer. The use of calcium chloride will not be permitted.

- 1. All concrete shall contain five percent (5%), plus or minus one percent (1%) entrained air of evenly dispersed air bubbles at the time of placement. The air-entraining agent shall contain no chloride and conform to ASTM C 260, or U.S. Army Corps of Engineers Specifications CRD-C13. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement. The Engineer, or Owner and his duly authorized representatives reserve the right, at any time, to sample and test the air-entraining agent or the air content of concrete received on the job by the Contractor. Air entrainment in the concrete shall be tested by ASTM C 138, ASTM C 231 or ASTM C 173. If any sample tested does not have the specified air content, a second test shall be performed. If the second test does not meet the specified air content, the concrete represented by the test shall be removed from the job.
- 2. A "super plasticizer" water reducing agent may be used at the Contractors option, subject to approval by the Engineer, for concrete in hydraulic structures. The amount of cement in the mix shall not be reduced. The slump may be increased to a maximum of 8-inches. Quantities of admixtures and procedures shall be in accordance with the manufacturers published recommendations. The super plasticizer shall conform to ASTM C 494, Type F or G. The admixture shall be a second-generation type, free of chlorides and alkalies, composed of a synthesized sulfonated complex polymer which shall be added to the concrete mixer at the batch plant.
- 3. Fly ash/pozzolan shall conform to ASTM C 618, including the requirements of Table 1A, therein, and the following supplementary requirements:
 - a. Class C Fly Ash

Loss on ignition, maximum	1%
SO3 content, maximum	4%
Moisture content, maximum	1%
R = (CaO - 5%)/(Fe2O3), maximum	4.5

b. Class F Fly Ash

Loss on ignition, maximum	1%
SO3 content, maximum	3%
Moisture content, maximum	1%
$R = (CaO - 5\%)/(Fe_2O_3)$, maximum	1.5

2.02 CONCRETE CURING MATERIALS

- A. Materials for curing concrete shall conform to the following requirements:
 - 1. <u>Concrete curing compound</u> shall be Protex LR-151 as manufactured by Protex Industries, Denver, CO; Hunt Process Clear ARB as manufactured by Hunt Process Co., Santa Fe Springs, CA; Select Cure CRB as manufactured by Select Products Co., Upland, CA; or equal. The curing compound shall contain a fugitive dye so that areas of application will be readily distinguishable.
 - 2. <u>Polyethylene sheet</u> for use as concrete curing blanket shall be white and shall have a normal thickness of 6 mils.
 - 3. <u>Burlap mats</u> for use as concrete curing blanket shall weight not less than 9-ounces per square yard. The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 grams per square centimeter of surface.

2.03 CONCRETE DESIGN REQUIREMENTS

- A. <u>General</u>: The concrete mixes shall be designed to produce a concrete of such consistency and composition so as to obtain maximum density and minimum shrinkage. Mix designs with more than forty-one percent (41%) of sand of the total weight of fine and coarse aggregate shall not be used.
- B. <u>Water-Cement Ratio and Compressive Strength</u>: The minimum compressive strength and cement content of concrete shall not be less than that specified in the following Table:

Type of Work	Min. 28-Day Compressive Strength psi	Maximum Size Aggregate (inches)	Minimum Cement W/C per cu yd (94# sacks)	Maximum Ratio (by wt.)
Slabs on grade, footings, floor slabs, and all other concrete items not specified elsewhere.	4,000	1	6.0	0.50
Sitework Concrete	3,500	1	6.0	0.50
Lean Concrete	2,500	1	4.5	0.60

- C. <u>Adjustments to Mix Design</u>: The mixes used shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability and surface finish and the Contractor shall be entitled to no additional compensation because of such changes.
- D. At the Contractors option, fly ash/pollozan may be used as a partial cement replacement in concrete as follows:
 - 1. Fly ash shall replace not more than fifteen percent (15%) by weight of the Portland Cement in the design mix. The design mix shall contain a minimum of six (6) sacks of cement per cubic yard before the replacement is made.
 - 2. Fly ash for hydraulic/liquid containing structures shall be Class C fly ash. Fly ash concrete for all other structures shall be Class C or F fly ash.

2.04 CONSISTENCY

A. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. The slumps shall be as follows:

Part of Work	Slump (inches)
Footings and Slabs	3-inches + 1/2-inches, - 1 inch.
Other Work	3-inches \pm 1-inch.

With High Range Water Reducer Added 8-inches maximum.

2.05 TRIAL BATCH AND LABORATORY TESTS

- A. Before placing any concrete, the Contractor shall submit the certified trial batch results of each class of concrete having a 28-day strength of 3,500 psi or higher, based on the preliminary concrete mixes submitted by the Contractor. All concrete shall conform to the requirements of this Section, whether the aggregate proportions are from the Contractors preliminary mix design, or whether the proportions have been adjusted during the trial batch process. The trial batch shall be prepared using the aggregates, cement and admixture proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain three (3) drying shrinkage, and six (6) compression test specimens from each batch. The costs for the trial batch tests shall be borne by the Contractor.
- B. The determination of compressive strength will be made by testing 6-inch diameter by 12-inch high cylinders; made, cured and tested in accordance with ASTM C 192 and ASTM C 39. Three (3) compression test cylinders will be tested at 7-days and three (3) at 28-days. The average compressive strength for the three (3) cylinders tested at 28-days for any given trial batch shall not be less than one hundred twenty-five percent (125%) of the specified compressive strength.
- C. A standard sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements for ASTM C 136. Values shall be given for percent passing each sieve.

2.06 SHRINKAGE LIMITATION

- A. Drying shrinkage specimens shall be 4-inch by 4-inch by 11-inch prisms with an effective gage length of 10-inches, fabricated, cured, dried and measured in accordance with ASTM C 157 modified as follows: Specimens shall be removed from molds at an age of 23± hours after trial batching, shall be placed immediately in water at 70 degrees F. ±3 degrees F. for at least thirty (30) minutes, and shall be measured within thirty (30) minutes thereafter to determine original length and then submerged in saturated lime water at 73 degrees F. ±3 degrees F. Measurement to determine expansion expressed as a percentage of original length shall be made at age 7-days. This length at age 7-days shall be the base length for drying shrinkage calculations ("0" days drying age). Specimens then shall be stored immediately in a humidity control room maintained at 73 degrees F. ±3 degrees F. and fifty percent (50%) ±4 percent relative humidity for the remainder of the test. Measurements to determine shrinkage expressed as percentage of base length shall be made and reported separately for 7, 14, 21 and 28-days of drying after 7-days of moist curing.
 - 1. The drying shrinkage deformation of each specimen shall be computed as the difference between the base length (at "0" days drying age) and the length after drying at each test age. the average drying shrinkage deformation of the specimens shall be computed to the nearest 0.0001-inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004-inch, the results obtained from that specimen shall be disregarded. Results of the shrinkage test shall be reported to the nearest 0.001 percent of shrinkage. Compression test specimens shall be taken in each case from the same concrete used for preparing during shrinkage specimens. These tests shall be considered a part of the normal compression tests for the project. Allowable shrinkage limitations shall be specified herein.
- B. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age (specified in Paragraph 2.07), shall be

- 0.036 percent or 0.042 percent, respectively. The Contractor shall only use a mix design for construction that has first met the trial batch shrinkage requirements.
- C. The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than twenty-five percent (25%).
- D. If the required shrinkage limitation is not met during construction, the Contractor shall take all necessary action, at not additional cost to the Owner, for securing the specified shrinkage requirements. These actions may include changing the source of aggregates, cement and/or admixtures; reducing water content ratio; washing or aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions designed to minimize shrinkage or the effects of shrinkage.

2.07 GROUT

- A. Grout to be placed in the Clarifier, DAF, and Launders shall be a mixture of one part Portland cement to 4-1/2 parts sand. Water content shall be such that the grout can be readily spread, yet not wet enough to cause trouble with surface water or laitance, or failure to stay in place after screeding. All grout mixes and mixing procedures shall be submitted in accordance with **Section 01 33 00 Submittal Procedures**, and shall be subject to review and approval by the Engineer prior to commencing the grouting operations.
- B. Procedures for Grout placement shall be approved by the equipment supplier, to insure that no equipment is overstressed, as well as proper placement tolerances. Equipment Supplier shall have final say on grouting procedures and final tolerances.

PART 3 - EXECUTION

3.01 MIXING CONCRETE

- A. Mixing equipment shall be subject to the Engineers approval. mixers shall be of the stationary plant or truck mixer type. Adequate equipment and facilities shall be provided for accurate measurement and control of all materials and for readily changing the proportions of the material. The mixing equipment shall be maintained in good working order and shall be capable of combining the aggregates, cement and water within the specified time into a thoroughly mixed and uniform mass and of discharging the mixture without segregation. Cement and aggregate shall be proportioned by weight.
- B. The batch plant shall be capable of controlling and delivering of all material to within one percent (1%) by weight of the individual material. If bulk cement is used, it shall be weighed on a separate visible scale which will accurately register the scale load at any stage of the weighing operation from zero to full capacity.
 - 1. Cement shall not come in contact with aggregate or with water until the materials are in the mixer ready for complete mixing with all mixing water. The procedure of mixing cement with sand or with sand and coarse aggregate for delivery to the jobsite for final mixing and an addition of mixing water will not be permitted. Retempering of concrete will not be permitted. The entire batch shall be discharged before recharging. The volume of the mixed material per batch shall not exceed the manufacturers rated capacity of the mixer.

- 2. Each mixer shall be equipped with a device for accurately measuring and indicating the quantity of water entering the concrete, and the operating mechanism shall be such that leakage will not occur when the valves are closed. Each mixer shall be equipped with a device for automatically measuring, indicating and controlling the time required for mixing. This device shall be interlocked to prevent the discharge of concrete from the mixer before the expiration of the mixing period.
- 3. Transit-mixed concrete shall be mixed and delivered in accordance with ASTM C 94. After the drum is once started, it shall be revolved continuously until it has completely discharged its batch. Water shall not be admitted to the mix until the drum has started revolving. The right is reserved to increase the required minimum number of revolutions allowed, if necessary, to obtain satisfactory mixing, and the Contractor will not be entitled to additional compensation because of such an increase or decrease.
- C. Mixed concrete shall be delivered to the site of the work and discharge shall be completed within one (1) hour after the addition of the cement to the aggregates. In hot weather or under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85 degrees F. or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed forty-five (45) minutes. The use of non-agitating equipment for transporting concrete will not be permitted.
- D. Truck mixers shall be equipped with counters so that the number of revolutions of the drum may be readily verified. The counter shall be of the resettable type and shall be actuated at the time of starting mixers at mixing speeds. Concrete shall be mixed in a truck mixer for not less than seventy (70) revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolution of mixing.

3.02 PREPARATION OF SURFACES FOR CONCRETING

- A. Earth surfaces shall be thoroughly and uniformly wetted by sprinkling prior to the placing of any concrete. These surfaces shall be kept moist by frequent sprinkling up to the time concrete is placed thereon. The surface shall be free from standing water, mud and debris at the time of placing concrete.
- B. The surfaces of all horizontal construction joints shall be cleaned of all latence, loose or defective concrete and foreign material. Such cleaning shall be accomplished by sandblasting followed by thorough washing. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.
- C. No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcement steel and preparation off surfaces involved in the placing have been completed and accepted by the Engineer at least four (4) hours before placement of concrete. All reinforcement, anchor bolts, sleeves, inserts and similar items shall be set and secured in the forms where shown or by shop drawings and shall be acceptable to the Engineer before any concrete is placed. Accuracy of placement is the responsibility of the Contractor. All surfaces of embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.

- D. All form surfaces in contact with the concrete shall be thoroughly cleaned of all previous concrete, dirt and other surface contaminants prior to use. Damaged form surfaces shall not be used.
 - 1. Wood form surfaces in contact with the concrete shall be coated with an approved release agent prior to form installation. The release agent shall be non-staining and non-toxic after thirty (30) days. Mill scale and other ferrous deposits shall be sandblasted or otherwise removed from the contact surface of steel forms. All steel forms shall have the contact surfaces coated with an approved release agent. The release agent shall be effective in preventing discoloration of the concrete from rust and shall be non-toxic after thirty (30) days.
- E. Where concrete is to be cast against old existing concrete, the old concrete shall be thoroughly roughened to exposed, hard aggregate by sandblasting or chipping. Any additional surface preparation shall be as called for in the drawings.
- F. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or diverted out of the forms and clear of the work. No concrete shall be deposited under water or allowed to rise on any concrete until the concrete has attained its initial set. Pumping or other necessary dewatering operations for removing ground water, if required, shall be the responsibility of the Contractor and will be subject to review by the Engineer.
- G. Pipe, conduit, dowels, sleeves and other ferrous items required to be embedded in concrete construction shall be adequately positioned and supported prior to placement of concrete. There shall be a minimum of 2-inches clearance between embedded items and any of the concrete reinforcement. Securing embeddments in position by wiring or welding them to the reinforcement will not be permitted.

3.03 PLACING CONCRETE

- A. No concrete shall be placed without prior inspection of the forms, reinforcing and embedded items and approval from an authorized representative of the Engineer. The Contractor shall notify he Engineer at least twenty-four (24) hours in advance of any scheduled concrete placement and shall call for final inspections no later than four (4) hours in advance of the scheduled placement. The Contractor shall notify the Engineer at least two (2) hours in advance of setting the opposite side of wall forms so that the construction joint preparation, water stop installation and reinforcing steel inspections can be conducted. It is the Contractors responsibility to see that the forms are properly cleaned and oiled before being set, the construction joints properly prepared, reinforcing steel is securely and properly supported in the correct position and that all embedment items including electrical conduit is correctly installed before calling for inspections. The Engineer may at his option require the use of placement cords if deemed necessary.
- B. Placement of concrete shall conform to the requirements and recommendations of ACI 301, 304 and 318, except as modified herein.
- C. Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed from the work. Concrete which is not placed in accordance with these specifications, or which is of inferior quality, shall be removed and replaced at the expense of the Contractor.

- D. No concrete shall be placed during rain or snow storms, unless completely covered to prevent storm water from coming in contact with it. Sufficient protective covering material shall be kept on hand at all times should rain or snow storms arise during concrete placement operations.
- E. Concrete shall be deposited at or near its final position to avoid segregation caused by rehandling or flowing. Concrete shall not be deposited in large quantities in one place and worked along the forms with vibrator or other means. Concrete shall be uniformly distributed during the placing process and in no case after depositing shall any portion be displaced in the forms more than 2-feet in horizontal direction. Concrete shall be deposited in forms in horizontal layers not to exceed 24-inches in depth and shall be brought up evenly in all parts of the form. The rate of placement of concrete in forms shall not exceed 5-feet of vertical rise per hour. As the concrete is placed it shall be consolidated thoroughly and uniformly by mechanical vibration to secure a dense mass, close bond with reinforcement and other embedded items and smooth surface. The mechanical vibrator shall penetrate not only the freshly placed concrete, but also the previously placed lift to ensure the lifts become monolith. New concrete shall be placed against previously placed concrete, not away from it. When concrete is placed on a slope, placement shall begin at the lower end of the slope and progress to the upper end for the full width of the placement. Consolidation by mechanical vibration shall follow directly behind placement and the rate of placement shall never get ahead of the consolidation crew. Concrete placement shall continue without avoidable interruption, in a continuous operation until the end of the placement is reached.
- F. The drop of concrete into slab or wall forms shall be vertical. Concrete shall not be dropped through reinforced steel, but deposited in forms using a hopper with a drop chute to avoid segregation and to keep mortar from coating the reinforcement steel and forms above the inplace concrete. In no case shall the free fall of concrete exceed 4-feet below the end of the hopper or chute.
- G. If it takes more than 20-minutes to get back to place concrete over concrete previously placed, the depth of the layers being placed at one time shall be reduced, and/or placing equipment increased, until it is possible to return with the placing operation to previously placed concrete within 20-minutes. If concrete is to be placed over previously poured concrete and more than 20-minutes have elapsed, then a layer of grout not less than 1/2-inch thick shall be spread over the surface before placing the additional concrete.
- H. The placement of concrete for slabs, beams or walkways cast monolithically with walls or columns shall not commence until the concrete in the walls or columns has been allowed to set and shrink. The time allowed for shrinkage shall be not less than one (1) hour.
- I. Concrete shall be placed with the aid of approved mechanical vibrators. Vibration shall be supplemented by manual forking or spading adjacent to the forms on exposed faced in order to secure smooth dense surfaces. The concrete shall be thoroughly consolidated around reinforcement, pipes or other shapes built into the work. The vibration shall be sufficiently intense to cause the concrete to flow and settle readily into place and to visibly affect the concrete over a radius of at least 18-inches.
 - 1. Sufficient vibrators shall be on hand at all times to vibrate the concrete as placed. In addition to the vibrators in actual use while concrete is being placed, the Contractor shall have on hand one (1) spare vibrator in serviceable condition. No concrete shall be placed until it has been ascertained that all vibrating equipment, including spares, is in serviceable condition.

- 2. Special care shall be taken to place the concrete solidly against the forms so as to leave no voids. Every precaution shall be taken to make all concrete solid, compact and smooth, and if for any reason the surfaces or interiors have voids or are in any way defective, such concrete shall be repaired as directed by the Engineer. No defective work shall be patched or repaired without the prior inspection and approval of the Engineer.
- J. The temperature of concrete when it is being placed shall be not more than 90 degrees F. nor less than 40 degrees F. in moderate weather, and not less than 50 degrees F. in weather during which the mean daily temperature drops below 40 degrees F. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F., the Contractor shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The Contractor shall be entitled to no additional compensation on account of the foregoing requirements.
- K. Concrete shall not be placed on a frozen subgrade or subgrade that contains frozen materials. All ice and snow shall be removed from inside forms and from reinforcing steel and embedded items. the temperature of all surfaces that the concrete will contact shall be raised above the freezing point for at least 12-hours prior to placing new concrete.
 - 1. The minimum temperature of fresh concrete as mixed shall be 60 degrees F. for ambient temperature above 30 degrees F.; 65 degrees F. for ambient temperature 0 degrees F. to 30 degrees F.; and 70 degrees F. for ambient temperature below 0 degrees F. The minimum temperature of fresh concrete after placing shall be 55 degrees F. for the first 72-hours.
 - 2. The use of calcium chloride shall not be permitted.
 - 3. In general, the Contractor shall adhere to the recommendations as outlined in ACI Standard 306 for cold weather concreting, except as required herein.

3.04 PUMPING OF CONCRETE

- A. Pumping of concrete will be permitted only with the Engineers approval. The pumping equipment must have two (2) cylinders and be designed to operate with one (1) cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor shall have a standby pump or crane and concrete bucket on site during pumping to provide assurance the concrete will be placed without cold joints in the event of pumping equipment breakdown. The minimum diameter of the hose (conduits) shall be 4-inches. Pumping equipment and hoses (conduits) that are not functioning properly, shall be replaced. Aluminum conduits for conveying the concrete will not be permitted.
- B. Concrete samples for slump and test cylinders will be taken at the discharge end of the pumping conduit.

3.05 ORDER OF PLACING CONCRETE

A. The order of placing concrete in all parts of the work shall be acceptable to the Engineer. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 7-days before the contiguous unit or

- units are placed, except that the corner sections of vertical walls shall not be placed until the two (2) adjacent wall panels have cured at least 14-days.
- B. The surface of the concrete shall be level whenever a run of concrete is stopped. To ensure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4-inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2-inch above the underside of the strip. About one (1) hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel.

3.06 TAMPING AND VIBRATING

- A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets and bringing only a slight excess of water to be exposed surface of concrete during placement. Vibrators shall be high speed power vibrators (8,000 to 10,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required.
- B. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat-strip type waterstops are horizontal, the concrete shall be worked under the waterstops by hand, making sure that all air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration, over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.
- C. Concrete in walls shall be internally vibrated and at the same time rammed, stirred or worked with suitable appliances, tamping bars, shovels or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein specified with fifteen (15) minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner than causes segregation of its constituents.

3.07 FINISHING CONCRETE SURFACES

- A. <u>General</u>: Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles and dimensions shown are defined as tolerances and are specified in Paragraph 1.05, G., herein. These tolerances are to be distinguished from irregularities in finish as described herein.; aluminum finishing tools shall not be used.
- B. <u>Unformed Surfaces</u>: After placing and consolidating concrete, all unformed top surfaces of slabs, walls, curbs, gutter and steps, shall be brought to a uniform finished surface. The classes of finish specified for unformed concrete surfaces are defined as follows:
 - 1. <u>Finish U1</u>: Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8-inch. No further special finish is required.

- 2. <u>Finish U2</u>: After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Excessive floating or surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform texture. Surface irregularities shall not exceed 1/4-inch. Joints and edges shall be tooled where shown or as determined by the Engineer.
- 3. <u>Finish U3</u>: After the floated surface (as specified for Finish U2) has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples and trowel marks. The finish shall be smooth and free of all irregularities.
- 4. <u>Finish U4</u>: Steel trowel finish (as specified for Finish U3) without local depressions or high points. In addition, the surface shall be given a light hairbroom finish with brooming perpendicular to drainage unless otherwise shown. The resulting surface shall be rough enough to provide a non-skid finish.
- C. The schedule for finished unformed surfaces shall be as follows:

Unformed Concrete Surface Schedule

<u>Area</u>	<u>Finish</u>
Grade slabs and foundations to be covered with concrete or fill material.	U1
Floor slabs to be covered with grouted tile or topping grout and slabs to be covered with built-up roofing.	U2
All building and machine room floors, basin floors not receiving a grout topping, channel floors, top of interior walls, top of interior curbs, steps and walkways. Grout Surfaces in Bottom of Clarifier and DAF.	U3
Exterior walkways, curb, gutter, sidewalk and steps, top of valve or meter vaults, electrical pull boxes and catch basins. Grout surface in Clarifier and DAF Launders.	U4

D. Floor Sealer Hardener (Surface Applied):

- 1. Floor hardener shall be applied where shown or noted on the drawings.
- 2. Floors to receive hardener shall be cured, cleaned and dry with all work above them completed. Apply zinc and/or magnesium fluosilicate evenly, using three (3) coats, allowing 24-hours between coats.
- 3. The first coat shall be 1/3 strength, second coat 1/2 strength and third coat shall be 2/3 strength. Each coat shall be applied so as to remain set on the concrete surface for fifteen (15) minutes. If sodium silicate is used, it shall be applied evenly, using three (3) coats, allowing twenty-four (24) hours between coats, and the material shall be applied full strength at the rate of one (1) gallon per 300 square feet. Approved proprietary hardeners

shall be applied in conformance with the manufacturers instruction. After the final coat is completed and dry, surplus hardener shall be removed from the surface by scrubbing and mopping with water.

- E. <u>Formed Surfaces</u>: Immediately following the removal of forms, the concrete shall be inspected for defects such as rock pockets, grout loss, damage from stripping forms, surface defects such as fins, offsets, bulges, excessive bug-holes and stains. All defective concrete work shall be removed and replaced or repaired to the satisfaction of the Engineer. Any work which has not been constructed in accordance with the plans and specifications will be considered defective.
 - 1. Correction of defective work shall be as directed by the Engineer and specified herein. No defective work shall be patched, repaired or covered without prior inspection and approval of the Engineer.
 - 2. Holes left by tie-rod cones or taper ties shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with non-metallic grout.
 - 3. The classes of formed concrete surfaces are defined as follows:
 - a. <u>Finish F1</u>: No special treatment is required after form removal except for curing, repair of defective concrete treatment of surface defects, removal of fins and projections, filling of tie holes and filling of depressions and bug-holes 3/8-inch or larger in width or depth with mortar.
 - b. <u>Finish F2</u>: All defective concrete shall be repaired, all fins, offsets, bulges and projections ground smooth, filling of tie holes and filling of depressions and bugholes 1/4-inch or larger in width or depth with mortar.
 - c. <u>Finish F3</u>: All defective concrete shall be repaired, all fins, offsets, bulges and projections ground smooth and tie holes filled with grout. The entire surface shall then receive a light stoning or grinding using a No. 50 or No. 60 grit carborundum stone or grinding wheel to remove any latence and curing film and to open up bugholes hidden beneath the thin surface grout film. The surface shall then be given a stoned-sand type architectural finish as follows:
 - 1) The concrete surface shall be pre-wet for several hours or overnight before treatment.
 - 2) While the surface is still damp, spread a sand mix, consisting of one (1) part of Type II Cement and one to one and a half (1 to 1-1/2) parts of fine sand passing the No. 70 screen mixed with enough water and an emulsified bonding agent to have the consistency of thick cream. The sand mix should be spread thinly over the damp surface with a rubber float and rubbed in over the entire area leaving only a minimum amount of material on the surface necessary to produce a sand texture, approximately 1/32-inch in thickness.
 - 3) The surface shall be kept continually damp for seventy-two (72) hours following this finish treatment.
- F. The schedule for formed surface finish shall be as follows:

Formed Concrete Surface Schedule

<u>Area</u>	<u>Finish</u>
Formed concrete surfaces to be covered by backfill or coated with below grade waterproofing systems.	F1
Formed concrete surfaces in water channels, below water surface of basins, inside meter and valve vaults, inside cells of hydraulic splitter boxes and weirs.	F2
Formed concrete surfaces inside buildings and machine rooms and all exposed exterior surfaces of foundations, basins, vaults, hydraulic structures and curbs.	F3

3.08 CURING AND DAMPPROOFING

A. <u>General</u>: All concrete shall be cured for not less than fourteen (14) days after placing, in accordance with the methods specified herein for the different parts of the work and described in detail in the following paragraphs:

Surface To Be Cured

<u>Area</u>	Method
Construction joints between footings and walls and between floor slab and columns.	1
Wall sections with forms removed, encasement concrete and all concrete surfaces not specifically provided for elsewhere in this Paragraph.	2
Floor slabs on grade in hydraulic structures and roof and slabs not on grade.	3

- B. <u>Method 1</u>: The surface shall be covered with burlap mats which shall be kept wet with water for the duration of the curing period, or until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 1.
- C. Method 2: The surface shall be sprayed with a liquid curing compound applied in accordance with the manufacturers printed instructions. Care shall be exercised to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.
 - 1. Curing compound specified shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and within one (1) hour after removal of forms from contact with formed surfaces. Repairs to formed surfaces shall be made within the said one (1) hour period. If repairs cannot be made with the one (1) hour period they shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be sandblasted to remove the curing compound, following which repairs shall be made as specified herein.

- D. Method 3: Immediately after the concrete has been finished, it shall be given a coat of curing compound in accordance with Method 2, Paragraph 3.08, C. herein. No less than one (1) hour nor more than four (4) hours after the coat of curing compound has been applied, the surface shall be wetted with water delivered through a fog nozzle, and concrete-curing blankets shall be placed on the slabs. The curing blanket material shall be clear 6 mil minimum polyethylene. The blankets shall be laid with the edges lapped not less than 12-inches and held in place by tape or other suitable means to prevent the blankets from separating or being removed by wind.
 - 1. The curing blankets shall be left in place during the fourteen (14) day curing period and shall not be removed until after concrete for adjacent work has been placed. Should the curing blankets become torn or otherwise ineffective, the Contractor shall replace damaged sections. During the first three (3) days of the curing period, no traffic of any nature and no depositing, temporary or otherwise, of any materials shall be permitted on the curing blankets. During the remainder of the curing period, foot traffic and temporary depositing of materials that impose light pressure will be permitted only on top of plywood sheets 5/8-inch minimum thickness, laid over the curing blanket. The Contractor shall add water under the curing blanket as often as necessary to maintain damp concrete surfaces at all times.

3.09 PROTECTION

- A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress or any other cause until final acceptance by the Owner. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damage to finish surfaces.
- B. Finished floor slabs in buildings and machine rooms shall be suitably protected from wear or damage from construction operations. The Contractor shall not use newly finished floors or buildings for machine assembly, fabrication, pipe fitting, curing or welding operations without covering the working area with plastic sheets and/or plywood. Any concrete found to be damaged or which may have been originally defective or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the Contractor's expense.
- C. Immediately following the first frost in the fall, the Contractor shall be prepared to protect all concrete against freezing.

3.10 CURING IN COLD WEATHER

- A. After the first frost, and until the mean daily temperature in the vicinity of the worksite falls below 40 degrees F. for more than one (1) day, the concrete shall be protected against freezing temperatures for not less than forty-eight (48) hours after it is placed. After the mean daily temperature in the vicinity of the worksite falls below 40 degrees F. for more than one (1) day, the concrete shall be maintained at a temperature not lower than 50 degrees F. for at least seventy-two (72) hours after it is placed.
 - 1. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40 degrees F. over a (3) three-day duration.

B. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected from drying and excessive carbon dioxide atmosphere by application of curing Method 2 or Method 3, as specified under Section 3.08, Paragraphs C and D herein.

3.11 REPAIR OF DEFECTIVE CONCRETE

- A. No concrete repairs shall be made until after inspection and approval of the method of repair by the Engineer. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing extensive voids, holes, honeycombing or similar depression defects shall be completely removed and replaced. Concrete containing minor voids, holes, honeycombing or similar depression defects shall be repaired as specified herein. All concrete repairs and replacements shall be promptly executed by the Contractor at its own expense.
- B. Prior to filling any structure with water, all cracks that may have developed shall be "vee'd" as shown on the Drawings and filled with construction joint sealant conforming to the requirements under **Section 03290 Joints in Concrete**. This repair method shall be done on the water bearing face of members. Prior to backfilling, faces of members in contact with fill, which are not covered with a waterproofing membrane shall also have cracks repaired as specified herein.
- C. The repair of holes left by rock pockets, penetrations, tie rods or other reasons will require the use of non-shrink, non-metallic grout material.

SECTION 03 35 00 - CONCRETE FINISHING

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section shall describe how the CONTRACTOR shall perform work in regard to concrete finishing.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. The well site concrete slab shall be trowel finished smooth. The rest of the pad and all other concrete structures shall have a final brush finish on exposed surfaces.
 - B. All concrete surfaces shall be finished by experienced finishers, as specified, as soon after placing the concrete as conditions will permit. The placing of concrete and the removal of forms shall be scheduled so that finishing the surfaces can be completed before the concrete reaches a final hard set. No cement plaster or cement brush-coats will be acceptable.
 - C. Unformed concrete surfaces shall be struck off to established grade and floated with a wood float until all irregularities are removed. Where required the surface shall then be troweled either with a wood trowel or a steel trowel, depending on the finish requirement of the area to be troweled, until a smooth dense finish is obtained. Troweling of the floated surface shall not be done until all excess water has evaporated.

PART 2 - PRODUCTS

- 2.01 SEALER
 - A. Where specified, the sealer shall be Conspec #1, or Thomson's Water Seal 201 applied at a rate of 300 square feet per gallon for each coat.

PART 3 - EXECUTION

- 3.01 PREPARATION NONE
- 3.02 INSTALLATION
 - A. Concrete surfaces shall be finished as indicated on the DRAWINGS. Where not specified or indicated on the DRAWINGS, the surfaces shall be finished as follows:
 - 1. Concrete surfaces which are specified or indicated to be painted, and all concrete surfaces, interior or exterior, exposed to view shall have fins removed and joints ground smooth, and shall be "sacked" with cement mortar so that all pits and holes are filled. Surfaces in open channels, basins, and similar structures, which are normally below the

water surface shall have fins removed, but need not have joints ground. However, surfaces in such locations which are above the normal water surface and exposed to view shall have fins removed and joints ground smooth, and shall be "sacked" with cement mortar so that all pits and holes are filled. Concrete surfaces in closed boxes or channels where there is normally no access or passageway shall have the fins removed. All form ties shall be removed from all surfaces, and holes shall be filled after being cleaned and roughened by heavy sandblasting.

- B. The following surfaces (as applicable) shall be troweled, then given a light hairbroom finish:
 - 1. Exterior walkways
 - 2. Tops of exterior walls or beams which are to serve as walkways
 - 3. Tops of exterior walls or beams which are to support grating
- C. The following surfaces (as applicable) shall be screened off to grade and left rough:
 - 1. Projecting footings which are to be covered with dirt
 - 2. Slab surfaces which are to be covered with concrete fill or equipment pads
- D. The following surfaces (as applicable) shall receive a smooth steel trowel finish:
 - 1. Tops of corbels, walls and beams not covered above
 - 2. Tops of all slabs not covered above herein
 - 3. All other surfaces not specified to be finished otherwise
- E. The final steel trowel finish shall be uniformly smooth and free of all irregularities. Building and machine room floors which are not to be covered with surfacing material shall be free from trowel marks. Trowel marks will be permitted in other locations. Concrete floor surfaces to which a surfacing material is to be applied shall be finished level and smooth with a tolerance of not over 1/8 inch in 10 feet in any direction.

3.03 CONCRETE SEALER

- A. The following floors and slabs shall be sealed:
 - 1. All exterior slabs.
 - 2. Sealant shall be applied to any and all other floor slabs, except those to receive a seamless floor surfacing or any slab which will receive epoxy surfacing.
- B. Sealant shall be applied at a coverage not to exceed 300 square feet per gallon and shall be applied as soon as the slab or floor will bear weight. The entire surface to be sealed shall be swept clean with a very soft bristled brush which will not mark the finish. The sealer shall then be applied with a large, clean, sheepskin mop type applicator. Paint rollers are not acceptable. Workmen shall wear flat soled shoes which will not mark or scar the surface.
- C. Apply two (2) coats of concrete sealer on top surfaces of the concrete floor. Sealer shall be clear of color and non-staining. The sealer shall be Conspec #1, or Thomson's Water Seal 201 applied at a rate of 300 square feet per gallon for each coat.
- D. No traffic shall be allowed on floors and slabs until sealer has dried and hardened.

SECTION 03 36 10 – ASPHALTIC CONCRETE PAVEMENT AND BASE

PART 1 - GENERAL

1.01 REQUIREMENT

A. The CONTRACTOR shall furnish all labor, materials, plant equipment, supplies and facilities and perform all work required to provide a finished A.C. Pavement and Base satisfying all the requirements of the Contract Documents.

1.02 RELATED WORK

- A. Section 01 33 00 Submittal Procedures
- B. Section 31 05 00 Common Work Results of Earthwork

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Codes: All codes and "Standard Specifications" as referenced herein, are specified in Section 01 42 19 Reference Standards.

Cut-Back Asphalt (Medium Curing Type)

B. Commercial Standards:

AASHTO M 82

7 11 15111 O WI 02	cut back Asphalt (Medium curing Type)
AASHTO M 140	Emulsified Asphalt
AASHTO M 208	Cationic Emulsified Asphalt
AASHTO M 226	Viscosity Graded Asphalt Cement
ASTM D 242	Mineral Filler for Bituminous Paving Mixtures
ASTM D 692	Coarse Aggregate for Bituminous Paving Mixtures
ASTM D 977	Emulsified Asphalt
ASTM D 1073	Fine Aggregate for Bituminous Paving Mixtures
ASTM D 1188	Bulk Specific Gravity and Density of Compacted Bituminous
	Mixtures Using Paraffin-Coated Specimens
ASTM D 1557	Moisture-Density Relations of Soils and Soil - Aggregate Mixtures
	Using 10-lb (4.54-kg) Rammer and 18-in (457-mm) Drop
ASTM D 2027	Cutback Asphalt (Medium Curing Type)
ASTM D 2397	Cationic Emulsified Asphalt
ASTM D 2726	Bulk Specific Gravity and Density of Compacted Bituminous
	Mixtures using Saturated Surface-Dry Specimens
ASTM D 3381	Viscosity-Graded Asphalt Cement for Use in Pavement
	Construction
ASTM D 3515	Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

1.04 SUBMITTALS

A. The CONTRACTOR shall submit materials testing reports, job-mix formulas, and other pertinent information satisfactory to the ENGINEER demonstrating that materials and

methods the CONTRACTOR proposes to utilize will comply with the provisions of this Section. Tests for conformance with the Specifications shall be performed prior to start of the Work. The samples shall be identified as to material and aggregate source. Materials to be tested shall include aggregate base, coarse and fine aggregate for paving mixtures, mineral filler, and asphalt cement.

PART 2 - PRODUCTS

2.01 AGGREGATE BASE

A. Materials for aggregate base shall be Type 1 material as specified in the Section 31 05 00 Earthwork or the Standard Specification referenced under Section 01 42 19 Referenced Standards.

2.02 TACK COAT

A. Tack coat shall be as specified in the Standard Specification referenced under Section 01 42 19 Referenced Standards.

2.03 ASPHALTIC CONCRETE

A. Asphaltic-concrete shall be as specified in Section 203 of the Standard Specification except that hydrated lime need not be used. The mineral aggregate shall be 3/4-inch gradation. The bituminous material for the surface course shall be AC-10 penetration asphalt cement conforming to the requirements of ASTM M-226. The CONTRACTOR shall establish a mix gradation and the amount of bituminous material. A Marshall Mix Report shall be submitted for the ENGINEER's review to verify the percentage of voids. Regardless of the bituminous content, there shall not be more than 3 percent voids in the aggregate.

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

A. The subgrade on which the base course is to be placed shall be prepared as specified in the **Section 31 05 00 Earthwork**, as applicable to roadways and embankments and Section 209 of the "Referenced Standards". The subgrade for pavement shall be furnished and prepared as specified in **Section 31 05 00 Earthwork** as applicable and Section 301 of the Standard Specification. The subgrade for pavement shall not vary more than 0.02 foot from the specified grade and cross section. Subgrade for base material shall not vary more than 0.04 foot from the specified grade and cross section.

3.02 AGGREGATE BASE

A. Aggregate base shall be provided where shown and to the thickness shown. Imported aggregate bases shall be delivered to the job site as uniform mixtures and each layer shall be spread in one operation. Segregation shall be avoided and the base shall be free of pockets of coarse or fine material. Where the required thickness is 6-inches or less, the

base materials may be spread and compacted in one layer. Where the required thickness is more than 6-inches, the base material shall be spread and compacted in two or more layers of approximately equal thickness and the maximum compacted thickness of any one layer shall not exceed 6-inches. The relative compaction of each layer of aggregate base shall not be less than 95 percent of maximum density when measured in accordance with ASTM D 1557. The compacted surface of the finished aggregate shall be hard, uniform, smooth and at any point shall not vary more than 0.02-foot from the specified grade or cross section.

3.03 TACK COAT

A. A tack coat shall be applied in accordance with Section 404 of the Referenced Standards to existing paved surfaces where new asphalt concrete is to be placed on existing pavement. It shall also be applied to the contact surfaces of all cold pavement joints, curbs, gutters, manholes and the like immediately before the adjoining asphalt pavement is place.

3.04 ASPHALT CONCRETE

- A. At the time of delivery to the Work site, the temperature of mixture shall not be lower than 250 degrees F.
- B. Asphalt concrete shall not be placed when the atmospheric temperature is below 40 degrees F, or during unsuitable weather as determined by the ENGINEER.
- C. In no case shall the asphalt from 2 different sources be intermixed. If the source is changed during the course of the work, a new mix design shall be submitted.
- D. The depositing, distributing, and spreading of the asphalt concrete shall be accomplished in a single, continuous operation by means of a self-propelled mechanical spreading and finishing machine designed specially for that purpose. The machine shall be equipped with a screed or strike-off assembly capable of being accurately regulated and adjusted to distribute a layer of the material to a definite pre-determined thickness. When paving is of a size or in a location that use of a self-propelled machine is impractical, the ENGINEER may waive the self-propelled requirement.
- E. Spreading, once commenced, must continue without interruption.
- F. The mix shall be compacted immediately after placing. Initial rolling with a steel-wheeled tandem roller, steel three-wheeled roller, vibratory roller, or a pneumatic-tired roller shall follow the paver as closely as possible. If needed, intermediate rolling with a pneumatic-tired roller shall be done immediately behind the initial rolling. Final rolling shall eliminate marks from previous rolling. In areas too small for the roller, a vibrating plate compactor or a hand tamper shall be used to achieve thorough compaction.
- G. Upon completion, the pavement shall be true to grade and cross-section. When a 10-foot straight edge is laid on the finished surface parallel to the center of the roadway, the surface shall not vary from the edge of the straight edge more than 1/8-inch except at

- intersections or changes of grade. In the transverse direction, the surface shall not vary from the edge of the straightedge more than 1/4-inch.
- H. The relative density after compaction shall be 95 percent of the density obtained by using ASTM D 1188 or D 2726. A properly calibrated nuclear asphalt testing device shall be used for determining the field density of compacted asphalt concrete, or slab or cores may be laboratory tested in accordance with ASTM D 1188.

SECTION 03 39 00 - CONCRETE CURING

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section shall describe how the CONTRACTOR shall perform work in regard to concrete curing.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. Protection against loss of moisture from the surface of the concrete shall be accomplished by the following:
 - 1. Keeping the surface cured for a minimum period of 7 days.
 - 2. Keeping the surface in contact with the form.
 - 3. Covering with burlap or cotton mats kept continuously wet and covered with polyethylene plastic.
 - 4. Continuously sprinkling the exposed surfaces.
 - 5. Applying a curing and sealing compound as specified herein.

PART 2 - PRODUCTS

2.01 CURING AND SEALING COMPOUND

- A. Clear Curing and Sealing Compound (VOC compliant) shall comply with ASTM C309, Type 1D. The compound shall have 30 percent solids content minimum, and will not yellow under ultraviolet light after 500 hours of test and will have test data from an independent testing laboratory indicating a maximum moisture loss of 0.040 grams per sq. cm. when applied at a coverage rate of 300 sq. ft. per gallon.
- B. Compound shall be "Super Aqua Cure VOX" or "Super Diamond Clear VOX" by The Euclid Chemical Co. or an equal approved by the OWNER or ENGINEER.
- C. No curing compounds shall be used on any surfaces to which pneumatic mortar is to be applied, or on which any other type of concrete mortar or chemical waterproofing coating is to be used. They may be used in other places, however, upon the approval of the compound and its location by the OWNER.

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PART 3 - EXECUTION

3.01 PREPARATION – NONE

3.02 INSTALLATION

- A. All concrete shall be cured by the methods specified herein for a minimum of seven days.
- B. All concrete that is to be painted shall be water or plastic membrane cured. No curing compound shall be used on any concrete surface that is to receive paint or upon which any material is to be bonded. All other concrete shall be cured by water curing or sprayed curing membrane at the CONTRACTOR's option, except floors and slabs which are specified to be sealed with a concrete sealer. Floor slabs may be cured using a plastic film membrane curing.

C. Water Curing

1. All surfaces of concrete being water cured shall be kept constantly and visibly moist day and night for a period of not less than seven days and nights. Each day the forms remain in place may count as one day of water curing. No further curing credit will be allowed for forms in place after contact has once been broken between the concrete surface and the forms. Ties shall not be loosened during the period when concrete is being cured by leaving the forms in place. The top of walls shall be flooded with water at least three times per day, and the concrete surface shall be kept moist at all times during the sevenday curing period.

D. Sprayed Membrane Curing

- 1. The curing compound shall be applied to the concrete surface after repairing and patching, and within one hour after the forms are removed. If more than one hour elapses after the removal of the forms, membrane compound shall not be used and water curing shall be applied for the full curing period. If the surface requires repairing or painting, the concrete shall be water cured.
- Curing compound shall not be removed from the concrete in less than seven days.
 Curing compound may be removed by the CONTRACTOR only upon written request by the CONTRACTOR and acceptance by the OWNER, stating what measures the CONTRACTOR shall take to adequately cure the structure.
- 3. Care shall be taken to apply curing compound in the area of the constructions joints to see that curing compound is placed within the construction joint silhouette. The curing compound placed within the construction joint silhouette shall be removed by heavy sandblasting prior to placing any new concrete. The CONTRACTOR has the option of water curing the construction joint.
- 4. Curing compound shall be applied by a mechanical, power operated sprayer and mechanical agitator that will uniformly mix all pigment and compound. The compound shall be applied in at least two coats. Each coat shall be applied in a direction opposite to the preceding coat.
- 5. The compound shall be applied in sufficient quantity so that the surface will have a uniform appearance and will effectively and completely conceal all natural color of the concrete at the time of the spraying. The CONTRACTOR shall continue to coat and recoat the surface until the specified coverage is achieved and until a coating film remains on the surface of the concrete. The thickness and coverage of the compound

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- shall be such that the film can be scraped from the surface at any and all points after drying for at least 24 hours.
- 6. The CONTRACTOR is cautioned that the method of applying curing compound specified herein may require more compound than normally suggested by the manufacturer of the compound and also more than is customary in the trade.
- 7. If the CONTRACTOR desires to use a curing compound other than the specified compound, the CONTRACTOR shall coat sample areas of concrete wall with the proposed compound and also a similar adjacent area with the specified compound in the specified manner for comparison. Complete data on the proposed compound shall also be submitted for review. If the proposed sample is not equal or better, in the opinion of the OWNER, in all features, the proposed substitution will not be allowed.
- 8. Prior to final acceptance of the work, the CONTRACTOR shall remove, by sandblasting or other acceptable method, any curing compound on surfaces that will be exposed to view, so that only the natural color of the finished concrete will be visible uniformly over the entire surface.
- 9. When concrete slab placements are subject to high temperatures, wind and/or low humidity, the OWNER or the ENGINEER may require the use of the evaporation retarder to minimize plastic cracking. The compound may be required to be applied one or more times during the finishing operation.
- 10. At air temperatures of 90°F or above, concrete shall be kept below 90°F during placing and curing. Concrete surfaces shall be kept continuously moist by wet-curing for at least 24 hours after the concrete has been placed, and water shall be applied to formed surfaces while forms are still in place. After the period of wet-curing, a suitable heat-reflecting plastic membrane or white-pigmented curing compound or immediate membrane curing shall be used.

E. Plastic Membrane Curing

1. Polyethylene film may be used to cure slabs, and shall be sealed at joints and edges with a small sand berm. The plastic membrane shall be installed as soon as the concrete is finished and can be walked on without damage. The concrete shall be kept moist under the plastic membrane.

3.03 TESTING – NONE

END OF SECTION

CONCRETE CURING 03 39 00 - 3

SECTION 03 60 10 – GROUTING MORTAR

PART 1 - GENERAL

1.01 REQUIREMENT

- A. The Contractor shall furnish, place, finish and cure the following types of grouting mortars as called for herein and as shown in the Contract Documents
 - 1. <u>Non-Shrink Grout</u>: This type of grout shall be used wherever grout is shown or called for in the Contract Documents, unless another type is specifically referenced.
 - 2. Topping Grout: This type of grout shall be used for grouting clarifier bottoms.
 - 3. <u>Epoxy Grout</u>: This type of grout shall be used for anchor bolt or reinforcing steel embedment, repairs and resurfacing.

1.02 RELATED WORK

A. Section 03 30 00 - Cast-in-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Specifications, codes and standards is listed under Section 03 30 00 Cast-in-Place Concrete, and those additional commercial standards as follows:

CRD-C 621-85	Corps of Engineers Specification for Non-Shrink Grout
ASTM C 109	Standard Test Method for Compressive (Latest Edition) Strength of Hydraulic Cement Mortars (Using 2-inch or 50-mm Cube Specimens)
ASTM C-827-87	Standard Test Method for Early Volume Change of Cementitious Mixtures

1.04 SUBMITTALS

- A. <u>Non-Shrink Grout</u>: Submit manufacturers technical data including compressive strength and expansion data at plastic, flowable and fluid consistencies. Also submit manufacturers applications manual containing instructions and recommendations for mixing, handling, placement and appropriate uses for each type of non-shrink grout used in the work.
- B. <u>Topping Grout</u>: Provide certified mix design including proportions and gradations of all materials and compressive strength test results from at least one (1) trial batch. Tests shall be performed by a certified testing laboratory. All costs for such mix design and trial batch tests shall be borne by the Contractor.
- C. <u>Epoxy Grout</u>: Submit manufacturer's technical data including strengths and application manual of instructions for mixing, handling and placing.

1.05 QUALITY ASSURANCE

A. Mix design tests for topping grout shall be performed per the standards referenced herein.

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- B. During the progress of construction, the Engineer may have tests made of each type of grout used in the work to ensure compliance with the Contract Documents. These tests will be made in accordance with the standards referenced herein. The test expense during construction, except for the mix design and trial batch tests, will be borne by the Owner. The costs of additional tests including non-destructive tests and core drilling needed to verify or investigate the quality of questionable work or material shall be borne by the Contractor.
- C. Grout for testing shall be supplied by the Contractor at no cost to the Owner.
- D. If any grout fails to meet the requirements of these specifications, immediate corrective action shall be taken for all subsequent batches. Grout already in place which fails to meet these requirements is subject to removal and replacement with all costs borne by the Contractor.
- E. Construction tolerances shall be as specified in **Section 03 30 00 Cast-in-Place Concrete**, except as modified herein and elsewhere in the Contract Documents.

PART 2 - PRODUCTS

2.01 NON-SHRINK GROUT

- A. Non-shrink grout shall be a prepackaged, inorganic, non-gasliberating, non-metallic, cement-based grout requiring only the addition of water. Manufacturers instructions shall be printed on each bag or other container in which the materials are packaged.
- B. Non-shrink grouts for use as herein specified shall conform to the Corps of Engineers specifications for Non-Shrink Grout, CRD-C621-85 and to these specifications. The grout shall have a 28-day compressive strength of 6,000 psi or greater.
- C. Non-shrink grouts shall be as manufactured by: <u>Tremcrete Systems Incorporated, Woodland, California; Gifford-Hill & Company, Inc., Dallas, Texas; or approved equal.</u>

2.02 TOPPING GROUT

- A. Cement topping grout for clarifiers or channels shall be composed of one-part cement, three parts sand, and the minimum amount of water necessary to obtain the desired consistency. The minimum compressive strength at 28-days shall be 4,000 psi.
- B. Cement grout materials shall be as specified in **Section 03 30 00 Cast-in-Place Concrete**.

2.03 EPOXY GROUT

A. Epoxy grout shall be a pourable, non-shrink, one-hundred percent (100%) solids system. The epoxy grout system shall have three components; resin, hardener, and specially blended aggregate, all premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application. Manufacturer's instructions shall be printed on each container in which the materials are packaged.

GROUTING MORTAR 03 60 10 - 2

B. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75 degrees F. The epoxy grout shall develop a minimum compressive strength of 5,000 psi in 24-hours and 10,000 psi in 7-days.

2.04 CURING MATERIALS

A. Curing materials shall be as specified in **Section 03 30 00 Cast-in-Place Concrete**, for cement topping grout and as recommended by the manufacturer of non-shrink grouts.

PART 3 - EXECUTION

3.01 PLACING NON-SHRINK AND EPOXY GROUT

- A. All forming, mixing, surface preparation, handling, placing and consolidated of non-shrink and epoxy grouts shall be done according to the instructions and recommendations of the manufacturer.
- B. Curing shall be as specified herein.

END OF SECTION

GROUTING MORTAR 03 60 10 - 3

SECTION 04 05 00 - COMMON WORK RESULTS FOR MASONRY

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. This section includes all labor, materials, equipment, and appliances required to complete the masonry work as indicated on the DRAWINGS and specified herein. The General Conditions apply to all sections of this specification, which shall be completed as shown on the plans and as specified, and shall be properly coordinated with work in other Specifications.
- B. The DRAWINGS and these specifications are complementary to each other; what is called for by one shall be as binding as if called for by both. If there is any conflict between what is shown on the DRAWINGS and what is written in the specifications, the details described on the DRAWINGS shall take precedence and the CONTRACTOR shall communicate the conflicts to the ENGINEER in a timely manner.

C. Safety

1. The CONTRACTOR shall be familiar with, and shall at all times conform to, the regulations of the "OSHA General Industry Occupational Safety and Health Standards," "OSHA Safety and Health Regulations for Construction," and other applicable state and municipal standards and regulations

1.02 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 01 33 00 SUBMITTAL PROCEDURES
 - 2. SECTION 07 00 00 THERMAL AND MOISTURE PROTECTION
 - 3. SECTION 32 31 00 FENCES AND GATES

1.03 CITED STANDARDS

- A. All masonry shall conform to the requirements of the following standard specifications, of the latest revisions, as applicable:
 - 1. ASTM C90 Concrete Masonry Units Using Lightweight Aardelite Aggregate
 - 2. The Masonry Standards Joint Committee's (MSJC) 2008 Building Code Requirements and Specification for Masonry Structures (TMS 402/ACI 530/ASCE 5 and TMS 602/ACI 530.1/ASCE 6)
 - 3. "GREENBOOK" Standard Specifications for Public Works Construction, 2006 Edition written by Public Works Standards, Inc. Vista, CA.

1.04 NOTED RESTRICTIONS

A. Waterproofing shall be performed on block units, mortar with Sikagard 704W, Chemstop Barricade, or an equal approved by the ENGINEER.

B. Sealer may also be used on the exterior of concrete masonry unit (CMU) to block out moisture and to preserve the blocks.

1.05 QUALITY CONTROL

- A. Masonry Work shall include, but is not limited to, concrete masonry units, mortar, grout, and miscellaneous materials, complete in place.
- B. CONTRACTOR shall subject all masonry work to a Level II International Building Code (IBC) or Level C Masonry Building Standards Joint Committee (MSJC) inspection per cited standards.
- C. Masonry Inspection shall be conducted by an International Code Council (ICC) certified inspector for cast-in-place and post-installed anchors.

1.06 SUBMITTALS

- A. Before moving any materials to the site or commencing any of the work in this section, the CONTRACTOR shall submit the following items:
 - 1. Provide submittals in accordance with **Section 01 33 00 Submittal Procedures**.
 - 2. CONTRACTOR shall submit two samples of each size and type of concrete masonry units to be used on the Work. Samples shall show the range of texture and color of the exposed surface for all units, and all units delivered to the job shall fall within this range. Samples shall include special units such as bond beam units, pilaster units, units with an end web removed, and other special units.
 - 3. CONTRACTOR shall submit certified test reports of three sample concrete masonry units of each type proposed to be used on the job, performed by an independent testing laboratory acceptable to the OWNER indicating that the materials proposed for use meet the requirements of these Specifications. Test results shall include, but not be limited to, compressive strength, linear shrinkage, total absorption, moisture content as a percent of total absorption, and unit weight. Tests shall be performed in accordance with ASTM C 90, ASTM C 140, and ASTM C 426.
 - 4. The CONTRACTOR shall submit a wall elevation drawing for each wall, indicating the type of masonry unit to be used and layout of masonry units. Special units such as bond beam units, open ended web units, pilaster units, and other special units shall be identified.
 - 5. CONTRACTOR must provide product literature with submittals.

PART 2 - PRODUCTS

2.01 WATERPROOFING

A. Waterproofing application shall be Sikagard 704W, Chemstop Barricade, or approved equal.

2.02 SEALANT

A. Sealant application shall be Sikaflex Textured Sealant or approved equal.

PART 3 - EXECUTION - NOT USED

SECTION 04 05 13 - MASONRY MORTARING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This specification covers mortars for use in the construction of non-reinforced and reinforced unit masonry structures. The CONTRACTOR shall perform all Masonry Mortaring work as described below and as indicated on the DRAWINGS.

1.02 REFERENCED SECTIONS – NONE

1.03 CITED STANDARDS

- A. All masonry mortaring shall conform to the requirements of the following standard specifications, of the latest revisions, as applicable:
 - 1. ASTM C 144 Standard Specification for Aggregate for Masonry Mortar
 - 2. ASTM C207-06, Type S Standard Specification for Hydrated Lime for Masonry Purposes
 - 3. ASTM C270-08a Standard Specification for Mortar for Unit Masonry

1.04 NOTED RESTRICTIONS

A. Sills, ledges, offsets, and other projections shall be protected from droppings of mortar, and the construction of other trades shall be protected from effects of masonry work.

1.05 QUALITY CONTROL

- A. The CONTRACTOR shall provide mixes which comply with the specified strength requirements.
- B. Cement mortar shall consist of Portland cement, sand, and water. Cement and sand shall first be combined in the proper proportions, and then thoroughly mixed with the required amount of water.
- C. The quantity of water to be used in the preparation of the mortar shall be the minimum required to produce a mixture sufficiently workable for the purpose intended.
- D. Mortar color is to be selected by OWNER

PART 2 - PRODUCTS

2.01 MORTAR

A. Mortar for concrete masonry units shall be Type S mortar in accordance with ASTM C 270 and shall consist of 1 part of Portland cement, 1/4 part to 1/2 part of lime putty or hydrated lime, sand equal to not less than 2-1/4 and not more than three times the sum of the separate volumes of the cementitious materials, and water repellent admixture.

- B. Water repellent admixture shall be added to all mortar in the quantity recommended by the water repellent manufacturer.
- C. The mortar shall be used as soon as possible after mixing and shall show no visible signs of setting prior to use. Retempering of mortar shall not be permitted.
- D. Mortar shall attain a minimum compressive strength of 13MPa (1,800 psi) in 28 days.
- E. CONTRACTOR shall have compressive strength tests performed on trial batches of mortar in accordance with California Building Code Standard 24-22 by an independent testing laboratory acceptable to the OWNER. Certified copies of test results shall be submitted by CONTRACTOR. Cost of tests shall be paid by the CONTRACTOR.
- F. All mortar shall be mixed on the job site. No mixing off the job site, either complete or in part, will be allowed, except that lime putty may be mixed off the job site. Materials for mortar shall be measured by volume. Mortar shall be mixed in a mechanical mixer and only in such quantities as are needed for immediate use. Mortar shall be mixed for at least five minutes after all materials have been added to the mixer. No mortar which has been mixed for more than one hour shall be used. The mixer drum shall be completely emptied of materials and washed down before the next batch of materials is placed therein whenever the mix time has exceeded 90 minutes.

2.02 WATER

- A. The water used for concrete shall be clean, potable water, free from oil, soluble salts, chemicals, and other deleterious substances.
- B. Water shall not contain an amount of impurities that will cause a change in the time of setting of Portland cement of more than 25 percent nor a reduction in relative mortar strength at 7 and 28 days of more than 10% compared to results obtained with distilled water.

2.03 HYDRATED LIME

A. Hydrated lime shall conform to ASTM C 207, Type S.

2.04 SAND

A. Except as specified elsewhere, sand for mortar shall conform to ASTM C 144.

PART 3 - EXECUTION - NOT USED

SECTION 04 05 16 - MASONRY GROUTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The following sections establish the minimum requirements for masonry grout.

CONTRACTOR shall provide mixes which comply with the specified strength requirements and shall perform all masonry grouting work as described below and as indicated on the DRAWINGS.

1.02 REFERENCED SECTIONS – NONE

1.03 CITED STANDARDS

- A. All grouting shall conform to the requirements of the following standard specifications, of the latest revisions, as applicable:
 - $1. \hspace{0.5cm} \textbf{ASTM C207-06, Type S-Standard Specification for Hydrated Lime for Masonry Purposes} \\$
 - 2. ASTM C 404 Standard Specification for Aggregates for Masonry Grout
 - 3. ASTM C 476 Standard Specification for Grout for Masonry
 - 4. GREENBOOK Standard Specifications for Public Works Construction, 2006 Edition written by Public Works Standards, Inc. Vista, CA.

1.04 NOTED RESTRICTIONS

A. Mortar, mortar droppings, or other materials that may prevent the grout from bonding directly to the concrete foundation shall be removed before the grouting operation begins.

1.05 QUALITY CONTROL – NONE

PART 2 - PRODUCTS

2.01 MASONRY GROUT

- A. Measured by volume, grout shall consist of 1 part Portland cement, not more than \$1/10\$ part lime putty or hydrated lime, and fine aggregate equal to \$2-\frac{1}{4}\$ to 3 times the sum of the volumes of the cementitious materials. Sufficient water shall be added to produce consistency for pouring without segregation of the constituents of the grout.
- B. Grout which is used in grout spaces 4 inches or more in both horizontal dimensions may contain an addition of pea gravel equal to 1 to 2 times the sum of the volumes of the cementitious materials.
- C. Grout shall attain a minimum compressive strength of 14MPa (2,000psi) in 28 days.
- D. Tests to verify compressive strength in accordance with California Building Code Standard 24-28 shall be performed by an independent testing laboratory acceptable to the ENGINEER.

Certified copies of test results shall be submitted by CONTRACTOR. Cost of tests shall be paid by the CONTRACTOR.

2.02 WATER

A. The water used for concrete shall be clean, potable water, free from oil, soluble salts, chemicals, and other deleterious substances.

2.03 HYDRATED LIME

A. Hydrated lime shall conform to ASTM C 207, Type S.

2.04 AGGREGATE

- A. Except as specified elsewhere, and fine aggregate for grout shall conform to ASTM C 404.
- B. Coarse aggregate (pea gravel) for grout shall be clean, hard, fine grained, and shall be free of flat, chip-like, thin, elongated, friable, or laminated pieces.
- C. Pea gravel shall be uniformly graded with not more than 5 percent passing the No. 8 sieve and with 100 percent passing the ³/₈-inch sieve. Coarse grout and fine grout are defined by aggregate size in accordance with ASTM C 476.

PART 3 - EXECUTION

3.01 PREPARATION

A. Reinforcing bars shall be in place and reviewed by the OWNER before grouting shall begin.

3.02 GROUTING AND REINFORCEMENT

- A. All spaces and cells shall be filled solidly with grout. Vertical cells to be grouted shall be filled solidly with grout in lifts not exceeding 8 feet in height.
- B. When the grouting is stopped for one hour or longer, horizontal construction joints shall be formed by stopping the placement of grout 1-1/2 inches below the top of the uppermost unit containing grout.
- C. Vertical cells to be filled with grout shall have vertical alignment sufficient to maintain a clear, unobstructed continuous vertical cell measuring not less than 2 inches by 3 inches. The grout in the cells shall have full contact with the concrete foundation.
- D. Mortar, mortar droppings, or other materials that may prevent the grout from bonding directly to the concrete foundation shall be removed before the grouting operation begins.
- E. For grout pours in excess of 4 feet in height, cleanouts shall be provided at the bottom of each pour for each cell to be filled with grout. Overhanging mortar or other obstruction or debris shall be removed from the inside of such cell walls. The cleanouts shall be sealed after inspection and before grouting.
- F. After grout has been placed, it shall be consolidated by use of a mechanical immersion vibrator designed for the purpose.

3.03 TESTING – NONE

SECTION 04 05 19.13 – CONTINUOUS JOINT REINFORCING

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. The following sections establish the minimum requirements for continuous joint filler for masonry. The CONTRACTOR shall perform all continuous joint reinforcing work as described below and as indicated on the DRAWINGS.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. Cutting or reaming of members being anchored or other means of accommodating misaligned anchor bolts in support angles will not be accepted.
- 1.05 QUALITY CONTROL NONE

PART 2 - PRODUCTS

- 2.01 CONTROL JOINT FILLER
 - A. Premolded joint filler shall be wide flange Rapid Poly-Joint manufactured by Dur-O-Wal; wide flange Vert-A-Joint manufactured by Vert-A-Joint Company, or an ENGINEER approved equal.
- 2.02 CAULKING
 - A. Caulking for masonry control joints, around door jambs, window frames, at roof decks, and at other locations in masonry construction shall be done with a 1 part, non-sag, high performance, polysulfide base sealant.
 - B. Caulking shall conform to requirements of Interim Federal Specification TT-S-00230C, Type 2, Class A, and shall be Chem Calk 100 manufactured by Woodmont Products, Inc.; PRC 7000 manufactured by Products Research and Chemical Corp.; or an ENGINEER approved equal.
 - C. Color shall be selected by the ENGINEER from the Manufacturer's standard colors.
 - D. Application, including necessary primer and backer rod, shall be in accordance with Manufacturer's recommendations.
 - E. Sealant shall not be applied on wet or frosty surfaces or when surface temperature is higher than 130 degrees F. The depth of sealant in a joint shall not be greater than its width nor less than 1/4-inch.

F. Sealant depths shall be as follows:

Joint WidthSealant Depth1/4 inch to 3/8 inch1/4 inch1/2 inch to 1 inch3/8 inch

PART 3 - EXECUTION - NOT USED

SECTION 04 05 19.16 - MASONRY ANCHORS

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. The following sections establish the minimum requirements for masonry reinforcing bars. The CONTRACTOR shall perform all masonry reinforcing work as described below and as indicated on the DRAWINGS.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. Cutting or reaming of members being anchored or other means of accommodating misaligned anchor bolts in support angles will not be accepted.
- 1.05 QUALITY CONTROL NONE

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

- 3.01 PREPARATION NONE
- 3.02 ANCHORING BOLTS
 - A. A 6-inch minimum width of grouted hollow masonry shall be provided all around anchor bolts and other attachment locations.
 - B. Anchor bolts shall be held in place by a template to assure precise alignment of anchor bolts. Cutting or reaming of members being anchored or other means of accommodating misaligned anchor bolts in support angles will not be accepted.
- 3.03 TESTING NONE

SECTION 04 05 19.26 - MASONRY REINFORCING BARS

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. The following sections establish the minimum requirements for masonry reinforcing bars. The CONTRACTOR shall perform all masonry reinforcing work as described below and as indicated on the DRAWINGS.
- 1.02 REFERENCED SECTIONS
 - A. Related sections are shown below.
 - 1. SECTION 03 20 00 CONCRETE REINFORCING
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. Reinforcing bars shall be in place and reviewed by the ENGINEER before grouting shall begin.
- 1.05 QUALITY CONTROL NONE

PART 2 - PRODUCTS

- 2.01 REINFORCING BARS
 - A. Reinforcing bars in masonry shall be as specified in Section 03 20 00 Concrete Reinforcing.
- 2.02 WIRE JOINT REINFORCEMENT
 - A. Wire joint reinforcement shall be Ladder type manufactured by Masonry Reinforcing Corporation of America; Ladur-type manufactured by Dur-O-Wall Inc.; or equal. Wire joint reinforcement shall consist of side wires and cross wires of No. 9 gauge galvanized steel unless otherwise indicated on the DRAWINGS.
 - B. Wire shall conform to the requirements of ASTM A 82 and shall be galvanized in accordance with ASTM A 641, Class 1. Side wires for 8-inch wide masonry units shall be 6 inches wide and cross rods shall be 16 inches on center.

PART 3 - EXECUTION

- 3.01 PREPARATION NONE
- 3.02 REINFORCEMENT
 - A. Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding 200 diameters of the reinforcement, nor 10 feet. Bars shall be held in position by steel wire bar positioners or tied to dowels with wire ties.

- B. Where horizontal and vertical bars are spliced and adjacent lap splices are separated by more than 3 inches, the lap splice length shall not be less than 72 bar diameters. Where adjacent lap splices are separated by 3 inches or less, the lap splice length shall be increased by 1.3 times or the lap splices may be staggered at least 24 bar diameters with no increase in length.
- C. Reinforcing bars shall be in place and reviewed by the OWNER before grouting shall begin.
- 3.03 TESTING NONE

SECTION 04 05 23 – MASONRY ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Rainscreen Drainage Planes:
 - 1. Full Stone Veneers:
 - a. 10MM Sure Cavity. (SCMM 2516 and SCMM 2532)
 - 2. Cladding (Cladded Siding):
 - a. Sure Cavity. (SC 5016 and SC 5032)
 - b. Sure Cavity No Fabric. (SC 5016NF and SC 5032NF)
 - c. Gravity Cavity. (GC 1816 and GC 1832)
 - d. Gravity Cavity No Fabric. (GC 1816NF and GC 1832NF)
- B. Single-Wythe (CMU or Jumbo Brick) Wall Drainage Plane:
 - I. Interior Above Grade (CMU or Jumbo Brick) Wall:
 - a. Perforated Control Cavity. (PCC 4816)
 - b. Perforated Control Cavity. (PCC 4832)
 - c. 10MM Perforated Control Cavity. (PCC 2416)
 - d. 10MM Perforated Control Cavity. (PCC 2432)
 - 2. Interior Below Grade Drainage Plane:
 - a. Control Cavity. (CC 4800)
 - b. 10MM Control Cavity. (CC 4810)
 - 3. Interior Below Grade (Basement) Floor Retrofit Cap Slab Slip Sheet/Drainage Plane:
 - a. Control Cavity. (CC 4800)
 - b. 10MM Control Cavity. (CC 4810)
- C. Exterior Horizontal Low Slope Drainage Plane and Slip Sheet:
 - 1. Sure Cavity. (SC 5016 & SC 5032)
- D. Window Rough Opening Sill Drainage Plane:
 - 1. Window Drainage Plane. (WDP 5000)
- E. Weep Systems:
 - 1. Full Stone Veneers:
 - a. Stone Cavity Weep. (SCV 5012)
 - b. Wall Opening Weeps. (WOW 9095)
 - 2. Steel Lintel:
 - a. Head Joint Weeps. (HJW 3845)
 - 3. Concealed Steel Lintel:
 - a. Concealed Steel Lintel/Shelf Angle Weep System. (CLW 9040)
 - 4. Shelf Angle:
 - a. Head Joint Weeps. (HJW 3845)
 - b. Vent Strip. (VS 3845)
 - 5. Concealed Shelf Angle:
 - a. Concealed Steel Lintel/Shelf Angle Weep System. (CLW 9040)
 - b. Vent Strip. (VS 3845)
- F. Masonry Accessories:
 - 1. L & R Weep Screed. (LR 3501)

- 2. Weep Screed Deflector. (WSD 1309)
- 3. Edge Metal. (MEM 3168)
- 4. Vented Edge Metal. (VMEM 3168)
- 5. Moisture Diverter. (DS 2858)
- 6. Mortar Belt. (MB 3550)
- 7. Trash Mortar Diverter. (TMD 9548)
- 8. Floor Edging. (FE 8555)
- 9. H Cove. (HC 3504)
- 10. Sump Basket. (SF30PR)

1.2 RELATED SECTIONS

A. Section 03 30 00 - Cast-in-Place Concrete.

1.3 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM C 1338 Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2008.
 - 2. ASTM D 1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics; 2010.
 - 3. ASTM D 4533 Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 1996 (2209).
 - 4. ASTM D 4632 Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 1991 (2008).
 - 5. ASTM D 4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products; 2000 (2007).
 - 6. ASTM SEQ CHAPTER 1E 96/E 96M Standard Test Methods for Water Vapor Transmission of Materials; 2005.
 - 7. ASTM E 2273 Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies; 2003.
 - 8. ASTM G 154 Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials; 2000a (2006).
- B. CAN/CGSB 148.1 No. 7.3 Methods of Testing Geotextiles and Geomembranes Grab Tensile Test for Geotextiles; 1992.
- C. ICC-ES EG 114 Low Temperature Flux.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 33 Submittal Procedures
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings: Provide drawings of special joint conditions.
- D. Sustainable Design Submittals:
 - 1. Submit invoices and documentation from manufacturer of the amounts of preconsumer and post-consumer recycled content for products specified.

- 2. Submit invoices and documentation showing manufacturing locations and origins of materials for products manufactured and sourced within 500 miles of project location.
- E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square representing actual product, color, and patterns.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 5-year experience manufacturing similar products.
- B. Installer Qualifications: Minimum 2-year experience installing similar products.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship is approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.

1.6 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to starting work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage and Handling Requirements: Store materials in clean, dry, inside area in accordance with manufacturer's instructions. Protect materials from damage during handling and installation.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.9 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.10 WARRANTY

A. Manufacturer Warranty: Submit manufacturer's standard 20-year limited warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Masonry Technology, Inc, which is located at: 24235 Electric St. P. O. Box 214; Cresco, IA 52136; Toll Free Tel: 800-879-3348; Tel: 563-547-1122; Fax: 563-547-1133; Email:request info (info@mtidry.com); Web:www.mtidry.com

- B. Substitutions: Not permitted.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 Product Requirements.

2.2 RAINSCREEN DRAINAGE PLANE - SURE CAVITY (SC 5016 and SC 5032)

- A. Description: Maintains separation between thin veneer cementitious materials and moisture resistance system on structural substrates creating drainage plane system for cavity moisture to drain down and out of wall.
- B. Materials: High impact polystyrene sheets, 0.024 inch (0.61 mm) thick, formed with corrugations and a spunbond polypropylene fabric, charcoal color, attached on one side with a 4 inch (102mm) overlapping skirt on one edge.
 - 1. Roll Length: 50 feet (15.24 m).
 - 2. Roll Width: 15.75 inches (324 mm) (SC5016).
 - 3. Roll Width: 31.5 inches (800 mm) (SC5032).
 - 4. Squared Channel Depth: 3/16 inch (4.76 mm).

C. Performance Criteria:

- 1. Fungi Resistance: No Growth; ASTM C 1338.
- 2. Ultra-Violet (UV) Exposure: No Peeling, chipping, cracking, flaking, pitting, crazing, erosion or other deleterious effects were observed under a 5X magnification; ASTM G 154
- 3. Drainage Efficiency with EIFS Cladding: Pass; ASTM E 2273.
- 4. Water Vapor Transmission: ASTM E 96/E 96M.
 - a. 9.60 grains/hr sq ft.
 - b. Permeance (perms) grains/hr sq ft 23.45 in Hg.
 - c. Permeability perm-inches 8.79.
- 5. Load: 583 lbf at 10 percent strain; ASTM D 1621.
- 6. Compressive Strength: 36.1 psi at 10 percent strain; ASTM D 1621.
- 7. Compressive Modulus: 362 psi; ASTM D 1621.
- 8. Fabric Tearing Strength: 42.2 lbs, maximum; ASTM D 4533.
- 9. Breaking Load: ASTM D 4632.
 - a. Machine Direction: 207 lbs.
 - b. Transverse Direction: 156 lbs.
- 10. Puncture Resistance: 44.4 lbs; ASTM D 4833.
- 11. Low Temperature Flex: No cracks in area of bend; ICC-ES EG 114.
- D. Description: Maintains separation between thin veneer cementitious materials and moisture resistance system on structural substrates creating drainage plane system for cavity moisture to drain down and out of wall
- E. Materials: High impact polystyrene sheets, 0.024 inch (0.61mm) thick, formed with corrugations and a spunbond polypropylene fabric, charcoal color, attached on one side with a 4 inch (102mm) overlapping skirt on one edge.
 - 1. Roll Length: 25 feet (7.6 m).
 - 2. Roll Width: 15.75 inches (324 mm) (SCMM2516).
 - 3. Roll Width: 31.5 inches (800 mm) (SCMM2532).
 - 4. Angled Channel Depth: 7/16 inch (11mm).
- F. Performance Criteria:

- 1. Fungi Resistance: No Growth; ASTM C 1338.
- 2. Ultra-violet (UV) Exposure: No Peeling, chipping, cracking, flaking, pitting, crazing, erosion or other deleterious effects were observed under a 5X magnification; ASTM G 154.
- 3. Drainage Efficiency with EIFS Cladding: Pass; ASTM E 2273.
- 4. Water Vapor Transmission: ASTM E 96/E 96M.
 - a. 4.14 grains/hr sq ft.
 - b. Permeance (perms) grains/hr sq ft 10.12 in Hg.
 - c. Permeability perm-inches 4.47.
- 5. Compressive Strength: At 10 percent strain; ASTM D 1621.
 - a. 4.9 psi (SCMM 2532).
 - b. 5.6 psi (SCMM 2516).
- 6. Puncture Resistance: 44.4 lbs; ASTM D 4833.
- 7. Low Temperature Flex: No cracks in area of bend; ICC-ES EG 114.
- 8. Tensile Strength: 10 kN/m; CAN/CGSB 148.1 No. 7.3.
- 9. Elongation at Maximum Load: 32 percent; CAN/CGSB 148.1 No. 7.3.

2.3 RAINSCREEN DRAINAGE PLANE - GRAVITY CAVITY (GC 1816 and GC 1832)

- A. Description: Maintains separation between thin veneer cementitious materials and moisture resistance system on structural substrates creating drainage plane system for cavity moisture to drain down and out of wall.
- B. Materials: High impact polystyrene sheets, 0.024 inch (0.61mm) thick, formed with corrugations and a spun bond polypropylene fabric, white color, attached on one side with a 4 inch (102 mm) overlapping skirt on one edge.
 - 1. Roll Length: 76 feet (23 m).
 - 2. Roll Width: 15.75 inches (324 mm) (GC 1816).
 - 3. Roll Width: 31.5 inches (800 mm) (GC 1832).
 - 4. Curved Channel Depth: 1/8 inch (3.25 mm).

C. Performance Criteria:

- 1. Fungi Resistance: No Growth; ASTM C 1338.
- 2. Ultra-Violet (UV) Exposure: No Peeling, chipping, cracking, flaking, pitting, crazing, erosion or other deleterious effects were observed under a 5X magnification; ASTM G 154.

2.4 CLADDING RAINSCREEN DRAINAGE PLANE - SURE CAVITY NO FABRIC (SC 5016NF & SC 5032NF)

- A. Description: Creates a 3/16 inch (4.8 mm) vertical void. A continuous and predictable separation between the backside of the rainscreen (cladding siding veneer) and the face of the (WRB, rigid insulation, etc.).
- B. Materials: High impact polystyrene sheets, 0.024 inch (0.61mm) thick, formed with corrugations.
 - 1. Roll Length: 50 feet (15.24 m).
 - 2. Roll Width: 15.75 inches (324 mm) (SC 5016NF).
 - 3. Roll Width: 31.5 inches (800 mm) (SC 5032NF).
 - 4. Squared Channel Depth: 3/16 inches (4.76mm).
- C. Performance Criteria:

- 1. Fungi Resistance: No Growth: ASTM C 1338.
- 2. Ultra-Violet (UV) Exposure: No peeling, chipping, cracking, flaking, pitting, crazing erosion or other deleterious effects were observed under a 5X magnification; ASTM G 154.
- 3. Drainage efficiency with EIFS Cladding: Pass; ASTM E 2273.
- 4. Water Vapor Transmission: ASTM E 96/E 96M.
 - a. 9.60 grains/hr sq ft.
 - b. Permeance (perms) grains/hr sq ft 23.45 in Hg.
 - c. Permeability perm-inches 8.79.
- 5. Load: 583 lbf at 10 percent strain; ASTM D 1621.
- 6. Compressive Strength: 36.1 psi at 10 percent strain; ASTM D 1621.
- 7. Compressive Modulus: 362 psi; ASTM D 1621.
- 8. Breaking Load: ASTM D 4632.
 - a. Machine Direction: 207 lbs.
 - b. Transverse Direction: 156 lbs.
- 9. Puncture Resistance: 44.4 lbs; ASTM D 4833.
- 10. Low Temperature Flex: No cracks in area of bend; ICC-ES EG 114.

2.5 CLADDING RAINSCREEN DRAINAGE PLANE - GRAVITY CAVITY NO FABRIC (GC 1816NF & GC 1832NF)

- A. Description: Creates a 1/8 inch (3.25 mm) vertical void. A continuous and predictable separation between the backside of the rainscreen (cladding/siding veneer) and the face of the (WRB, rigid insulation etc.).
- B. Materials: impact polystyrene sheets, 0.024 inch (0.61mm) thick, formed with corrugations.
 - 1. Roll Length: 76 feet.
 - 2. Roll Width: 15.75 inches (324 mm) (GC 1816NF)
 - 3. Roll Width: 31.5 inches (800 mm) (GC 1832NF)
 - 4. Curvred Channel Depth 1/8 inch (3.25mm).
- C. Performance Criteria:
 - 1. Fungi Resistance: No Growth; ASTM C 1338.
 - 2. Ultra-Violet (UV) Exposure: No peeling, chipping, cracking, flaking, pitting, crazing erosion or other deleterious effects were observed under a 5X magnification; ASTM G 154.

2.6 SINGLE-WYTHE MOISTURE CONTROL - PERFORATED CONTROL CAVITY (PCC 4816 & PCC 4832)

- A. Description: Maintains separation between interior surface of single-wythe concrete masonry unit (CMU) substrate and moisture sensitive interior finished walls creating drainage system that allows moisture to drain down and out of walls.
- B. Materials: High impact polystyrene sheets, 0.024 inch (0.61 mm) thick, formed with corrugations and a cross-woven polyolefin fabric, green color, attached on one side with a 4 inches (102 mm) overlapping skirt on one edge.
 - 1. Roll Length: 50 feet (15.24 m).
 - 2. Roll Width: 15.75 inches (324 mm) (PCC4816).
 - 3. Roll Width: 31.5 inches (800 mm) (PCC4832).
 - 4. Squared Channel Depth: 3/16 inch (4.76 mm).

- C. Performance Criteria:
 - 1. Fungi Resistance: No Growth; ASTM C 1338.
 - 2. Ultra-violet (UV) Exposure: No Peeling, chipping, cracking, flaking, pitting, crazing, erosion or other deleterious effects were observed under a 5X magnification; ASTM G 154
 - 3. Load: 583 lbf at 10 percent strain; ASTM D 1621.
 - a. Compressive Strength: 36.1 psi at 10 percent strain; ASTM D 1621.
 - b. Compressive Modulus: 362 psi; ASTM D 1621.

2.7 SINGLE-WYTHE MOISTURE CONTROL - 10mm PERFORATED CONTROL CAVITY (PCC 2416 & PCC 2432)

- A. Description: Maintains separation between interior surface of single-wythe concrete masonry unit (CMU) substrate and moisture sensitive interior finished walls creating drainage system that allows moisture to drain down and out of walls.
- B. Materials: High impact polystyrene sheets, 0.024 inch (0.61 mm) thick, formed with corrugations and a cross-woven polyolefin fabric, green color, attached on one side with a 4 inches (102 mm) overlapping skirt on one edge.
 - 1. Roll Length: 25 feet (7.62 m).
 - 2. Roll Width: 15.75 inches (324 mm) (PCC2416).
 - 3. Roll Width: 31.5 inches (800 mm) (PCC2432).
 - 4. Angled Channel Depth: 7/16 inch (11 mm).
- C. Performance Criteria:
 - 1. Fungi Resistance: No Growth; ASTM C 1338.
 - 2. Ultra-violet (UV) Exposure: No Peeling, chipping, cracking, flaking, pitting, crazing, erosion or other deleterious effects were observed under a 5X magnification; ASTM G 154
 - 3. Compressive Strength: At 10 percent strain; ASTM D 1621.
 - a. 4.9 psi (PCC 2432).
 - b. 5.6 psi (PCC 2416).

2.8 CAVITY DRAINAGE PLANES - CONTROL CAVITY (CC 4800)

- A. Description: Provides separation between wood framing, insulation and gypsum board from concrete or masonry wall substrates and providing ventilation of these cavities.
- B. Materials: High impact polystyrene sheets, 0.024 inch (0.61 mm) thick, formed with corrugations.
 - 1. Roll Length: 50 feet (15.24 m).
 - 2. Roll Width: 31.5 inches (800 mm).
 - 3. Squared Channel Depth: 3/16 inch (4.76 mm).
- C. Performance Criteria:
 - 1. Fungi Resistance: No Growth; ASTM C 1338.
 - 2. Ultra-violet (UV) Exposure: No Peeling, chipping, cracking, flaking, pitting, crazing, erosion or other deleterious effects were observed under a 5X magnification; ASTM G 154.
 - 3. Load: 583 lbf at 10 percent strain; ASTM D 1621.
 - a. Compressive Strength: 36.1 psi at 10 percent strain; ASTM D 1621.
 - b. Compressive Modulus: 362 psi; ASTM D 1621.

2.9 CAVITY DRAINAGE PLANES - 10mm CONTROL CAVITY (CC 4810)

- A. Description: Provides separation between wood framing, insulation and gypsum board from concrete or masonry wall substrates and providing ventilation of these cavities.
- B. Materials: High impact polystyrene sheets, 0.024 inch (0.61 mm) thick, formed with corrugations.
 - 1. Roll Length: 50 feet (15.24 m).
 - 2. Roll Width: 31.5 inches (800 mm).
 - 3. Angled Channel Depth: 7/16 inch (11mm).

C. Performance Criteria:

- 1. Fungi Resistance: No Growth; ASTM C 1338.
- 2. Ultra-violet (UV) Exposure: No Peeling, chipping, cracking, flaking, pitting, crazing, erosion or other deleterious effects were observed under a 5X magnification; ASTM G 154.
- 3. Compressive Strength: 5.4 psi at 10 percent strain; ASTM D 1621.

2.10 HORIZONTAL LOW SLOPE DRAINAGE PLANE AND SLIP SHEET FOR STONE OVERLAYS - SURE CAVITY (SC 5016 and SC 5032)

- A. Description: Creates a horizontal void between the bottom side of the stone overlay or overlay setting mortar and the waterproofing system. It is a drainage plane and a slip-sheet.
- B. Materials: High impact polystyrene sheets, 0.024 inch (0.61 mm) thick, formed with a 4 inches (102 mm) overlapping skirt on one edge.
 - 1. Roll Length: 50 feet (15.24 m).
 - 2. Roll Width: 15.75 inches (324 mm) (SC 5016).
 - 3. Roll Width: 31.5 inches (800 mm) (SC 5032).
 - 4. Squared Channel Depth: 3/16 inch (4.76mm).

C. Performance Criteria:

- 1. Resistance: No Growth; ASTM C 1338.
- 2. Ultra-violet (UV) Exposure: No peeling, chipping, cracking, flaking, pitting, crazing erosion or other deleterious effects were observed under a 5X magnification; ASTM G 154
- 3. Drainage Efficiency with EIFS Cladding: Pass; ASTM E 2273.
- 4. Water Vapor Transmission: ASTM E 96/E 96M.
 - a. 9.60 grains/hr sq ft.
 - b. Permeance (perms) grains/hr sq ft 23.45 in Hg.
 - c. Permeability perm-inches 8.79.
- 5. Load: 583 lbf at 10 percent strain; ASTM D 1621.
- 6. Compressive Strength: 36.1 psi at 10 percent strain; ASTM D 1621.
- 7. Compressive Modulus: 362 psi; ASTM D 1621.
- 8. Tearing Strength: 42.2 lbs, maximum; ASTM D 4533.
- 9. Breaking Load: ASTM D 4632
 - a. Machine Direction: 207 lbs.
 - b. Transverse Direction: 156 lbs.
- 10. Puncture Resistance: 44.4 lbs; ASTM D 4833.
- 11. Low Temperature Flex: No cracks in area of bend.

2.11 WINDOW SUB-SILL DRAINAGE PLANES WINDOW DRAINAGE PLANE (WDP 5000)

- A. Description: Creates a horizontal and vertical void that separates the bottom side of the window frame from the top (slope to drain) sill pan flashing and the back side of the veneer from the face of the sill pan flashing.
- B. Materials: High impact polystyrene sheets, 0.024 inch (0.61 mm) thick, formed with corrugations and bent into L-Shape, 5 inches (127 mm) wide by 9 inches (229 mm) high, to fit on top of sub-sill area of window rough opening prior to window installation.
 - 1. Length: 4 feet (1.2 m).
 - 2. Curved Channel Depth: 1/8 inch (3.25mm).
 - 3. Window Drainage Plane WDP 5000

C. Performance Criteria:

- 1. Fungi Resistance: No Growth; ASTM C 1338.
- 2. Ultra-Violet (UV) Exposure: No Peeling, chipping, cracking, flaking, pitting, crazing, erosion or other deleterious effects were observed under a 5X magnification; ASTM G 154.

2.12 WEEP SYSTEMS FOR FULL STONE VENEERS

- A. Stone Cavity Weep (SCV 5012):
 - 1. Description: Forms the bottom side of the bed joint of mortar to create tunnels/channels that reach from the face of the masonry unit (full depth stone 3 inches (76 mm)minimum 10 inches (254 mm) maximum) into the cavity at the backside of full depth stone veneer or into the vertical drainage plane (the rainscreen drainage plane) created by 10MM Sure Cavity (SCMM 2516 or SCMM 2532)
 - 2. Materials: High impact polystyrene sheets, 0.024 inch (0.61 mm) thick, formed with corrugations.
 - a. Weep Legs: 2-1/4 inches (57 mm) wide at 9-1/2 inches (242 mm) on center.
 - b. Continuous Belt Width: 1 inch (25 mm).
 - c. Overall Width: 12 inches (305 mm).
 - d. Length: 25 feet (7.62 m).
 - e. Squared Channel Depth: 3/16 inch (4.76 mm).
 - f. Color: Translucent.
 - 3. Performance Criteria:
 - a. Fungi Resistance: No Growth; ASTM C 1338.
 - b. Ultra-violet (UV) Exposure: No Cracking, checking, crazing, erosion or other characteristics that might affect performance; ASTM G 154.

B. Wall Opening Weeps (WOW 9095):

- 1. Description: Forms the bottom side of the bed joint of mortar to create tunnels/channels that reach from the face of the masonry unit (full depth stone 3 inch minimum to 6 inches (76 mm) maximum) into the cavity at the backside of the full depth stone veneer or into the vertical drainage plane (The rainscreen drainage plane) created by 10MM Sure Cavity (SCMM 2516 or SCMM 2532).
- 2. Materials: High impact polystyrene sheets, 0.024 inch (0.61 mm) thick, formed with corrugations and bent into L-Shape, 9 inches (229 mm) on one leg by 5 inches (127 mm) on other leg.
 - a. Width: 2 1/2 inches (63.5 mm).
 - b. Squared Channel Depth: 3/16 inch (4.76 mm).
 - c. Color: Translucent.
- 3. Performance Criteria:
 - a. Fungi Resistance: No Growth; ASTM C 1338.

b. Ultra-violet (UV) Exposure: No Cracking, checking, crazing, erosion or other characteristics that might affect performance; ASTM G 154.

2.13 WEEP SYSTEM FOR STEEL LINTEL

- A. Head Joint Weeps (HJW 3845):
 - 1. Description: Is a 3/8 inch x 3/8 inch spacer that is installed in each head joint of brick course laid dry on a flashing system that covers a steel lintel. It maintains a 3/8 inch high void in the bottom of the head joint of mortar from the exterior surface of the full brick veneer back into the vertical void created by the rainscreen drainage plane Sure Cavity (SC 5016/SC 5032), 10MM Sure Cavity (SCMM 2516/SCMM 2532) or Gravity Cavity (GC 1832).
 - 2. Materials: Acetac, 0.24 inch (0.6 mm) thick.
 - a. Width: 3/8 inch (9.5 mm).
 - b. Height: 3/8 inch (9.5 mm).
 - c. Length: 4 1/2 inches (114mm) to 9 inches (228 mm).
 - d. Color: Light gray.

2.14 WEEP SYSTEM FOR CONCEALED STEEL LINTEL

- A. Concealed Steel Lintel/Shelf Angle Weep System (CLW 9040):
 - Description: Forms the bottom side of the bed joint of mortar and the front nose of the bed joint of mortar to create tunnels/channels from behind the lip of a lip brick at the front of the steel lintel into the vertical void created by rainscreen drainage plane Sure Cavity (SC 5016/SC 5032) or 10MM Sure Cavity (SCMM 2516/SCMM 2532) or Gravity Cavity (GC 1832).
 - 2. Materials: High impact polystyrene sheets, 0.024 inch (0.61 mm) thick, formed with corrugations and bent into L-Shape, 5 inches (127 mm) or less on one leg by 9 inches (229 mm) or less on other leg.
 - a. Length: 4 feet (1.2 m).
 - b. Curved Channel Depth: 1/8 inch (3.25 mm).
 - 3. Performance Criteria:
 - a. Fungi Resistance: No Growth; ASTM C 1338.
 - b. Ultra-violet (UV) Exposure: No Peeling, chipping, cracking, flaking, pitting, crazing, erosion or other deleterious effects were observed under a 5X magnification; ASTM G 154.

2.15 WEEP SYSTEM FOR SHELF ANGLE

- A. Head Joint Weeps (HJW 3845):
 - 1. Description: Is a 3/8 inch x 3/8 inch spacer that is installed in each head joint of brick course laid dry on a flashing system that covers a shelf angle. It maintains a 3/8 inch high void in the bottom of the head joint of mortar from the exterior surface of the full brick veneer back into the vertical void created by the rainscreen drainage plane, Sure Cavity (SC 5016/SC 5032) or 10MM Sure Cavity (SCMM 2516/SCMM 2532) or Gravity Cavity (GC 1832).
 - 2. Materials: Acetac, 0.24 inch (0.6mm) thick.
 - a. Width: 3/8 inch (9.5 mm).
 - b. Height: 3/8 inch (9.5 mm).
 - c. Length: 4-1/2 inches (114 mm) to 9 inches (228 mm)
 - d. Color: Light gray.

B. Vent Strip (VS 3845):

- Description: Forms a flexible joint and maintains ventilation opening at top of masonry veneer or underside of the expansion pad mounted on the underside of the shelf angle from outside surface of the brick veneer into the cavity of the full brick veneer or into the vertical drainage plane created by the rainscreen drainage plane Sure Cavity (SC 5016/SC 5032) or 10MM Sure Cavity (SCMM 2516/SCMM 2532) or Gravity Cavity (GC 1832).
- 2. Materials: High impact polystyrene sheets, 0.024 inch (0.61mm) thick, formed with corrugations.
 - a. Width: 4-5/8 inch (117 mm).
 - b. Length: 50 feet (15.2 m)
 - c. Curved Channel Depth: 1/8 inch (3.25 mm).
- 3. Performance Criteria:
 - a. Fungi Resistance: No Growth; ASTM C 1338.
 - b. Ultra-violet (UV) Exposure: No Peeling, chipping, cracking, flaking, pitting, crazing, erosion or other deleterious effects were observed under a 5X magnification; ASTM G 154.

2.16 WEEP SYSTEM FOR CONCEALED SHELF

- A. Concealed Steel Lintel/Shelf Angle Weep System (CLW 9040):
 - 1. Description: Forms the bottom side of the bed joint of mortar and the front nose of the bed joint of mortar to create tunnel / channels from behind the lip of a lip brick at front of the steel lintel into the vertical void created by rainscreen drainage plane Sure Cavity (SC 5016/SC 5032) or 10MM Sure Cavity (SCMM 2516 /SCMM 2532) or Gravity Cavity (GC 1832).
 - 2. Materials: High impact polystyrene sheets, 0.024 inch (0.61 mm) thick, formed with corrugations and bent into L-Shape, 5 inches (127 mm) or less on one leg by 9 inches (229 mm) or less on other leg.
 - a. Length: 4 feet (1.2 m).
 - b. Curved Channel Depth: 1/8 inch (3.25 mm).
 - 3. Performance Criteria:
 - a. Fungi Resistance: No Growth; ASTM C 1338.
 - b. Ultra-violet (UV) Exposure: No Peeling, chipping, cracking, flaking, pitting, crazing, erosion or other deleterious effects were observed under a 5X magnification; ASTM G 154.

B. Vent Strip (VS 3845):

- 1. Description: Forms flexible joint and maintains ventilation opening at top of masonry veneer or underside of the expansion pad mounted on the underside of the shelf angle from outside surface of the full brick veneer into the cavity of the full brick veneer or into the vertical drainage plane created by the rainscreen drainage plane, Sure Cavity (SC 501/SC 5032) or 10MM Sure Cavity (SCMM 2516/SCMM 2532) or Gravity Cavity (GC 1832).
- 2. Materials: High impact polystyrene sheets, 0.024 inch (0.61 mm) thick, formed with corrugations.
 - a. Width: 4-5/8 inch (117 mm).
 - b. Length: 50 feet (15.2 m)
 - c. Curved Channel Depth: 1/8 inch (3.25 mm).
- 3. Performance Criteria:
 - a. Fungi Resistance: No Growth; ASTM C 1338.

b. Ultra-violet (UV) Exposure: No Peeling, chipping, cracking, flaking, pitting, crazing, erosion or other deleterious effects were observed under a 5X magnification; ASTM G 154.

2.17 MASONRY ACCESSORIES

- A. L & R Weep Screed (LR 3501):
 - 1. Description: A sheet metal device that creates a bottom of thin veneer wall termination detail that encapsulates and weeps the bottom edge of the WRB, the bottom edge of the rainscreen drainage plane Sure Cavity (SC 5016 / SC 5032) or Gravity Cavity (GC 1832). The bottom edge of the self-furring expanded metal lath and scratch coat, a metal detail that bridges the construction joint created by the bottom of the wall sheathing and the top outside edge of the foundation wall.
 - 2. Material: 26 gauge galvanized steel, bent into "V" shaped channel, with a long vertical leg and a short leg at 70 degree angle out from other leg and slots punched into bottom edge.
 - a. Length of Long Vertical Leg: 3-1/2 inches (38 mm).
 - b. Anchor Holes in Vertical Leg: 3/16 inch (4.76 mm) diameter.
 - 1) Vertical Spacing: 1-5/16 inches (33.3 mm) apart.
 - 2) Horizontal Spacing: 2-3/4 inches (69.8 mm) apart.
 - c. Length of Short Leg: 1-1/32 inch (26.19 mm).
 - d. Length of Slots: 1 inch (25.4 mm).
 - e. Space between Slots: 1-3/4 inches (44 mm).
 - f. Length: 8 feet (2.4 m).
- B. Weep Screed Deflector (WSD 1309):
 - 1. Description: Formed metal termination material that provides mechanical termite barrier, used with weep screed to deflect drainage water away from foundation wall.
 - 2. Material: 26 gauge galvanized steel, bent into "L" shaped channel, with long vertical leg and short leg at 120 degree angle out from other leg.
 - a. Length of Long Vertical Leg: 3 1/2 inches (88.9 mm).
 - b. Anchor Holes in Vertical Leg: 3/16 inch (4.76 mm) diameter.
 - 1) Vertical Spacing: 1-5/16 inches (33.3mm) apart.
 - 2) Horizontal Spacing: 2-3/4 inches (69.8mm) apart.
 - c. Length of Short Leg: 51/64 inch (20.24 mm)
 - d. Length: 8 feet (2.4m).
- C. MTI Edge Metal (MEM 3168):
 - 1. Description: Formed metal termination to accommodate rainscreen drainage plane material.
 - 2. Material: 26 gauge galvanized steel, bent into "J" shaped channel, with long vertical leg and short leg at 5 degree angle out from other leg.
 - a. Length of Long Vertical Leg: 3-21/32 inches (92.9 mm).
 - b. Anchor Holes in Vertical Leg: 3/16 inch (4.76 mm) diameter
 - 1) Vertical Spacing: 1-5/16 inches (33.3 mm) apart.
 - 2) Horizontal Spacing: 2-3/4 inches (69.8 mm) apart.
 - c. Length of Short Leg: 3/8 inch (9.5mm)
 - d. Width at Bottom: 11/32 inch (8.6mm).
 - e. Length: 8 feet (2.4m).
- D. Vented MTI Edge Metal (VMEM 3168):
 - 1. Description: Formed metal termination to accommodate rainscreen drainage plane

- material and weep.
- 2. Material: 26 gauge galvanized steel, bent into "J" shaped channel, with long vertical leg and short leg at 5 degree angle out from other leg and slots punched into bottom edge.
 - a. Length of Long Vertical Leg: 3-21/32 inches (92.9 mm).
 - b. Anchor Holes in Vertical Leg: 3/16 inch (4.76 mm) diameter
 - 1) Vertical Spacing: 1-5/16 inches (33.3mm) apart.
 - 2) Horizontal Spacing: 2-3/4 inches (69.8 mm) apart.
 - c. Length of Short Leg: 3/8 inch (9.5 mm)
 - d. Width at Bottom: 11/32 inch (8.6 mm).
 - e. Length of Slots: 1 inch (25.4 mm)
 - f. Space Between Slots: 1.75 inches (44.45 mm).
 - g. Length: 8 feet (2.4 m).

E. Moisture Diverter (DS 2858):

- 1. Description: Forms a diversion for moisture above wall openings such as windows and doors, directing the moisture to one side of opening and away from these moisture sensitive wall details.
- 2. Materials: 26 gauge galvanized steel, bent into "L" shaped channel, with long vertical leg and short leg at 65 degree angle out from other leg.
 - a. Length of Long Vertical Leg: 1-7/8 inches (47.6 mm).
 - b. Length of Short Leg: 5/8 inch (15.9 mm)
 - c. Length: 4 feet (1.2 m).

F. Mortar Belt (MB 3550):

- 1. Description: Forms a barrier within cores of CMU to suspend and trap mortar occurring within cells.
- 2. Materials: High impact polystyrene sheets, 0.024 inch (0.61mm) thick, formed with corrugations.
 - a. Width: 3-1/2 inch (89 mm).
 - b. Length: 50 feet (15.2 m).
 - c. Squared Channel Depth: 3/16 inch (4.76 mm).
 - d. Color: Black.
- 3. Performance Criteria:
 - a. Fungi Resistance: No Growth; ASTM C 1338.
 - b. Ultra-violet (UV) Exposure: No Peeling, chipping, cracking, flaking, pitting, crazing, erosion or other deleterious effects were observed under a 5X magnification; ASTM G 154.

G. Trash Mortar Diverter (TMD 9548):

- 1. Description: Formed in a "V" Shape to hold and encapsulate trash mortar and prevent mortar bridging within 1-1/2 inch (38.1 mm) to 3 inches (76.2 mm) wide cavity air space.
- 2. Materials: High impact polystyrene sheets, 0.024 inch (0.61 mm) thick, formed with corrugations and bent into V-Shape, with 8-1/2 inches (216 mm) back leg and 5-1/2 inch (140 mm) front leg. Contains weep holes at 2-1/2 inches (63.5 mm) on center in bottom of "V" and at 1 inch (25.4 mm) on center up each leg.
 - a. Length: 4 feet (1.2 m).
 - b. Squared Channel Depth: 3/16 inch (4.76 mm).
 - c. Color: Black.
- 3. Performance Criteria:

- a. Fungi Resistance: No Growth; ASTM C 1338.
- b. Ultra-violet (UV) Exposure: No Peeling, chipping, cracking, flaking, pitting, crazing, erosion or other deleterious effects were observed under a 5X magnification; ASTM G 154.

H. Floor Edging (FE 8555):

- 1. Description: Forms horizontal and vertical ventilation channels at edge of concrete floors at foundation walls and prevents attachment, moisture and thermal transfer, and shrinkage cracking along this edge.
- 2. Materials: High impact polystyrene sheets, 0.024 inch (0.61 mm) thick, formed with corrugations and bent into L-Shape, with 9 inches (229 mm) on one leg by 5 inches (127 mm) on other leg.
 - a. Length: 4 feet (1.2 m).
 - b. Squared Channel Depth: 3/16 inch (4.76 mm).
 - c. Color: Black.
- 3. Performance Criteria:
 - a. Fungi Resistance: No Growth; ASTM C 1338.
 - b. Ultra-violet (UV) Exposure: No Peeling, chipping, cracking, flaking, pitting, crazing, erosion or other deleterious effects were observed under a 5X magnification; ASTM G 154.

I. H Cove (HC 3504):

- 1. Description: Forms displacement channel at edge of slab concrete for wet basement renovations creating passageway for water to flow to gas sealed sump basket.
- 2. Material: Extruded PVC, 0.06 inch (1.52 mm) thick and in an "h" shape to sit on top of footing with vertical leg against the foundation wall.
 - a. Length of Vertical Leg: 3.03 inches (79.96 mm).
 - b. Radius of Cove: 1-11/16 inches (43.13 mm).
 - c. Width at Bottom: 3-3/8 inches (86.49 mm).
 - d. Vertical Offset from Front to Rear: 1/2 inch (13.21 mm).
 - e. Length: 4 feet (1.2 m).

J. Sump Basket (SF30PR):

- 1. Description: Formed tall basket with non-corrosive, nylon encapsulated inserts to protect stainless steel bolts and washers. Lid of basket is thick and strong with an easy grab handle and provides access panel for sump pump and electrical supply, gas tight with gaskets, and provides water discharge and gas vent port.
- 2. Materials: Structural foam.
 - a. Diameter: 18 inches (457 mm).
 - b. Height: 30 inches (762 mm).
 - c. Capacity: 30 gallons (114 L).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 VERIFICATION OF CONDITIONS

- A. Verify that field conditions are acceptable and are ready to receive this work.
- B. Verify that related items provided under other sections are properly sized and located.

3.4 DRAINAGE PLANE INSTALLATION

- A. Install systems in accordance with manufacturer's instructions and as follows.
 - 1. Rainscreen Drainage Planes for Full Brick Veneers:
 - a. Install first course of rainscreen drainage plane with fabric side facing to weather with 4 inches (102 mm) fabric skirt overlapping continuous belt of Cavity Weep (CV 5010).
 - b. Install successive courses so 4 inches (102 mm) long fabric skirt overlaps top edge of lower course of rainscreen drainage plane -- Sure Cavity (SC 5016 or SC 5032), 10MM Sure Cavity (SCMM 2516 or SCMM 2532), or Gravity Cavity (GC 1816 or GC 1832).
 - c. Install weeps for full brick veneers, Cavity Weep (CV 5010), atop flashing with continuous belt centered in cavity and weep legs extending out from exposed face of full brick veneer a minimum of 1 inch to 1-1/2 inches (25 mm to 38 mm).
 - d. As an Contractor Option to Cavity Weep (CV 5010) at the bottom of wall and as a weep system to accommodate the top of wall openings details, install Wall Opening Weeps (WOW 9095), 10-1/2 inches (267 mm) on center with appropriate leg 5 inches or 9 inches (127 mm or 229 mm) extending up the backup wall behind Sure Cavity (SC 5016 or SC 5032), 10MM Sure Cavity (SCMM 2516 or SCMM 2532), or Gravity Cavity (GC 1816 or GC 1832) and horizontal leg 5 inches or 9 inches (127 mm or 229 mm) extending out from face of brick veneer a minimum of 1 inch or 1-1/2 inches (25 mm or 38 mm).
 - e. Tool joints and lightly score weep legs at face of brick veneer and crack off by pushing downward while mortar is still plastic.
 - f. Finish tool joints and brush brick wall.
 - g. Install the required accessories to accommodate wall opening and top of wall detail etc.
 - 2. Rainscreen Drainage Planes for Full Stone Veneers: 10MM Sure Cavity (SCMM 2516 or SCMM 2532)
 - a. Install first course of rainscreen drainage plane over appropriate weather resistant barrier (WRB) and flashing system with fabric side facing to weather with 4 inches (102 mm) fabric skirt overlapping continuous belt of Stone Cavity Weep (SCV 5012).
 - b. Install successive courses so 4 inches (102 mm) long fabric skirt overlaps top edge of lower course of rainscreen drainage plane -- Sure Cavity (SC 5016 or SC 5032), 10MM Sure Cavity (SCMM 2516 or SCMM 2532), or Gravity Cavity (GC 1816 or GC 1832).
 - c. Install weeps for full veneers, Stone Cavity Weep (SCV 5012), atop flashing with continuous belt 1/2 inch (12 mm) from rear of cavity and weep legs extending out from exterior face of full stone veneer.

- d. As an Contractor Option to Stone Cavity Weep (SCV 5012) at the bottom of wall and as a weep system to accommodate the top of wall opening details, install Wall Opening Weeps (WOW 9095), 10-1/2 inches (267 mm) on center with appropriate leg 5 inches or 9 inches (127 mm or 229 mm) extending up the backup wall behind 10MM Sure Cavity (SCMM 2516 or SCMM 2532) and horizontal leg 5 inches or 9 inches (127 mm or 229 mm) extending out from the exterior face of full stone veneer a minimum of 1 inch to 1 1/2 inches (25mm to 38mm).
- e. Install mortar bed joint atop weep assembly and lay stone veneer.
- f. Tool joints and lightly score weep legs at face of stone veneer and crack off by pushing downward while mortar is still plastic.
- g. Finish tool joints and brush stone wall.
- h. Install the required accessories to accommodate wall opening and top of wall detail etc.
- 3. Rainscreen Drainage Plane for (Adhered) Thin Brick, Thin Manmade Stone, Thin Natural Stone, and for Three-Course Stucco Veneers.
 - a. Weep Screed L & R Weep Screed (LR 3501)
 - Install L & R Weep Screed at bottom of (adhered) thin brick, thin stone, thin natural stone or three-course stucco veneer wall with a 3-1/2 inches (89 mm) back flange transitioning the construction joint created by the top outside corner of the foundation wall and the bottom edge of the wall sheathing.
 - 2) The 3-1/2 inches (89 mm) back flange should be fastened to the framed sheathing only with approximately 1-1/2 to 2 inches (38 to 50.8 mm) overlapping down over face of foundation.
 - b. Rainscreen Drainage Plane: Sure Cavity (SC 5016 or SC 5032) or Gravity Cavity (GC 1816 or GC 1832).
 - 1) Install Cavity or Gravity Cavity over acceptable weather resistant barrier (WRB) and flashing system, with fabric side facing to weather.
 - 2) Back wrap 4 inches (102 mm) fabric skirt at bottom edge.
 - 3) Sure Cavity or Gravity Cavity and the WRB should overlap 3-1/2 inches (89 mm) back flange of L & R Weep Screed (LR 3501).
 - 4) The back wrapped bottom edge of Sure Cavity or Gravity Cavity should be fully embedded in bottom of L & R Weep Screed.
 - c. Wall Opening Weeps (WOW 9095)
 - 1) Install Wall Opening Weeps (WOW 9095) with 9 inches (229 mm) vertical leg up on wall on weather resistant barrier (WRB) and flashing and 5 inches (127 mm) horizontal down on flashing and extending perpendicular out from face of wall 10-1/2 inches (267 mm) on center.
 - 2) Clean out mortar from top slot of horizontal leg between application of scratch coat and adhering and joint grouting mortar application. Cut off horizontal leg at wall line while grouting mortar is still plastic and finish tool joint.
- 4. Rainscreen Drainage Plane for Cladded Siding
 - a. Install Sure Cavity (SC 5016) (SC 5032) or (SC 5016NF) (SC 5032NF) or Gravity Cavity (GC 1816) (GC 1832) or (GC 1816NF) (GC 1832NF) with fabric facing to the weather (if fabric specified) over the appropriate weather resistant barrier (WRB) or rigid insulation, etc.
 - b. Install Sure Cavity or Gravity Cavity with 4 inches (102 mm) fabric skirt back wrapped as a bug screen on the bottom of first course (for both fabric and nonfabric systems).

- c. Install Vented MTI Edge Metal (VMEM 3168) with 3 inches (76 mm) back flange transitioning the construction joint created by the top outside corner of the foundation wall and the bottom edge of the wall sheathing.
- d. The 3 inches (76 mm) back flange shall be fastened to the framing sheathing only with approximately 1 inch (25 mm) overlapping down over the face of the foundation.
- e. Install back-wrapped bottom edge of the first course of Sure Cavity or Gravity Cavity into the bottom of "J" channel of the Vented MTI Edge Metal.
- f. Install successive courses of Sure Cavity or Gravity Cavity with 4 inches (102 mm) fabric skirt overlapping the top edge of the previous course.
- g. Install the required siding starter strip over the bottom edge of Sure Cavity or Gravity Cavity installed in the Vented MTI Edge Metal.
- h. Install cladded siding.
- 5. Drainage Plane for the Interior Surface of an Above Grade Single-Wythe (CMU or Jumbo Brick) Wall:
 - a. Install Perforated Control Cavity (PCC 4816 and PCC 4832) or 10MM Perforated Control Cavity (PCC 2416 PCC 2432) with the fabric facing to the interior of the living area.
 - b. Install Perforated Control Cavity with the 4 inches (102 mm) fabric skirt tucked behind the top edge of the fabric of the course below it.
 - c. Fasten Perforated Control Cavity 1 feet (305 mm) on center.
 - d. Install first course of Perforated Control Cavity with the 4 inches (102 mm) fabric skirt back wrapped.
 - e. Install of Perforated Control Cavity with the bottom edge approximately 4 inches to 6 inches (102 mm to 152 mm) below bottom elevation or concrete floor
 - f. Install the first course of Perforated Control Cavity with the bottom edge into the drain field of the perimeter sub slab drain field drain tile system.
 - g. All wall openings shall be furred out to meet approximate interior finish plane.
 - h. Install Perforated Control Cavity with the edges abutting furred outsides and bottoms of all openings.
 - i. Install Moisture Diverter (DS 2858) with a 1/4 inch (6.24 mm) slope to drain per foot to the interior surface of single wythe wall, approximately 4 inches to 6 inches (102 mm to 152 mm) above furred out wall openings, with the ends of the moisture diverter extending 4 inches to 6 inches (102 mm to 152 mm) passed the outside edge of wall opening side furring.
 - j. Install approximately 4 inches to 6 inches (102 mm to 152 mm) wide flashing tape over top edge of the Moisture Diverter (DS 2858).
 - k. Install corrugated plastic bottom edge of Perforated Control Cavity into Moisture Diverter (DS 2858) with 4 inches (102 mm) fabric skirt overlapping Moisture Diverter.
- 6. Drainage Planes for Interior of Below Grade (Basement) Walls and Concrete Floor Overlay Concrete Cap Slabs:
 - a. Install Control Cavity (CC 4800) or 10MM Control Cavity (CC 4810) to the interior of basement walls.
 - b. Fasten Control Cavity 1 foot (305 mm) on center.
 - c. Overlap bottom edge of first course 1 inch to 2 inches (25 mm to 51 mm); start coursing at top of wall.
 - d. Overlap ends 1 inch to 2 inches (25 mm to 51 mm).
 - e. Position bottom edge of bottom course of Control Cavity behind vertical leg of Floor Edging (FE 8555) on top surface of footing with the outside horizontal

leg extending past the interior edge of footings.

- 7. Horizontal Drainage Planes for Interior Below Grade Basement Floor Retrofit Cap Slab Slip Sheet/Drainage Plane:
 - a. Install Control Cavity (CC 4800) or 10MM Control Cavity (CC 4810) to prepared basement floor.
 - b. Fasten Control Cavity as required to control movement when installing cap slab.
 - c. Overlap edges and ends 2 inches to 3 inches (51 mm to 76 mm).
 - d. Overlap floor edging (FE 8555) at perimeters 4 inches to 5 inches (102 mm to 127 mm).
 - e. Install cap slab.
- 8. Horizontal Drainage Planes and Slip Sheets Low Slope Stone Overlays on Verandas:
 - a. Install Sure Cavity (SC 5016 SC 5032) to low slope horizontal waterproofing system on deck of veranda.
 - b. Lay loose, do not fasten.
 - c. Overlap shingle-fashion with slope.
 - d. Install stone bedding mortar and stone.
- 9. Window Sub-Sill Drainage Plane (Rainscreen Drainage Plane for Window Rough Opening Sill. View examples at http://www.mtidry.com/hyperspecs/ and Wall Openings.
 - a. Install Window Drainage Plane (WDP 5000) on the horizontal and vertical surfaces of the waterproofing system (sill pan) at bottom of window rough opening.
 - b. Minimize fastening vertical leg only.
 - c. Fabricate horizontal leg of window drainage plane to fit dimensions of horizontal plane of rough opening.
 - d. Install window.

3.5 WEEP SYSTEM INSTALLATION

- A. Install systems in accordance with manufacturer's instructions and as follows:
 - 1. Weep System for Full Brick Veneers:
 - a. Rainscreen Drainage Plane: Sure Cavity (SC 5016 or SC 5032), 10MM Sure Cavity (SCMM 2516 or SCMM 2532) or Gravity Cavity (GC 1832)
 - 1) Install rainscreen drainage plane with fabric side facing to weather with 4 inches (102 mm) fabric skirt overlapping continuous belt of Cavity Weep (CV 5010).
 - 2) Install 4 inches (102 mm) fabric skirt to overlap top edge of lower course of rainscreen drainage plane, Sure Cavity (SC 5016 or SC 5032), 10MM Sure Cavity (SCMM 2516 or SCMM 2532) or Gravity Cavity (GC 1832).
 - b. Install weeps for full brick veneers, Cavity Weep (CV5010) atop flashing with continuous belt centered in cavity and weep legs extending out from exposed face of full brick veneer a minimum of 1 inch to 1-1/2 inches (25 mm to 38 mm).
 - c. As an Contractor Option to Cavity Weep (CV 5010), at the bottom of wall and as a weep system to accommodate the top of wall openings details, install Wall Opening Weeps (WOW 9095) 10-1/2 inches (267 mm) on center with appropriate leg 5 inches or 9 inches (127 mm or 229 mm) extending up the backup wall behind Sure Cavity (SC 5016 or SC 5032), 10MM Sure Cavity (SCMM 2516 or SCMM 2532), or Gravity Cavity (GC 1832) and horizontal

- leg 5 inches or 9 inches (127 mm or 229 mm) extending out from face of full brick veneer a minimum of 1 inch to 1-1/2 inches (25 mm to 38 mm).
- d. Install mortar bed joint atop weep assembly and lay brick veneer.
- e. Tool joints and lightly score weep legs at face of full brick veneer and crack off by pushing downward while mortar is still plastic.
- f. Finish-tool joints and brush brick wall.
- g. Install required accessories to accommodate wall opening and top of wall detail, etc.
- 2. Weep Systems for Full Stone Veneers:
 - a. Rainscreen Drainage Plane: 10MM Sure Cavity (SCMM 2516 or SCMM 2532).
 - 1) Install rainscreen drainage plane over appropriate weather resistant barrier (WRB) and flashing system with fabric side facing to weather with 4 inches (102 mm) fabric skirt overlapping continuous belt of Stone Cavity Weep (SCV 5012).
 - 2) Install 4 inches (102 mm) fabric skirt to overlap top edge of lower course of rainscreen drainage plane 10MM Sure Cavity (SCMM 2516 or SCMM 2532).
 - b. Install weeps for full stone veneers, Stone Cavity Weep (SCV 5012), atop flashing with continuous belt 1/2 inch (12 mm) from rear of cavity and weep legs extending out from exterior face of full stone veneer.
 - c. As an Contractor Option to Stone Cavity Weep (SCV 5012) at the bottom of wall and as a weep system to accommodate the top of wall opening details, install Wall Opening Weeps (WOW 9095), 10-1/2 inches (267 mm) on center with appropriate leg 5 inches or 9 inches (127 mm or 229 mm) extending up the backup wall behind 10MM Sure Cavity (SCMM 2516 or SCMM 2532) and horizontal leg 5 inches or 9 inches (127 mm or 229 mm) extending out from the exterior face of full stone veneer a minimum of 1 inch to 1-1/2 inches (25 mm to 38 mm).
 - d. Install mortar bed joint atop weep assembly and lay full stone veneer.
 - e. Tool joints and lightly score weep legs along face of full stone veneer and crack off by pushing downward while mortar is still plastic.
 - f. Finish-tool joints and brush stone wall.
 - g. Install required accessories to accommodate wall opening and top of wall details.
- 3. Weep Systems for Adhered Thin Brick, Thin Manmade Stone, Thin Natural Stone and Three Course Stucco Veneers.
 - a. Weep Screed L & R Weep Screed (LR 3501)
 - Install L & R Weep Screed at bottom of adhered thin brick veneer wall, with 3-1/2 inches (88.9 mm) back flange transitioning the construction joint created by the top outside corner of the foundation wall and the bottom edge of the wall sheathing.
 - 2) The 3-1/2 inches (88.9 mm) back flange shall be fastened to the framed sheathing only, with approximately 1-1/2 to 2 inches (38 to 50.8 mm) overlapping down over face of foundation.
 - b. Rainscreen Drainage Plane: Sure Cavity (SC 5016 or SC 5032) or Gravity Cavity (GC 1832)
 - 1) Install Sure Cavity or Gravity Cavity over appropriate weather resistant barrier (WRB) and flashing system with fabric side facing to weather.
 - 2) Back wrap 4 inches (102 mm) fabric skirt at bottom edge.
 - 3) Sure Cavity or Gravity Cavity and the WRB shall overlap 3-1/2 inches

- (88.9) back flange of L & R Weep Screed (LR 3501).
- 4) The back wrapped bottom edge of Sure Cavity or Gravity Cavity should be fully embedded in bottom of L & R Weep Screed.
- c. Wall Opening Weeps (WOW 9095):
 - 1) Install Wall Opening Weeps (WOW 9095) with 9 inches (229 mm) vertical leg up on wall on weather resistant barrier (WRB) and flashing and 5 inches (127 mm) horizontal leg down on flashing and extending perpendicular out from face of wall, 10-1/2 (267 mm) inches on center.
 - 2) Clean out excess mortar from top slot of horizontal leg between application of scratch coat and adhering and joint grouting mortar application. Cut off horizontal leg at wall line while grouting mortar is still plastic and finish tooling mortar joint.
- 4. Weep Systems for Hollow Core Masonry Units (CMU Jumbo Brick) as a Single Wythe Wall:
 - a. Cavity Weep (CV 5010) installed in conjunction with a through wall Z flashing system. Installed on the first course above a bond beam.
 - 1) Install Cavity Weep (CV 5010) on the lower horizontal surface of the Z flashing.
 - 2) Position Cavity Weep (CV 5010) with the back of the 1 inch (25 mm) continuous belt 1/2 inch (12 mm) from the vertical surface of the Z flashing and the 6 inches (152 mm) legs extending out from the exterior face of the wall.
 - 3) Cut down to the appropriate height Sure Cavity (SC 5016) or 10MM Sure Cavity (SCMM 2516) and install to the vertical surface of Z flashing trim 4 inches (102 mm) fabric skirt to overlay Cavity Weeps 1 inch (25 mm) continuous belt.
 - 4) Install mortar bed joint atop weep system and lay CMU.
 - 5) Tool joints and lightly score weep legs along face of CMU wall and crack off by pushing downward while mortar s still plastic.
 - 6) Finish-tool joints and brush wall
 - 7) Install required accessories to accommodate wall opening and top of wall details.
 - b. Cavity Weep (CV 5010) install on the top of a CMU bond beam with the top surface of the grouted bond beam struck off with a 1/4 inch (6 mm) slope to drain to the exterior of the wall.
 - 1) Install Cavity Weep (CV 5010) on the top surface of the sloped to drain water proofed bond beam.
 - 2) Center 1 inch (25 mm) continuous belt of Cavity Weep on CMU wall with 6 inches (152 mm) legs extended out past the exterior surface of the wall.
 - 3) Install mortar bed joint atop weep system and lay CMU.
 - 4) Tool joint and lightly score weep leg along face of CMU wall and crack off by pushing downward while mortar is still plastic.
 - 5) Finish-tool joints and brush wall.
 - 6) Install required accessories to accommodate wall opening and top of wall details.
- 5. Weep System for Hollow Core Masonry Units (CMU Jumbo Brick) as a Veneer.
 - a. Rainscreen Drainage Plane: Sure Cavity (SC 5016 or SC 5032), 10MM Sure Cavity (SCMM 2516 or SCMM 2532) or Gravity Cavity (GC 1832).
 - 1) Install Sure Cavity or Gravity Cavity with fabric side facing the weather with 4 inches (102 mm) fabric skirt over lapping the ends of the legs of

- the Core Cavity Weep (CCV 5020) that extend into the cavity.
- b. Core Cavity Weep (CCV 5020):
 - 1) Install Core Cavity (CCV 5020 on a water stop / flashing at the bottom of an open core of a CMU wall designed and constructed as a veneer.
 - 2) Position Core Cavity Weep (CCV 5020) with the 1-1/2 inches (38 mm) center belt centered on the open core of the CMU used as a veneer. Core / Cell of veneer CMU shall be a minimum of 3 inches (76 mm) inside diameter with one of the opposing weep legs extending into the cavity and other opposing leg extending out past the exterior face of the veneer wall.
 - 3) Install mortar bed joints atop weep system and lay CMU.
 - 4) Tool joints and lightly score weep legs along exterior face of CMU veneer wall and crack off by pushing downward while mortar is still plastic.
 - 5) Finish-tool joints and brush CMU veneer wall.
 - 6) Install required accessories to accommodate wall opening and top of wall details.
- 6. Weep Systems for Hollow Core Masonry Units (CMU Jumbo Brick) as a Below-Grade Foundation Wall:
 - a. Vent Mat (VM 9025):
 - 1) Install Vent Mat (VM 9025) on footing with the 1-1/2 inches (38 mm) continuous belt centered on wall with the weep legs extending past the interior face of the CMU wall and over the interior edge of the footing.
 - 2) Install mortar bed joint atop weep system and lay CMU.
 - 3) Finish-tool joints and clean excess mortar off footing.
 - 4) Install required accessories to accommodate wall opening and top of wall details.
- 7. Weep System for Steel Lintels (When masonry units are laid dry/no bed joint of mortar on flashing):
 - a. Rainscreen Drainage Plane: Sure Cavity (SC 5016 or SC 5032), 10MM Sure Cavity (SCMM 2516 or SCMM 2532) or Gravity Cavity (GC 1832).
 - 1) Install Sure Cavity or Gravity Cavity on vertical surface of flashing, WRB and vertical leg of steel lintel with 4 inches 9102 mm) fabric skirt overlapping the back ends of the Head Joint Weeps (HJW 3845).
 - 2) Trim 4 inches (102 mm) fabric skirt to appropriate length.
 - b. Head Joint Weeps (HJW 3845):
 - 1) Install Head Joint Weeps as spacers at each head joint, beginning with the first head joint on steel lintel.
 - Position Head Joint Weeps with the front end flush with the exterior face
 of full brick veneer and the back end extending into cavity or vertical
 void created by Sure Cavity or Gravity Cavity.
 - 3) Strengthen up first course of masonry units.
 - 4) Spread bed joint of mortar on top of first course of masonry units.
 - 5) Tuckpoint bed joint of mortar into head joints.
 - 6) Tool finish mortar joints.
 - 7) Install required accessories to accommodate wall opening and top of wall details.
- 8. Weep System for Concealed Steel Lintels:
 - a. Rainscreen Drainage Plane: Sure Cavity (SC 5016/SC 5032), 10MM Sure Cavity (SCMM 2516/SCMM 2532) or Gravity Cavity (GC 1832).
 - 1) Install Sure Cavity or Gravity Cavity on vertical surface of flashing,

WRB, and vertical leg of steel lintel with 4 inches (102 mm) fabric skirt overlapping the back edge of Concealed Steel Lintel / Shelf Angle Weep (CLW 9040).

- 2) Trim 4 inches (102 mm) fabric skirt to appropriate length.
- b. Concealed Steel Lintel/Shelf Angle Weep (CLW 9040):
 - 1) Install Concealed Steel Lintel/Shelf Angle Weeps on horizontal leg of steel lintel over drip plate and flashing system.
 - 2) Cut (CLW 9040) to required size.
 - 3) Position (CLW 9040) with the front nose edge over the front edge of the lintel flashing and the back edge into the vertical void created by the Sure Cavity (SC 5016/SC 5032), 10MM Sure Cavity (SCMM 2516/SCMM 2532), or Gravity Cavity (GC 1832).
 - 4) Spread bed joint of mortar and lay masonry unit (lip brick).
 - 5) Finish tool joint
 - 6) Clean out and finish-tool mortar joint up under lip of lip brick.
 - 7) Install required accessories to accommodate wall opening and top of wall details.
- 9. Weep System for Shelf Angle (when masonry units are laid dry/no bed joint of mortar on flashing):
 - a. Rainscreen Drainage Plane: Sure Cavity (SC 5016/SC 5032), 10MM Sure Cavity (SCMM 2516/SCMM 2532) or Gravity Cavity (GC 1832).
 - 1) Install Sure Cavity or Gravity Cavity on vertical surface of flashing, WRB and vertical leg of shelf angle with 4 inch fabric skirt overlapping the back ends of the Head Joint Weeps (HJW 3845).
 - 2) Trim 4 inches (102 mm) fabric skirt to appropriate length.
 - b. Head Joint Weeps (HJW 3845):
 - 1) Install Head Joint Weeps as spacers at each head joint, beginning with the first head joint on shelf angle.
 - Position Head Joint Weeps with the front end flush with the exterior face
 of full brick veneer and the back end extending into cavity or vertical
 void created by Sure Cavity or Gravity Cavity.
 - 3) Strengthen up first course of masonry units.
 - 4) Spread bed joint of mortar on top of first course of masonry units.
 - 5) Tuckpoint bed joint of mortar into head joints.
 - 6) Tool finish mortar joints.
 - 7) Install required accessories to accommodate wall opening and top of wall details.
 - c. Vent Strip (VS 3845):
 - Fasten Vent Strip (VS 3845) to bottom of expansion pad that is adhered to bottom side of shelf angle.
 - Position Vent Strip with front edge extending past front edge of expansion pad and back edge extended into vertical void created by Sure Cavity (SC 5016 or SC 5032), 10MM Sure Cavity (SCMM 2516 or SCMM 2532), or Gravity Cavity (GC 1832
 - 3) Lay up top course of brick and tuckpoint mortar on top joint.
 - 4) Finish tool joint
 - 5) Cut off excess vent strip even with face of full brick veneer
 - 6) Install required accessories to accommodate wall opening and top of wall details.
- 10. Weep System for Concealed Shelf Angle:
 - a. Rainscreen Drainage Plane: Sure Cavity (SC 5016 or SC 5032), 10MM Sure

Cavity (SCMM 2516 or SCMM 2532), or Gravity Cavity (GC 1832)

- 1) Install Sure Cavity or Gravity Cavity on vertical surface of flashing, WRB, and vertical leg of shelf angle lintel with 4 inches (102 mm) fabric skirt overlapping the back edge of concealed steel lintel / shelf angle weep (CLW 9040).
- 2) Trim 4 inches (102 mm) fabric skirt to appropriate length.
- b. Concealed Steel Lintel / Shelf Angle Weep (CLW 9040).
 - 1) Install Concealed Steel Lintel / Shelf Angle Weeps on horizontal leg of shelf angle over drip plate and flashing system.
 - 2) Cut (CLW 9040) to required size.
 - 3) Position (CLW 9040) with the front nose edge over the front edge of the shelf angle flashing and the back edge into the vertical void created by the Sure Cavity (SC 5016 or SC 5032), 10MM Sure Cavity (SCMM 2516 or SCMM 2532), or Gravity Cavity (GC 1832)
 - 4) Spread bed joint of mortar and lay masonry unit (lip brick).
 - 5) Finish tool joint.
 - 6) Clean out and finish-tool mortar joint up under lip of lip brick.
 - 7) Install required accessories to accommodate wall opening and top of wall details.
- c. Vent Strip (VS 3845):
 - 1) Fasten Vent Strip (VS 3845) to bottom of expansion pad that is adhered to bottom side of shelf angle.
 - Position Vent Strip with front edge extending past front edge of expansion pad and back edge extended into vertical void created by Sure Cavity (SC 5016 or SC 5032), 10MM Sure Cavity (SCMM 2516 or SCMM 2532), or Gravity Cavity (GC 1832)
 - 3) Lay up top course of brick and tuckpoint mortar on top joint.
 - 4) Finish tool joint.
 - 5) Cut off excess vent strip even with face of brick veneer.
 - 6) Install required accessories to accommodate wall opening and top of wall details.

3.6 MASONRY ACCESSORY INSTALLATION

- A. Install systems in accordance with manufacturer's instructions and as follows.
 - 1. Weep Systems for Thin Veneers (Thin Brick Thin Stone Stucco):
 - a. Weep Screed L & R Weep Screed (LR 3501).
 - 1) Install L & R Weep at bottom of thin veneer wall with 3-1/2 inches (88.9 mm) back flange transitioning the construction joint created by the top outside corner of the foundation wall and the bottom edge of the wall sheathing.
 - 2) The 3-1/2 inches (88.9 mm) back flange should be fastened to the framed sheathing only with approximately 1-1/2 to 2 inches (38 to 50.8 mm) overlapping down over face of foundation.
 - b. Weep Screed Deflector (WSD 1309).
 - 1) Install Weep Screed Deflector at bottom of thin veneer wall with back flange transitioning the construction joint created by the top outside corner of the foundation wall and the bottom edge of the wall sheathing.
 - 2) The 3-1/2 inches (88.9 mm) back flange is installed behind the 3-1/2 inches (88.9 mm) back flange of the L & R Weep Screed (LR 3501).
 - 3) The Weep Screed Deflector is fastened (nailed) to the framing wall only.

- 4) The Weep Screed Deflector should overlap the foundation wall approximately 1-1/2 inches to 2 inches (38 to 50.8 mm).
- 2. Edge Metal (MEM 3168) for enclosing the edge of Sure Cavity (SC 5016 or SC 5032) or Control Cavity (CC 4800) on the rake edge of sloped roof and the vertical edge of wall panel:
 - a. Edge Metal (MEM 3168) used on the rake edge of roof.
 - 1) Install Edge Metal on top of the rake roof edge drip cap or roof edge.
 - 2) Apply flashing tape to the interior edge of Edge Metal and the interior edge of the rake roof Edge Metal and onto the roof deck.
 - 3) Install roofing paper over the interior edge of rake roof Edge Metal.
 - 4) Install edge of Sure Cavity (SC 5016 or SC 5032) or Control Cavity (CC 4800) over nailing flange and into Edge Metal.
 - 5) Install roofing shingles.
 - b. Edge Metal (MEM 3168) for enclosing Sure Cavity (SC 5016 or SC 5032) or Control Cavity (CC 4800) at the edge of a wall panel.
 - 1) Install Edge Metal on the vertical edge of a wall panel over end cap edge metal.
 - 2) Apply flashing tape to the interior edge of Edge Metal and onto wall sheathing.
 - 3) Install WRB over the interior edge of Edge Metal.
 - 4) Install edge of Sure Cavity or Control Cavity.
 - 5) Install siding.
- 3. Vented Edge Metal (VMEM 3168) for enclosing and weeping the bottom edge of Control Cavity (CC 4800) at the edge of roof overhang or Sure Cavity (SC 5016 or SC 5032) at the bottom of wall panels:
 - a. Vented Edge Metal (VMEM 3168) use on bottom edge of roof.
 - 1) Install Vented Edge Metal on top of the drip cap or roof edge metal on the bottom edge of roof.
 - 2) Position bottom edge of water stop/ice shield over nailing flange of Vented Edge Metal.
 - 3) Install roofing papers over water stop/ice shield and nailing flange of Vented Edge Metal.
 - 4) Install bottom edge of first course of Sure Cavity or Control Cavity into Vented Edge Metal.
 - 5) Install shingles.
 - b. Vented Edge Metal (VMEM 3168) use at bottom of wall.
 - 1) Install Vented Edge Metal at bottom of wall to transition construction joint created by bottom edge of sheathing and top outside edge of foundation wall.
 - 2) Apply flashing tape to the top edge of Vented Edge Metal and onto sheathing.
 - 3) Install WRB over 3-1/2 inches (88.9 mm) back flange of Vented Edge Metal.
 - 4) Back-wrap 4 inches (102 mm) fabric skirt of Sure Cavity for bug screen.
 - 5) Install edge of Sure Cavity or Control Cavity over nailing flange and into Vented Edge Metal.
 - 6) Install siding.
- 4. Moisture Diverter (DS 2858) for thin veneers:
 - a. Install Moisture Diverter directly above wall openings such as windows and doors and not in contact with mounting flanges or flashing systems.
 - b. Install Moisture Diverter providing a watertight seal against weather resistant

- barrier on masonry and concrete substrates and flash the top on sheathing substrates.
- c. Install Moisture Diverter with 1/4 inch per foot (6.35 mm per 305 mm) slope-to-drain and extend sides at least 4 inches (102mm) beyond door and window mounting flange and trim boards on both sides.
- d. Install required accessories such as rainscreen drainage plane and flashing for complete installation.
- 5. Mortar Belt (MB 3500) for trash mortar control in CMU Walls
 - Install Mortar Belt centered on CMU wall every 4 to 6 courses.
 - b. Do not use when CMU cells are less than 5 inches (17mm) wide.
 - c. Install necessary accessories for complete installation.
- 6. Trash Mortar Diverter (TMD 9548) for trash mortar control in cavity walls with air spaces (cavities) of 1-1/2 inches (38 mm) to 3 inches (76 mm):
 - a. Install Trash Mortar Diverter into wall cavity with "V" in downward position and with short leg edge to the weather side.
 - b. Install Trash Mortar Diverter in a (checkerboard) or (stair step) or (architect approved) pattern within the wall cavity.
 - c. Install necessary accessories such as wall ties and flashing for complete installation.
- 7. Floor Edging (FE 8555) for interior of below grade (basement) moisture management:
 - a. Install along the perimeter of concrete floor against the concrete masonry foundation wall on footing with short leg vertical and long leg horizontal.
 - b. Fasten Floor Edging to wall at 2 feet (0.61 m) on center.
 - c. Install top of Floor Edging vertical leg at least 1 inch (25.4 mm) higher than concrete slab.
 - d. Install top edge of Floor Edging at least 3 inches (76.2 mm) higher than bottom of weep cores.
 - e. Install necessary accessories such as Control Cavity (CC 4800) and Vapor retarder, Mortar Belt (MB 3550) and Vent Mat (VM 9025) for complete installation.
- 8. H-Cove (HC 3504) for interior below grade (basement) moisture management restoration:
 - a. Remove concrete floor slab along perimeter and as indicated for renovation work.
 - b. Clean debris from area, footing and wall.
 - c. Provide small weep penetrations into cores of CMU wall at lowest level possible in every core.
 - d. Install H-Cove with the vertical leg flat against the (drainage plane) Control Cavity (CC 4800) on the foundation wall with front lip atop the footing.
 - e. Anchor the vertical leg through the drainage plane and into the foundation wall substrate.
 - f. Pre-drill the holes using a masonry bit and fasten lightly to not crush the drainage plane.
 - g. Field fabricate 45 degree corners and other connections as necessary to sump basket drain.
 - h. Install adhesive tape over each connection.
 - i. Upon completion of floor edge drain installation re-pour concrete patch as required.
 - j. Install necessary accessories such as drainage plane Control Cavity (CC 4800) and sump basket for complete installation. Refer to other sections for additional information.

- 9. Sump Basket (SF 30PR) for interior below grade (basement), to be used in conjunction with drain field drain tile system:
 - a. Install Sump Basket plumb and level in location as indicated on drawings.
 - b. Do not use when CMU cells are less than 5 inches (127 mm) wide.
 - c. Install necessary accessories for complete installation. Refer to other sections for additional information.

3.7 PROTECTION

- A. Protect installed thin veneer system from damage during construction.
- B. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 04 06 20 – SCHEDULES FOR UNIT MASONRY

Item	No.	Ref. Drawing No.	Approx. Structure Size	Block Size	CMU Type
Masonry Block Wall	2	Masonry Wall Plan & Elev. and Detail DRAWINGS	As per DRAWINGS	8"x8"x16"	OWNER's Choice Split Face Architectural
Masonry Block Fence columns	1	Fence Layout and Detail DRAWINGS	As Per DRAWINGS	8"x8"x16"	OWNER's Choice Split Face Architectural

END OF SECTION

SECTION 04 22 20 – REINFORCED CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.01 REQUIREMENT

A. The Contractor shall furnish all materials and construct the brick masonry work for the project, complete, including the furnishing, fabrication and placing of reinforcing steel, clips, ties, anchors and the setting of embedded items all in accordance with the requirements of the Contract Documents.

1.02 RELATED SECTIONS

- A. Section 01 33 00 Submittal Procedures
- B. Section 03 11 00 Galvanized Reinforcing Steel
- C. Section 03 30 00 Cast-in-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The Building Code, as referenced herein, shall be the latest edition of the California Building Standards Code (CBC), Title 24, California Code of Regulations.
- B. ASTM C-90.
- C. ASTM C404 Std. Spec. for Aggregates for masonry grout.
- D. ASTM A 615-86 Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- E. ASTM C270 Std. Spec. for Mortar for Unit Masonry.
- F. ASTM A-92-85 Standard Specification for Steel Wire, Plain for Concrete Reinforcement.
- G. ASTM C144 Standard Spec. for Aggregates for masonry mortar.
- H. ASTM C150 Std. Spec. for Portland Cement.
- I. ASTM C207 Std. Spec. for Hydrated lime for masonry.

1.04 SUBMITTALS

- A. Submit full-sized samples of concrete masonry units of each type, color and texture required. Also submit certification that the product meets ASTM C90, Type I moisture controlled, Grade N units.
- B. The Contractor shall prepare in accordance with CBC 2105.2.2 Prism test method, a set of five (5) masonry prisms using a representative test batch of mortar and masonry materials to be used in the structure. These prisms shall be tested by a certified testing laboratory. Samples of the trial batch mortar used in preparing the prisms shall also be taken in accordance with CBC

2105.3.1 Prism sampling and removal and tested by a certified testing laboratory. The prism and mortar test reports shall be submitted to the Engineer prior to beginning masonry construction.

1.05 QUALITY ASSURANCE

- A. The size, color and texture of the masonry units shall be as specified herein under Part 2, Products. The color of the mortar shall be determined in the field, prior to construction, as best matches masonry and approved by the Engineer.
- B. During construction, a set of three (3) masonry prisms shall be built and tested in accordance with CBC 2105.3.1 Prism sampling and removal for each 5,000 square feet of wall area, but not less than one (1) set of three (3) masonry prisms per individual structure. The costs of the first sampling, testing and test reports shall be paid for by the TVMWD, repeated additional tests required to complete the work shall be paid for by the Contractor. The compressive strength of masonry determined in accordance with ASTM C 1314 for each set of prisms shall equal or exceed the minimum strengths specified herein.
- C. During masonry construction, filling grout shall be sampled and tested in accordance with CBC Sections 2103A.9 and 2103A.13. The following schedule shall be followed:
 - 1. At the beginning of masonry work, at least one test sample of the mortar and grout shall be taken on three successive working days and at least at one-week intervals thereafter. Additional samples shall be taken whenever any change in materials or job conditions occur, or whenever in the judgement of the architect, structural engineer, or the enforcement agency such tests are necessary to determine the quality of the material.

PART 2 - PRODUCTS

2.01 CMU

- A. Hollow concrete masonry units shall be:
 - 1. Grade: N
 - 2. Type: I
 - 3. Size: 8-inch x 8-inch x 16-inch
 - 4. Color: Natural standard grey
 - 5. The minimum masonry assemblage compressive strength, f'm, at age of 28 days shall be 1500 psi.
 - 6. Finish:
 - a. Standard Finish not textured.
 - 1) Integrally colored to match engineer's sample, for walls on exterior of building.
 - 2) Standard color.
 - b. Split Face Textured Units with single score.
 - 1) Integrally colored to match engineer's sample for walls on exterior of building.

2.02 REINFORCEMENT AND METAL ACCESSORIES

- A. Reinforcement steel and metal accessories for all reinforced hollow clay masonry shall conform to the following requirements:
 - 1. Reinforcing bars shall be Grade 60 and shall conform to the requirements of ASTM A 615-86 for deformed billet steel for concrete reinforcement.
 - 2. Joint reinforcement shall be manufactured with wire conforming to CBC Section 2104A.5.1.2 and ASTM A 82-85. Joint reinforcement wire shall be formed from wire that has been zinc coated in accordance with the referenced standards, Class I.

2.03 MORTAR AND GROUT

- A. Mortar: Mortar shall be Type S Portland Cement Lime bay proportion with a minimum 28-day 1800 psi. The color of mortar shall match adjacent CMU color as selected by engineer from manufacturer's full range of colors.
- B. Grout: Grout shall have a minimum 28-day compressive strength of 3500 psi. Proportions shall be one (1) part Portland Cement, two to three (2-3) parts sand, and not more than one (1) part pea gravel. Grout shall have a slump of 9-inches plus or minus 1-inch. Transit-mixed grout may be used and shall be continually rotated at idle speed from the time the water is added until the grout is discharged.

2.04 MISCELLANEOUS MATERIALS

- A. Portland Cement shall be Type I or II, low alkali, conforming to CBC Chapter 19 and ASTM C 150. Masonry cements or plastic cements will not be permitted.
- B. Hydrated lime shall be Type N conforming to UBC Standard 24-18.
- C. Mortar aggregates shall conform to UBC Standard No. 24-21 (ASTM C 144). Grout aggregate shall conform to UBC Standard No. 24-23 (ASTM C 404).
- D. Water for mixing into mortar or grout shall be clear, potable water.
- E. Admixtures other than coloring for use in mortar and grout shall not be used unless approved by the engineer. Coloring admixture for mortar shall be pure mineral oxide pigments delivered in sealed packages providing accurate measured amounts for uniform mix proportioning and color shall be approved by the Engineer.

PART 3 - EXECUTION

3.01 COLD WEATHER CONSTRUCTION

A. All masonry work shall be performed only under weather conditions and in conformance CBC 2104A.3 Cold weather construction and subject to the approval of the ENGINEER.

3.02 PREPARATION OF FOUNDATION

A. Prior to laying the first course of masonry, the concrete foundation surface shall be clean and free of latence, loose aggregate, grease and curing materials. This surface preparation shall be

- accomplished by sandblasting or high pressure washing. The surface shall be rough to provide a good bond between foundation concrete, mortar and grout.
- B. The foundation shall be sufficiently level such that the bed joint thickness is not less than 1/4-inch nor more than 5/8-inch. The foundation face shall be sufficiently true to line so that the masonry face projects no more than 1/4-inch.

3.03 MATERIAL HANDLING, STORAGE AND PREPARATION

- A. Cement, lime and other calcareous materials delivered to the site shall be properly stored and protected from the weather in unbroken bags, barrels or other approved containers which are plainly marked and labeled with the manufacturers' names and brands. Materials shall be stored and handled in a manner which will prevent the intrusion of foreign materials and damage by water or dampness.
- B. Masonry units shall be handled with care to avoid chipping and breakage and shall be protected from contact with the earth and exposure to the weather and shall be kept dry and clean until used. Materials stored on newly constructed floors shall be stacked in such a manner that the uniformly-distributed loading does not exceed 30 psf.
- C. Reinforcing steel and all embedded items shall be stored off the ground and shall be protected from mud, oil, concrete, mortar, grout and weather conditions that will cause excessive rusting.

3.04 PLACING MASONRY UNITS

- A. Masonry units shall be placed in the pattern and per the details called for on the Drawings. All work shall be plumb, level and true to line with all corners and angles square unless otherwise indicated on the Drawings.
- B. All masonry cutting shall be by machine.
- C. Vertical and horizontal mortar joints shall be 3/8-inch and tooled to a concave pattern.
- D. The Contractor shall set or embed all required anchors, bolts, reglets, sleeves, conduits and other items as called for in the Drawings. All adjoining work including door jams and corners shall be protected from damage or disturbance during the masonry work. All sills, ledges and offsets shall be protected from droppings of mortar.

3.05 REINFORCING STEEL

- A. Reinforcement bar details shall conform to CBC 1705.12.1 and ASTM A 615 and shall be placed as shown on the Drawings. All dowels shall be in proper location prior to start of the work. Securing reinforcing bars in their proper position shall be strictly adhered to.
- B. Horizontal joint reinforcement shall conform to CBC 1705.12.1 and ASTM A 615 and shall be placed as shown on the Drawings.

3.06 GROUTING

- A. Grouting operations and conditions shall conform to CBC 2104A.5.1.1.1 Low-lift grouted construction. Only low lift grouting to a maximum height of 5-feet will be permitted during any twenty-four (24) hour period.
- B. Grout shall be placed in a continuous pour, shall be consolidated by puddling or mechanical vibrating during placing and shall be reconsolidated after excess moisture has been absorbed, but before plasticity has been lost.

3.07 POINTING AND CLEANING

- A. At the completion of the work all holes or defective mortar joints in exposed masonry shall be pointed. Defective joints shall be cut out and repointed.
- B. Exposed masonry shall be protected against staining from wall grouting or other sources and excess mortar shall be cleaned off the surfaces as the work progresses.
- C. At the completion of the work, all exposed masonry shall be cleaned using a dilute acid solution.
- D. All waste and surplus masonry materials shall be removed from the job and all stains or dirt from this operation affecting adjacent surfaces shall be removed by an approved cleaning method.
- E. All masonry walls shall be sealed per the requirements of **Section 09 96 00 High-Performance Coatings**, herein.

END OF SECTION

SECTION 04 43 11 – NATURAL FIELDSTONE MASONRY VENEER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes natural fieldstone veneer in the following applications:
 - 1. Adhered to unit masonry backup of block modular design.
- B. Stone proposed for use on Project is natural fieldstone cobbles native to the area. Contractor's installer shall select stone for veneer work according size and horizontal placement thickness limits shown on the plans. Selection of stone will include the installer's experience in aesthetics to provide an installed look of consistent variation in color and texture.
- C. Mockups of the installed wall and pilaster work will be required to ensure the installer's aesthetics of color/size/texture blend of well with the adjacent neighborhood 'old mission' theme.
- D. TVMWD is making available to the Contractor, at no cost, natural fieldstone cobbles stock piled at the Miramar WTP. The Contractor may also select alternate sources of natural field stone native to the area, such as cobbles encountered on the project well site during excavation work.
- E. The Contractor will be required to sort, wash, and transport the fieldstone cobbles to the project site.
- F. A mandatory pre-bid site visit to the well site and to the Miramar WTP to inspect the stock pile of fieldstone will be required. Bidders are offered samples of the fieldstone cobbles on request to aid in developing bid packages.
- G. It is the responsibility of the Contractor evaluate the project needs for veneer fieldstone and estimate the quantity of suitable fieldstone in the stockpile. The Contractor shall determine if sufficient quantity of fieldstone meeting project constraints is available at the Miramar WTP and to procure additional fieldstone if required to complete to the work. Any additional fieldstone or materials required beyond the supply at the Miramar WTP stockpile, or derived from Contractor well site excavation work, will be at the cost of the Contractor.
- H. A copy of geotechnical report for the project well site is included with the bid package for use in evaluating composition of native soil and data on native fieldstone cobbles.
- I. Related Sections include the following:
- 1. Division 3 Section "Cast-in-Place Concrete" for dovetail slots in concrete for anchoring

- stone veneer.
- 2. Division 4 Section "Unit Masonry Assemblies" for concealed flashing, horizontal joint reinforcement, and veneer anchors.
- 3. Division 4 Section "Dimension Stone Cladding" for descriptions of stone types required by this Section.
- 4. Division 7 Section "Building Insulation" for insulation installed between stone veneer assemblies and backup material.
- 5. Division 7 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing.
- 6. Division 9 Section "Stone Paving and Flooring."
- J. Products installed, but not furnished, in this Section include the following:
 - 1. Steel support lintels and shelf angles for stone veneer assemblies specified in Division 5 Section "Metal Fabrications."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Stone proposed for use on Project is natural fieldstone cobbles native to the area. Contractor shall select stone for veneer work according size and horizontal placement thickness limits shown on the plans.
 - 2. Submit manufacturer's data sheets on proposed materials including anchors, mortar, screeding, anchor spacing recommendations for the project fieldstone material and installation methods.
- B. Colored Mortar Samples for Verification: For each color required. Label Samples to indicate types and amounts of pigments used.
- C. <u>List of Materials Used in Constructing Mockups:</u> List generic product names together with manufacturers, manufacturers' product names, sources of supply, and other information as required to identify materials used. Include mix proportions for mortar and source of aggregates.
 - 1. Submittal is for information only. Neither receipt of list nor approval of mockups constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- D. Oualifications Data: For Installer.

1.4 QUALITY ASSURANCE

- A. Teleconference to discuss options on fieldstone veneer installation.
 - 1. Contractor and the installer will participate in teleconference with TVMWD to discuss options on the installation of fieldstone veneer that will impact structural integrity and aesthetics.
 - 2. Items such as grout depth, width, color and the ability of the overall appearance to blend with the adjacent community's architectural accents will be important.
- B. <u>Installer Qualifications:</u> An installer who employs experienced stone masons and stone fitters who are skilled in installing stone veneer assemblies similar in material, design, and extent to

those indicated for this Project and whose projects have a record of successful in-service performance.

- 1. Submit installer's resume including 3 projects utilizing natural fieldstone cobbles as veneer for masonry unit walls and/or pilasters.
- 2. Include job references of owners name and contact information.
- C. <u>Source Limitations for Stone</u>: Supplied by TVMWD and/or sorted from well site excavation work. Contractor shall sort by size, color, and texture to apply uniform aesthetic natural variations of the stones and within the requirements shown on the plans. Should additional stone material be required the Contractor shall obtain local sources matching color and physical characteristics.
- D. <u>Source Limitations for Mortar Materials:</u> Obtain ingredients of a uniform quality for each mortar component from a single manufacturer and each aggregate from one source or producer.
- E. <u>Mockups:</u> Build partial mockups of an example wall and pilaster to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
 - 1. Contractor to anticipate up to three (3) variations on fieldstone work styles for each type of installation to be requested to be mocked-up for consideration and final acceptance by TVMWD as the style for use in the building and pilaster veneer work. Provide a temporary concrete support slab onsite to construct the mockups as needed to demonstrate the aesthetics of the installer's fieldstone design, sized as required for the mockup design.
 - 2. Submit proposed mockup design sketches 1 week prior to construction of mockups.
 - 3. Build mockups for each type of stone veneer assembly in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup.
 - a. Include stone coping at top of mockup.
 - b. Include through-wall flashing installed for a 24-inch length in corner of mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit stone veneer above half of flashing).
 - c. Demonstrate transitions around corners and to boundary edges.
 - 4. Protect accepted mockups from the elements with weather-resistant membrane.
 - 5. Approval of mockups is for color, texture, and blending of stone; relationship of mortar and sealant colors to stone colors; tooling of joints; and aesthetic qualities of workmanship.
 - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
 - 6. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion and approved by the Engineer. However, rejected mockups will require removal by the Contractor at no additional cost.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- C. Deliver pre-blended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store pre-blended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 PROJECT CONDITIONS

- A. Protection of Stone Veneer Assemblies: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed stone veneer assemblies when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
- B. Stain Prevention: Immediately remove mortar and soil to prevent them from staining the face of stone veneer assemblies.
 - 1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on the ground and over the wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at end of each day to prevent rain from splashing mortar and dirt on completed stone veneer assemblies.
- C. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 STONE SOURCES

A. Supplied by TVMWD at their Miramar WTP stockpile and/or sorted from well site excavation work by the Contractor. Contractor shall sort by size, color, and texture to apply uniform aesthetic natural variations of the stones and within the requirements shown on the plans.

2.4 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
 - 1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.
- B. Hydrated Lime: ASTM C 207 Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or III, and hydrated lime complying with ASTM C 207.

- D. Mortar Cement: ASTM C 1329
- E. Masonry Cement: ASTM C 91
- F. For pigmented mortar, use a colored cement formulation as required to produce color indicated or, if not indicated, as selected from manufacturer's standard formulations.
 - 1. Pigments shall be composed of natural or synthetic iron oxides, compounded for use in mortar mixes, and with a record of satisfactory performance in stone masonry mortars.
 - 2. Pigments shall not exceed 10 percent of Portland cement by weight.
 - 3. Pigments shall not exceed 5 percent of mortar cement by weight.
 - 4. For colored-aggregate mortar, use natural color or white cement as necessary to produce required mortar color.
- G. Aggregate: ASTM C 144 and as follows:
 - 1. For pointing mortar, use aggregate graded with 100 percent passing No. 16 sieve.
 - 2. White Aggregates: Natural white sand or ground white stone.
 - 3. Colored Aggregates: Natural-colored sand or ground marble, granite, or other sound stone; of color necessary to produce required mortar color.
 - a. Match Architect's sample.
- H. Mortar Pigments: Natural or synthetic iron oxides, compounded for use in mortar mixes and with a record of satisfactory performance in stone masonry mortars.
- I. Cold-Weather Admixture: No chloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
- J. Water: Potable.

2.5 VENEER ANCHORS

A. Materials:

- 1. Hot-Dip Galvanized Steel Wire: ASTM A 82, with ASTM A 153/A 153M, Class B-2.
- 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 316.
- 3. Hot-Dip Galvanized Steel Sheet: ASTM A 366/A 366M, cold-rolled, carbon-steel sheet hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M, Class B-2.
- 4. Stainless-Steel Sheet: ASTM A 666, Type 316.
- B. Corrugated-Metal Veneer Anchors: Not less than 0.030-inch- thick by 7/8-inch- wide stainless-steel sheet with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch.
- C. Wire Veneer Anchors: Formed from W1.7 or 0.148-inch- diameter stainless-steel wire.
- D. Adjustable, Screw-Attached Veneer Anchors: Units consisting of a wire tie section and a metal anchor section that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:

- 1. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
- 2. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches wide by 3 inches high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit veneer anchor section.
- 3. Anchor Section: Sheet metal plate with screw holes top and bottom and with raised ribstiffened strap stamped into center to provide a slot between strap and plate for connection of wire tie.
- 4. Anchor Section: Gasketed sheet metal plate with screw holes top and bottom; top and bottom ends bent to form pronged legs to bridge insulation or sheathing and contact studs; and with raised rib-stiffened strap stamped into center to provide a slot between strap and plate for connection of wire tie.
 - a Plate 1-1/4 inches wide by 6 inches long with strap 5/8 inch wide by 6 inches long; slot clearance formed between face of plate and back of strap shall not exceed diameter of wire tie by more than 1/32 inch.

- b. Provide veneer anchor manufacturer's standard, self-adhering, modified-bituminous gaskets manufactured to fit behind veneer anchor plate and to prevent moisture from penetrating sheathing at pronged legs and screw holes.
- 5. Metal Sheet: Galvanized steel sheet, 0.1046-inch base metal thickness.
- 6. Wire Tie Section: Triangular shaped, 0.25-inch- diameter, stainless-steel wire tie sized to extend at least halfway through veneer but with at least 5/8-inch cover on outside face.
- E. Screw-Attached Veneer Anchors: Units consisting of a wire tie section and a metal anchor section for attachment over sheathing to wood or metal studs, and as follows:
 - 1. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
 - 2. Anchor Section: Zinc-alloy barrel section with flanged head with eye and corrosion-resistant, self-drilling screw. Eye designed to receive wire tie section and to serve as head for drilling fastener into framing. Barrel length to suit sheathing thickness, allowing screw to seat directly against framing with flanged head covering hole in sheathing.
- F. Seismic Veneer Anchors: Units consisting of a metal anchor section and a connector section designed to engage a continuous wire embedded in the veneer mortar joint, complying with the following requirements:
 - 1. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
 - 2. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches wide by 3 inches high; with projecting tabs having slotted holes for inserting vertical leg of connector section.
 - 3. Connector Section: Rib-stiffened, sheet metal bent plate with down-turned leg designed to fit in veneer anchor section slot and with integral tabs designed to engage continuous wire. Size connector to extend at least halfway through veneer but with at least 5/8-inch cover on outside face.
 - 4. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches wide by 3 inches high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit veneer anchor section. Size wire tie to extend at least 1-1/2 inches into veneer but with at least 5/8-inch cover on outside face.
 - 5. Connector Section: Sheet metal clip welded to wire tie with integral tabs designed to engage continuous wire.
 - 6. Anchor Section: Gasketed sheet metal plate with screw holes top and bottom; top and bottom ends bent to form pronged legs to bridge insulation or sheathing and contact studs; and with raised rib-stiffened strap stamped into center to provide a slot between strap and plate for connection of wire tie.
 - a Plate 1-1/4 inches wide by 6 inches long with strap 5/8 inch wide by 6 inches long; slot clearance formed between face of plate and back of strap shall not exceed diameter of wire tie by more than 1/32 inch.

- b. Provide veneer anchor manufacturer's standard, self-adhering, modified-bituminous gaskets manufactured to fit behind veneer anchor plate and to prevent moisture from penetrating sheathing at pronged legs and screw holes.
- 7. Connector Section: Triangular-shaped, 0.25-inch diameter, stainless-steel wire tie and rigid PVC extrusion with snap-in grooves for inserting continuous wire. Size wire tie to extend at least halfway through veneer but with at least 5/8-inch cover on outside face.
- 8. Continuous Wire: 0.1875-inch- diameter, stainless-steel wire.
- G. Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene washer, No. 10, in length required to penetrate steel stud flange by not less than 3 exposed threads, and with the following corrosion-protective coating:
 - 1. Organic polymer coating with salt-spray resistance to red rust of more than 500 hours per ASTM B 117.
- H. Stainless-Steel Drill Screws for Steel Studs: Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with ASTM C 954 except manufactured with hex washer head and neoprene washer, No. 10, in length required to penetrate steel stud flange by not less than 3 exposed threads.
- I. Steel Drill Screws for Wood Studs: Self-drilling, bugle-head or wafer-head wood screws recommended by veneer anchor manufacturer for fastening to wood studs; not less than No. 10, 1-1/2 inches long, and with the following corrosion-protective coating:
 - 1. Organic polymer coating with salt-spray resistance to red rust of more than 500 hours per ASTM B 117.
- J. Steel Tapping Screws for Concrete Masonry: Self-tapping screws with specially designed threads for tapping and wedging into masonry, with hex washer head and neoprene washer, 3/16-inch diameter by 1-1/2-inch length, and with the following corrosion-protective coating:

2.6 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Fabricate from the following metal complying with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim" and below:
 - 1. Stainless Steel: 0.0156 inch thick.
 - 2. Copper: 10-oz./sq. ft. weight or 0.0135 inch thick for fully concealed flashing; 16-oz./sq. ft. weight or 0.0216 inch thick elsewhere.
 - 3. Fabricate through-wall metal flashing embedded in masonry with dovetail ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
 - 4. Fabricate metal expansion-joint strips to shape indicated.
 - 5. Fabricate metal drip edges to extend at least 3 inches into wall and 1/2 inch out from wall, with a hemmed outer edge bent down 30 degrees.
 - 6. Fabricate metal flashing terminations to extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and then down into joint 3/8 inch to form a stop for retaining sealant backer rod.
- B. Contractor's Option for Concealed Flashing: For flashing partly exposed to the exterior, use metal flashing specified above. For flashing not exposed to the exterior, use one of the

following, unless otherwise indicated:

- 1. Copper-Laminated Flashing: Manufacturer's standard laminated flashing consisting of sheet copper bonded with asphalt between 2 layers of glass- fiber cloth. Use only where flashing is fully concealed in masonry.
- 2. Asphalt-Coated Copper Flashing: Manufacturer's standard product consisting of sheet copper coated with flexible asphalt. Use only where flashing is fully concealed in masonry.
- 3. Rubberized-Asphalt Flashing: Manufacturer's standard composite flashing product consisting of a pliable and highly adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness 0.040 inch.
- 4. Elastomeric Thermoplastic Flashing: Manufacturer's standard composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy 0.025 inch thick with a 0.015-inch- thick layer of rubberized-asphalt adhesive.
- 5. Provide flashing as a complete system with preformed corners, end dams, other special shapes, and seaming materials all produced by flashingsheet manufacturer.
- 6. EPDM Flashing: Manufacturer's standard flashing product formed from a terpolymer of ethylene-propylene-diene, complying with ASTM D 4637, 0.040 inch thick.
- C. Solder and Sealants for Sheet Metal Flashings: As specified in Division 7 Section "Sheet Metal Flashing and Trim."

2.7 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
- B. Damp proofing for Limestone: Cementitious formulations that are recommended by ILI and that are nonstaining to stone, compatible with joint sealants, and noncorrosive to veneer anchors and attachments.
- C. Asphalt Damp proofing for Concrete Backup: Cut-back asphalt complying with ASTM D 4479, Type I, or asphalt emulsion complying with ASTM D 1227, Type III or IV.

D. Weep Holes:

1. Round Plastic Tubing: Medium-density polyethylene, 3/8-inch OD by thickness of stone veneer assembly.

- 2. Rectangular Plastic Tubing: Clear butyrate, 3/8 by 1-1/2 inches by thickness of stone veneer assembly.
- 3. Wicking Material: Cotton or polyester rope, 1/4 to 3/8 inch in diameter, in length required to produce 2-inch exposure on exterior and 18 inches in cavity behind stone veneer assembly.
- 4. Aluminum Weep Hole/Vent: One-piece, L-shaped units made from sheet aluminum, designed to fit into head joint and consisting of vertical channel with louvers stamped in web and with top flap to keep mortar out of head joint; painted to comply with Division 9 Section before installation, in color approved by Architect to match that of mortar.
- 5. Plastic Weep Hole/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, designed to fill head joint with outside face held back 1/8 inch from exterior face of stone veneer, in color selected from manufacturer's standard.
- 6. Vinyl Weep Hole/Vent: One-piece, offset, T-shaped units made from flexible, injection-molded PVC, designed to fit into head joint and consisting of louvered vertical leg, flexible wings to seal against ends of stone units, and top flap to keep mortar out of head joint; in color approved by Architect to match that of mortar.
- E. Woven-Wire Lath: ASTM C 1032, fabricated into 1-1/2-inch hexagonal-shaped mesh with minimum 0.0510-inch- diameter, galvanized steel wire.
- F. Lath Attachment Devices: Material and type required by ASTM C 1063 for installations indicated.

2.8 MASONRY CLEANERS

A. Job-Mixed Detergent Solution: Solution of 1/2-cup dry-measure tetra sodium polyphosphate and 1/2-cup dry-measure laundry detergent dissolved in 1 gal. of water.

2.9 STONE FABRICATION

- A. General: Fabricate stone in sizes and shapes necessary to comply with requirements indicated, including details on Drawings.
- B. Select stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association or, if none, by stone source, for faces, edges, beds, and backs.
 - 1. Clean sawed backs of stone to remove rust stains and iron particles.
- C. Gage backs of stones for adhered veneer if more than 81 sq. in. in area.
- D. Thickness of Stone Veneer: Provide thickness indicated, but not less than the following:
 - 1. Thickness: 1 inch plus or minus per plans.
- E. Dress joints (bed and vertical) straight and at right angle to face, unless otherwise indicated.
- F. Finish exposed faces and edges of stone to comply with requirements indicated for finish and to match approved samples and mockups.
 - 1. Finish: Smooth, naturally rounded edges.

G. Carefully inspect stone at source site for compliance with requirements for appearance, material, and fabrication. Replace defective units before shipment.

2.10 MORTAR MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride.
 - 2. Add cold-weather admixture (if used) at same rate for all mortar, regardless of weather conditions, to ensure that mortar color is consistent.
 - 3. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding water. Then mix again, adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for one to two hours. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
 - 1. Extended-Life Mortar: Mortar complying with ASTM C 1142 may be used instead of mortar specified above, at Contractor's option.
 - 2. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
- C. Latex-Modified Portland Cement Setting Mortar: Proportion and mix portland cement, aggregate, and latex additive to comply with latex-additive manufacturer's writteninstructions.
- D. Cement-Paste Bond Coat: Mix either neat cement and water or cement, sand, and water to a consistency similar to that of thick cream.

- 1. For latex-modified portland cement setting-bed mortar, substitute latex admixture for part or all of water, according to latex-additive manufacturer's written instructions.
- E. Mortar for Scratch Coat over Metal Lath: 1 part portland cement, 1/2 part lime, 5 parts loose damp sand, and enough water to produce a workable consistency. (Adhered Veneer)
- F. Mortar for Scratch Coat over Unit Masonry: 1 part portland cement, 1 part lime, 7 parts loose damp sand, and enough water to produce a workable consistency. (Adhered Veneer)
- G. Pigmented Mortar: Select and proportion pigments with other ingredients to produce color required.
 - 1. Mix to match Architect's sample.
 - 2. Pigments shall not exceed 10 percent of portland cement by weight.
 - 3. Pigments shall not exceed 5 percent of mortar cement by weight.
- H. Colored-Aggregate Mortar: Produce color required by combining colored aggregates with cementitious materials of selected color.
 - 1. Mix to match Architect's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces indicated to receive stone veneer assemblies, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Examine substrate to verify that dovetail slots, inserts, reinforcement, veneer anchors, flashing, and other items installed in unit masonry or concrete and required for or extending into stone veneer assemblies are correctly installed.
 - 2. Examine wall framing, sheathing, and building paper or building wrap to verify that stud locations are suitable for spacing of veneer anchors and that installation will result in a weatherproof covering.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Advise installers of other work about specific requirements for placement of reinforcement, veneer anchors, flashing, and similar items to be built into stone veneer assemblies.
- B. Accurately mark stud centerlines on face of building paper or building wrap before beginning stone installation.
- C. Coat concrete backup with asphalt dampproofing.

D. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

3.3 SETTING OF STONE VENEER, GENERAL

- A. Perform necessary field cutting as stone is set. Use power saws to cut stone. Cut lines straight and true, with edges eased slightly to prevent snipping.
- B. Sort stone before it is placed in wall to remove stone that does not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.
- C. Arrange and trim stones for accurate fit in polygonal (mosaic) pattern with uniform joint widths.
- D. Do not place cut or broken rock facing outwards, place only naturally smoothed and rounded fieldstone facing outwards.
- E. Place the fieldstones in a uniform average thickness with a tolerance of +/- 1 inch per plans.
- F. Arrange stones with color and size variations uniformly dispersed for an evenly blended appearance.
- G. Set stone to comply with requirements indicated on Drawings. Install veneer anchors, supports, fasteners, and other attachments indicated or necessary to secure stone veneer assemblies in place. Set stone accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
- H. Maintain uniform joint widths except for variations due to different stone sizes and where minor variations are required to maintain bond alignment, if any.
- I. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.
 - 1. Keep expansion and pressure-relieving joints free of mortar and other rigid materials.
 - 2. Sealing expansion, control, and pressure-relieving joints is specified in Division 7 Section "Joint Sealants."
- J. Install embedded flashing and weep holes at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
 - 1. At cold-formed metal-framed walls, extend flashing from exterior face of veneer, through the veneer, up the face of sheathing at least 8 inches, and behind building paper or building wrap.
 - 2. At lintels and shelf angles, extend flashing full length of angles but not less than 4 inches into masonry at each end.
 - 3. At heads and sills, extend flashing 4 inches at ends and turn up not less than 2 inches to form a pan.
 - 4. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 7 Section "Joint Sealants" for

application indicated.

- 5. Extend sheet metal flashing 1/2 inch beyond face of masonry at exterior and turn flashing down to form a drip.
- 6. Install metal drip edges beneath flashing at exterior face of wall. Stop flashing 1/2 inch back from outside face of wall and adhere flashing to top of metal drip edge.
- 7. Install metal flashing termination beneath flashing at exterior face of wall. Stop flashing 1/2 inch back from outside face of wall and adhere flashing to top of metal flashing termination.
- 8. Cut flashing flush with face of wall after masonry wall construction is completed.
- K. Place weep holes and vents in joints where moisture may accumulate, including at base of cavity walls, above shelf angles, and at flashing.
- L. Trim wicking material used in weep holes flush with outside face of wall after mortar has set.
- M. Install vents in vertical head joints at the top of each continuous cavity at spacing indicated.
 - 1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.4 CONSTRUCTION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch in 40 feet or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.

- B. Variation from Level: For lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.
- C. Variation of Linear Building Line: For position shown in plan, do not exceed 1/2 inch in 20 feet or 3/4 inch in 40 feet or more.
- D. Measure variation from level, plumb, and position shown in plan as variation of the average plane of the face of each stone from level, plumb, or dimensioned plane.
- E. Variation in Mortar-Joint Thickness: Do not vary from joint size range indicated.
- F. Variation in Plane between Adjacent Stones: Do not exceed one-half of tolerance specified for thickness of stone.
- G. Variation in Plane on Face of Individual Stone: Do not exceed one-half of tolerance specified for thickness of stone.

3.5 INSTALLATION OF ANCHORED STONE VENEER ASSEMBLIES

- A. Anchor stone veneer to concrete with corrugated-metal veneer anchors as follows:
 - 1. Secure veneer anchors by inserting dovetailed ends into dovetail slots in concrete.
 - 2. Embed veneer anchors in mortar joints to within 1 inch of face.
- B. Anchor stone veneer to unit masonry with metal veneer anchors as follows:
 - 1. Embed corrugated-metal anchors in unit masonry mortar joints or grouted cells for distance at least one-half of veneer thickness.
 - 2. Secure wire anchors by inserting pintles into eyes of masonry wall reinforcement projecting from horizontal mortar joints.
 - 3. Secure triangular wire anchors with vertical rods inserted through anchors and through eyes of masonry wall reinforcement projecting from horizontal mortar joints.
 - 4. Embed anchors in veneer mortar joints to within 1 inch of face.
 - 5. Bend ends of wire anchors at right angles to form hooks not less than 2 inches long.
- C. Anchor stone veneer to unit masonry with adjustable, screw-attached veneer anchors as follows:
 - 1. Fasten each anchor section to unit masonry with two screws.
 - 2. Embed wire tie section in mortar joints to within 1-1/2 inches of face.
- D. Anchor stone veneer to unit masonry with seismic veneer anchors as follows:
 - 1. Fasten each anchor section to unit masonry with two screws.
 - 2. Embed connector section in mortar joints to within 1-1/2 inches of face.
- E. Anchor stone veneer to framing with adjustable, screw-attached veneer anchors as follows:
 - 1. Fasten each anchor section through sheathing to framing with two screws.
 - 2. Embed wire tie section in mortar joints to within 1-1/2 inches of face.

- F. Anchor stone veneer to framing with metal veneer anchors as follows:
 - 1. Fasten wire anchors through sheathing to wood studs with corrosion-resistant roofing nails.
 - 2. Fasten wire anchors to metal studs by tying.
 - 3. Embed anchors in mortar joints to within 1 inch of face.
 - 4. Bend ends of wire anchors at right angles to form hooks not less than 2 inches long.
- G. Space veneer anchors not more than 16 inches o.c. vertically and 24 inches o.c. horizontally. Install additional veneer anchors within 12 inches of openings, sealant joints, and perimeter at intervals not exceeding 12 inches.
- H. Space veneer anchors not more than 18 inches o.c. vertically and 32 inches o.c. horizontally, with not less than 1 veneer anchor per 2.67 sq. ft. of wall area. Install additional veneer anchors within 12 inches of openings, sealant joints, and perimeter at intervals not exceeding 12 inches.
- I. Set stone in full bed of mortar with full head joints, unless otherwise indicated. Build veneer anchors into mortar joints as stone is set.
 - 1. Install continuous wire reinforcement in horizontal joints indicated and attach to seismic veneer anchors as stone is set.
- J. Provide 1-inch air space between stone veneer assemblies and backup construction, unless otherwise indicated. Keep air space free of mortar droppings and debris.
 - 1. Place mortar spots in cavity at veneer anchors to maintain spacing.
 - 2. Slope beds toward air space to minimize mortar protrusions into air space. As work progresses, trowel mortar fins protruding into air space flat against back of veneer.
- K. Rake out joints for pointing with mortar to depth of not less than 3/4 inch before setting mortar has hardened. Rake joints to uniform depths with square bottoms and clean sides.
- 3.6 INSTALLATION OF ADHERED STONE VENEER ASSEMBLIES

- A. Install flashing over sheathing and behind building paper or building wrap by fastening through sheathing into framing.
- B. Install lath over building paper or building wrap by fastening through sheathing into framing to comply with ASTM C 1063.
- C. Install lath over unit masonry and concrete to comply with ASTM C 1063.
- D. Install scratch coat over metal lath 3/8 inch thick to comply with ASTM C 926.
- E. Coat backs of stone units and face with cement-paste bond coat, then butter both surfaces with setting mortar. Use sufficient setting mortar so a slight excess will be forced out the edges of stone units as they are set. Tap units into place, completely filling space between units.
- F. Rake out joints for pointing with mortar to depth of not less than 3/4 inch before setting mortar has hardened. Rake joints to uniform depths with square bottoms and clean sides.

3.7 POINTING

- A. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply pointing mortar in layers not more than 3/8 inch deep until a uniform depth is formed.
- B. Point stone joints by placing and compacting pointing mortar in layers not more than 3/8 inch deep. Compact each layer thoroughly and allow to become thumbprint hard before applying next layer.

3.8 ADJUSTING AND CLEANING

- A. Remove and replace stone veneer assemblies of the following description:
 - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
 - 2. Defective joints.
 - 3. Stone veneer assemblies not matching approved samples and mockups.
 - 4. Stone veneer assemblies not complying with other requirements indicated.
- B. Replace in a manner that results in stone veneer assemblies' matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.

- C. In-Progress Cleaning: Clean stone veneer assemblies as work progresses. Remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean stone veneer assemblies as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels
 - 2. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before cleaning stone veneer assemblies.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaner; remove cleaner promptly by rinsing thoroughly with clear water.
 - 5. Clean stone veneer assemblies by bucket and brush hand-cleaning method described in BIA Technical Note No. 20 Revised II, using job-mixed detergent solution.
 - 6. Clean stone veneer assemblies with proprietary acidic cleaner applied according to manufacturer's written instructions.
 - 7. Clean limestone veneer assemblies to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.9 EXCESS MATERIALS AND WASTE

- A. Excess Stone: Stack excess stone where directed by Owner for Owner's use.
- B. Disposal as Fill Material: Dispose of clean masonry waste, including mortar and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches in greatest dimension.
 - 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 2 Section "Earthwork."
 - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 05 05 00 – COMMON WORK RESULTS FOR METALS

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. This section includes all labor, materials, equipment, and appliances required to complete Miscellaneous Metal Work. The General Conditions apply to all sections of this Specification, which shall be completed as shown on the plans and as specified, and shall be properly coordinated with work in other Specifications.
- B. The DRAWINGS and these Specifications are complementary to each other; what is called for by one shall be as binding as if called for by both. If there is any conflict between what is shown on the DRAWINGS and what is written in the Specifications, the details described on the DRAWINGS shall take precedence and the CONTRACTOR shall communicate the conflicts to the ENGINEER in a timely manner.

C. Safety

1. The CONTRACTOR shall be familiar with, and shall at all times conform to, the regulations of the "OSHA General Industry Occupational Safety and Health Standards," "OSHA Safety and Health Regulations for Construction," and other applicable state and municipal standards and regulations.

1.02 REFERENCED SECTIONS

- A. Related Sections are shown below:
 - 1. SECTION 01 33 00 SUBMITTAL PROCEDURES
 - 2. SECTION 09 90 00 PAINTING AND COATING

1.03 CITED STANDARDS

- A. All work specified herein shall conform to or exceed the requirements of the Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.
- B. Products and their delivery, handling and installation shall be in accordance with the following trade standards, codes or specifications:
 - 1. Aluminum Association AA-M32 C22 A41
 - 2. AISC Specifications and Commentary
 - 3. AISI Specifications and Commentary
 - 4. ASTM A 36/A36M Specification for Structural Steel
 - 5. ASTM A 48 Specification for Gray Iron Castings
 - 6. ASTM A 53 Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated, Welded and Seamless
 - 7. ASTM A 123 Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strip

- 8. ASTM A 153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- 9. ASTM A 307 Specification for Carbon Steel Externally Threaded Standard Fasteners
- 10. ASTM A 563 Specification for Carbon and Alloy Steel Nuts
- 11. ASTM A 575 Specifications for Steel Bars, Carbon, Merchant Quality, M-Grades
- 12. ASTM F1554 07a Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
- 13. ANSI/AWS D1.1 Structural Welding Code Steel
- 14. NFPA 101 Life Safety Code
- 15. NAAMM Metal Stairs Manual

1.04 NOTED RESTRICTIONS

A. The CONTRACTOR shall furnish, fabricate and install miscellaneous metalwork and appurtenances, complete and in accordance with the requirements of the Contract Documents.

1.05 QUALITY CONTROL

A. For welding operations, the CONTRACTOR shall provide for continuous inspection of welding by International Code Council certified inspector.

1.06 SUBMITTALS

A. Shop DRAWINGS

1. Shop DRAWINGS of all miscellaneous metalwork shall be submitted to the ENGINEER for review in accordance with **Section 01 33 00 Submittal Procedures**.

B. Welders Qualifications

1. Welders shall submit certified qualifications for the type of welding being performed.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All structural steel shapes, plates, bars and their products shall conform to the requirements of ASTM A 36.

B. Corrosion Protection

- 1. Unless otherwise shown, miscellaneous metalwork of fabricated steel, which will be used in a corrosive environment and/or will be submerged in water/wastewater shall be coated in accordance with **Section 09 90 00 Painting and Coating**, and shall not be galvanized prior to coating.
- 2. All other miscellaneous steel metalwork shall be hot-dip galvanized after fabrication as specified herein.

C. Stainless Steel

1. Stainless steel metalwork shall by of Type 316 stainless steel.

2.02 SEAT ANGLES AND SUPPORTS

A. Seat angles for grating shall be aluminum or stainless steel. All support angles buried, submerged or below top of hydraulic structures shall be stainless steel.

2.03 BOLTS AND ANCHORS

- A. Except as otherwise specified herein, steel for bolts, anchor bolts and cap screws shall be in accordance with the requirements of ASTM A 307 Grade B, or threaded parts of ASTM A 36 and shall meet the following additional requirements:
 - 1. The nut material shall be free-cutting steel.
 - 2. The nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. All bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.
 - 3. The length of all bolts shall be such that after joints are made up, each bolt shall extend through the entire nut, but in no case more than ½-inch beyond the nut.

B. Galvanized Bolts

1. Except where otherwise shown or specified, all bolts, anchor bolts and nuts shall be steel, galvanized after fabrication as specified herein. Threads on galvanized bolts and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing.

C. Stainless Steel Bolts

1. Unless otherwise shown, all bolts, anchor bolts, washers and nuts which are buried, submerged or below the top of the wall inside any hydraulic structure shall be of Type 316 stainless steel. A non-seize compound shall be applied to the threads when attaching stainless steel bolts.

D. Anchors

1. Unless otherwise shown, expanding-type anchors shall be steel expansion type Phillips Drill Company "Red Head" anchors; McCullock Industries "Kwick-Bolt"; or equal. Lead caulking anchors will not be permitted. Size shall be as shown. Expansion type anchors which are to be embedded in grout may be steel. Non-embedded buried, submerged or below top of hydraulic structure anchors shall be entirely stainless steel.

E. Power-Driven Pins

1. Power-driven pins shall not be used unless specifically approved by the ENGINEER.

PART 3 - EXECUTION

3.01 PREPARATION – NONE

3.02 INSTALLATION

A. Fabrication and Installation Requirements

1. Fabrication and Erection: Except as otherwise shown, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction".

B. Welding

- 1. Method: All welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.
- Quality: In assembly and during welding, the component parts shall be adequately clamped, supported and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified for the AWS Code. Upon completion of welding, all weld splatter, flux, slag and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions. All burrs, spatter and sharp corners of material shall be ground smooth prior to coating.

C. Galvanizing

1. All structural steel plates, shapes, bars and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A 123. Any galvanized part that becomes warped during the galvanizing operation shall be straightened. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153. Field repairs to galvanizing shall be made using "Galvinox", "Galvo-Weld", or approved equal.

3.03 TESTING – NONE

PART 4 - MEASUREMENT AND PAYMENT- NOT USED

END OF SECTION

SECTION 05 05 20 - BOLTS, WASHERS, ANCHORS, AND EYEBOLTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes materials and installation of anchor bolts, connecting bolts, washers, drilled anchors, epoxy anchors, screw anchors, eyebolts, and stainless steel fasteners.

1.02 RELATED WORK

A. Concrete: 03 30 00.

1.03 DESIGN CRITERIA

A. Structural Connections: AISC Specification for Structural Steel Buildings (June 1, 1989), except delete the second paragraph of Section A7.1, the last sentence of the first paragraph of Section M5, the last sentence of Section M5.2, and Chapter N in its entirety.

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with the General Provisions and Section 01 33 00.
- B. Submit manufacturer's catalog data and ICBO reports for bolts, washers, and concrete anchors. Show dimensions and reference materials of construction by ASTM designation and grade.

PART 2 - PRODUCTS

2.01 ANCHOR BOLTS

A. Steel anchor bolts shall conform to ASTM A307, Grade A, B, or C for non-hydraulic structures and Type 316 stainless steel for exposed or hydraulic structures.

2.02 CONNECTION BOLTS

- A. Steel connection bolts shall conform to ASTM A307. Connection type shall be N per the AISC handbook.
- B. Provide self-locking nuts or lockwashers and plain nuts where shown in drawings.
- C. Provide galvanized bolts where shown in drawings. Galvanizing of bolts, nuts, and washers shall be in accordance with ASTM F2329.

2.03 STAINLESS STEEL BOLTS

A. Stainless steel bolts shall be ASTM F593, Type 316. Nuts shall be ASTM F594, Type 316. Use ASTM F594 nuts with ASTM F593 bolts. Provide washer for each nut and bolthead. Washers shall be of the same material as the nuts.

2.04 PLAIN UNHARDENED STEEL AND STAINLESS STEEL WASHERS

A. Washers shall comply with ASTM F844. Stainless steel washers shall be Type 316. Provide clipped washers where space limitations necessitate.

2.05 DRILLED ANCHORS

- A. Unless otherwise indicated in the drawings, drilled anchors shall be Type 316 stainless steel wedge anchors as manufactured by ITW Ramset/Redhead, Trubolt Kwik Bolt 3 by Hilti, or equal. Anchors shall have ICC-approved testing.
- B. Where indicated in the drawings, drilled anchors shall be Type 316 stainless steel heavy-duty wedge anchors suitable for dynamic loading. Anchors shall be HSL heavy-duty wedge anchor by Hilti, Power-Bolt by Rawlplug Company, or equal. For metric anchors, use the size that is closest to, but no smaller than, the required English size.

2.06 EPOXY ANCHORS

- A. Epoxy anchors in concrete shall be Type 316 stainless steel threaded rod adhesive anchors. Epoxy adhesive shall comply with ASTM C881, Type IV, Grade 3, Class B or C. Adhesive shall be Rawl Power-Fast, Hilti HIT RE 500, Simpson Epoxy-tie with SET epoxy, or equal. Epoxy anchor assemblies shall be ICC approved.
- B. Epoxy anchors in grouted concrete masonry walls shall be Hilti HIT HY-150 adhesive and ASTM A36 F593 Type 316 stainless steel threaded rods as indicated in the drawings.

2.07 SCREW ANCHORS

A. Screw anchors shall be Titan HD screw anchors by Simpson, HUS-H by Hilti, or equal.

2.08 EMBEDDED EYEBOLTS

A. Eyebolts shall be of the welded-eye or forged type, Type 316 stainless steel.

2.09 THREADED CARBON STEEL LIFTING EYES

A. Threaded carbon steel lifting eyes shall comply with ASTM A489, Type 1, Style B.

PART 3 - EXECUTION

3.01 STORAGE OF MATERIALS

A. Store material, either plain or fabricated, above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

3.02 GALVANIZING

A. Zinc coating for bolts, anchor bolts, and threaded parts shall be in accordance with ASTM F2329.

3.03 INSTALLING CONNECTION BOLTS

- A. Use steel bolts to connect structural steel members. Use stainless steel bolts to connect structural aluminum members.
- B. Install washers per AISC Specification for ASD.
- C. Bolt holes in structural members shall be 1/16 inch in diameter larger than bolt size. Measure cast-in-place bolt locations in the field before drilling companion holes in structural steel beam or assembly.
- D. Slotted holes, if required in the drawings, shall conform to AISC Specifications, Chapter J, Section J3, Table J3.1.
- E. Drive bolts accurately into the holes without damaging the thread. Protect boltheads from damage during driving. Boltheads and nuts or washers shall rest squarely against the metal. Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with a plane normal to the bolt axis, provide beveled washers to give full bearing to the head or nut. Where self-locking nuts are not furnished, bolt threads shall be upset to prevent the nuts from backing off.
- F. Bolts shall be of the length that will extend entirely through but not more than 1/4 inch beyond the nuts. Draw boltheads and nuts tight against the work. Tap boltheads with a hammer while the nut is being tightened.

3.04 INSTALLING ANCHOR BOLTS

- A. Preset bolts and anchors by the use of templates. For mechanical equipment (pumps, compressors, and blowers), do not use concrete anchors set in holes drilled in the concrete after the concrete is placed.
- B. For static items (storage tanks and heat exchangers), use preset anchor bolts or drilled anchors with ICC report data.
- C. After anchor bolts have been embedded, protect projecting threads by applying grease and having the nuts installed until the time of installation of the equipment or metalwork.
- D. Minimum depth of embedment of drilled mechanical anchors shall be as recommended by the manufacturer, but no less than that shown in the drawings.
- E. Minimum depth of embedment of epoxy anchors shall be as recommended by the manufacturer, no less than that shown in the drawings, or eight times the bolt diameter minimum.
- F. Prepare holes for drilled and epoxy anchors in accordance with the anchor manufacturer's recommendations prior to installation.

END OF SECTION

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.01 REQUIREMENT

A. The Contractor shall furnish and construct all light metal framing and appurtenant work, complete and in accordance with the requirements of the Contract Documents.

1.02 RELATED SECTIONS

- A. Section 05 50 00 Metal Fabrications
- B. Section 09 29 00 Gypsum Board

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Codes:

1. The Building Code, as referenced herein, shall be the Uniform Building Code (UBC), as specified in **Section 01 42 19 Reference Standards**.

B. Commercial Standards:

ANSI/ASTM A 446/5/446M-83 Specification for Steel Sheet, Zinc-Coated (Galvanized)

by the Hot-Dip Process, Structural (Physical) Quality.

ASTM A 570-84a Specification for Hot-Rolled Carbon Steel Sheet and

Strip, Structural Quality.

ASTM C 645 Specification for Non-Load (Axial) Bearing Steel Studs,

Runners (Track) and Rigid Furring Channels for Screw

Application of Gypsum Board.

Metal Lath Association Specifications for Metal Lathing and Furring.

Gypsum Association Specifications for Installation of Screw-Type Steel

Framing Member to Receive Gypsum Board, GA-203.

PART 2 - PRODUCTS

2.01 METAL STUDS

- A. Non-Load Bearing: Metal studs shall be of the non-load-bearing channel type, roll-formed from 18-gage and 20-gage electro-galvanized steel. Tracks and erection accessories shall be standard products of an established metal stud manufacturer unless otherwise specified or shown. Metal studs depth shall be 3-5/8 inch deep unless otherwise shown on the Drawings.
- B. <u>Height Limits and Schedule</u>: Maximum height limits for non-load-bearing studs shall be as follows, unless otherwise shown:

Stud Schedule Spacing Ctr. to Ctr.

Gage	(inches)	<u>2-1/2 Inch</u>
20	12	24-ft. 10-in.
20	16	23-ft. 7-in.
20	24	20-ft. 8-in.

C. 18-gage studs shall be used at non-load bearing walls having a lath and plaster condition.

2.02 MISCELLANEOUS MATERIALS

- A. <u>Hanger Wire</u>: Hanger wire for suspended gypsum board ceilings shall be of soft-temper, annealed and galvanized steel wire. Hanger wire size shall be not less than that required by governing code.
- B. <u>Runner Channels</u>: Runner channels shall be 1-1/2 inch cold-rolled channels and 3/4-inch stiffener channels, galvanized or factory-coated with rust-inhibitive paint. Channels shall have minimum weight of 475 and 300 lbs./1000 L.F., respectively.
- C. <u>Furring Channels</u>: Furring channels shall be designed for screw attachment of 5/8-inch gypsum wallboard. They shall be roll-formed, galvanized Grade "A" steel conforming to ANSI/ASTM A 446, with a metal thickness of 0.035-inch minimum, 7/8-inch depth and 1-3/8-inch web.
- D. Tie Wire: Tie wire shall be galvanized, 16-gage, annealed steel wire.
- E. <u>Fasteners</u>: Fasteners shall be as required and as recommended within the Reference Standards.
- F. <u>Welding Materials</u>: Welding materials shall be as recommended in the published standards of the structural stud manufacturer.
- G. <u>Power-Driven Pins</u>: Power-driven pins to be installed in concrete or steel shall be of heat-treated steel alloy. If the pins are not sufficiently corrosion-resistant for the conditions to which they are to be exposed, they shall be protected in an acceptable manner. Pins shall have capped or threaded heads capable of transmitting the loads the shanks are required to support. Pins that are connected to steel shall have longitudinal serrations around the circumference of the shank. Complete information describing pin capacity, connections and proposed area of use shall be submitted to the Engineer.

PART 3 - EXECUTION

3.01 INSTALLATION REQUIREMENTS

A. All work shall be installed in conformance with the manufacturer's recommendations and per the applicable requirements of UBC, ANSI and other referenced standards as specified or shown.

3.02 CEILING SUSPENSION SYSTEM

A. <u>Components</u>: All necessary items for a complete installation shall be provided, including devices for attachment to overhead construction, hanger wires, main runners, splines, splicers, connecting clips, wall connectors, hold-down clips, edge moldings and other appurtenances.

- B. <u>Hanger Wires</u>: Hanger wires shall be spaced along the main runner so that each hanger supports a minimum area of 16 square feet.
- C. <u>Runner Channels</u>: Main runners shall be 1/2-inch channels spaced at 4-feet on centers. Hanger wires shall be saddle-tied along runners. Cross furring channels shall be spaced at 16-inches on centers, maximum, and shall be saddle-tied to main runner channel.
- D. <u>Interruptions</u>: At any openings that interrupt the continuity of furring channels, additional cross reinforcing shall be provided to restore lateral stability or grillage.

3.03 METAL STUDS, FURRING AND FRAMING (FOR NON-BEARING WALLS)

- A. <u>Runner Track Attachment</u>: Floor and ceiling runner tracks shall be securely fastened to floor (or floor plate if required) and overhead construction as shown and as required.
- B. <u>Stud Attachment</u>: Studs shall be securely fastened to tracks and spaced in accordance with the stud schedule. Each stud shall be crimped into runner tracks at the top, bottom and both sides for friction fit 1/4-inch deflection clearance on top.
- C. <u>Wall Stiffening</u>: Walls shall be stiffened with 3/4-inch channels placed horizontally at not more than 4-1/2-foot vertical spacing.
- D. <u>Stud Requirements</u>: Metal stud installation shall conform to the following requirements:
 - 1. Studs shall be located at all door jambs, at abutting construction, intersecting walls and corners. Each corner and intersection of walls and partitions shall be formed with not less than three (3) studs.
 - 2. Double 20-gage studs shall be installed at all door jamb and header locations as shown on the Drawings and shall be secured to the jamb anchors of each door frame by bolt or screw attachment.
 - 3. Studs extending from door frame header to ceiling runner over door frames shall be positioned at wall board joints. Stud walls which do not extend to the structures above the ceiling shall be braced to the structure at every 6-feet and at door jamb locations.
 - 4. The Contractor shall install 20-gage studs at wall-mounted fixtures and at a maximum of 12-inches on centers at walls having a lath and plaster condition or receiving ceramic tile.
 - 5. Stud walls shall be braced as necessary to provide rigid construction. Double row of studs for chase walls shall be braced with cross ties of 5/8-inch thick gypsum board, 12-inches wide, installed at quarter points of studs.
 - 6. Parapet walls and hung exterior walls and soffits shall be framed as shown with not less than 18-gage studs.
 - 7. Double 20-gage studs shall be installed at all window jamb, sills and headers as shown on the Drawings.
- E. Openings: Openings shall conform to the following requirements:
 - 1. Channels shall be provided around openings for attachment of metal frames, dampers, grilles and ductwork in connection with metal studs and shall be securely fastened to studs.

- 2. Headers, sills and jack studs shall be provided as required at openings. Headers shall overlap adjacent vertical studs and shall be securely screw-attached to adjacent studs.
- 3. A 1-1/2-inch channel stiffener shall be installed 6-inches above all door openings. Stiffeners shall extend past the second single stud on each side of the opening and shall be saddle-tied to the structure.
- F. <u>Lintels</u>: Trussed or box-framed lintel members designed to resist applied loads without excessive deflection shall be provided and shall be secured together by screws or other approved means.
- G. <u>Support for Wall-Mounted Items</u>: Solid blocking, 1-1/2-inch channels, horizontal studding or other members within walls shall be provided as required and/or shown to provide secure and adjacent support for wall-mounted or wall-braced items. Galvanized plates shall be provide as backing for handrail brackets, 16-gage by 8-inch by 16-inch.
- H. <u>Horizontal Stiffeners</u>: Ends of horizontal stiffeners shall be securely fastened to abutting construction.
- I. <u>Furring Channels</u>: Furring channels shall be spaced 16-inches on centers, maximum, unless shown otherwise. Spans shall not exceed manufacturer's published recommendations and governing code requirements.

3.04 WORKMANSHIP

- A. <u>Alignment</u>: All metal studs shall be installed rigid, in line, level and plumb and shall be suitable for the application of the intended succeeding contiguous materials. The maximum allowable deviation in any plane shall be 1/8-inch from an 8-foot straight line and 1/4-inch maximum in a surface having a total length in excess of 8-feet.
- B. <u>Component Fit</u>: All framing members and tracks shall meet the following requirements:
 - 1. All framing components shall be cut squarely or on an angle, as in bracing, to fit squarely against abutting members.
 - 2. Tracks shall be securely anchored to the floor and overhead structure or other members.
 - 3. Studs shall be seated squarely in the track with the stud web and flanges abutting the track web, shall be plumbed, aligned and shall be adequately attached to the flanges or web of both the upper and lower tracks.

END OF SECTION

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.01 REQUIREMENT

- A. The Contractor shall furnish, fabricate and install miscellaneous metalwork and appurtenances, complete and in accordance with the requirements of the Contract Documents.
- B. Work included under this section includes but is not limited to: Anchor Bolts.
- 1.02 RELATED WORK NONE

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. All work specified herein shall conform to or exceed the requirements of the Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.
- B. Products and their delivery, handling and installation shall be in accordance with the following trade standards, codes or specifications.
- C. Commercial Standards:

Aluminum	A	A A 1 (122	C22 4 41
Aluminum	ASSn.	AA-WDZ	C22A41

AISC	Specifications and Commentary
AISI	Specifications and Commentary
ASTM A 36/A36M	Specification for Structural Steel
ASTM A 48	Specification for Gray Iron Casting
A C.T.M. A. 52	Specification for Ding Steel Plack

ASTM A 53 Specification for Pipe, Steel, Black and Hot-Dipped Zinc-

Coated, Welded and Seamless

ASTM A 123 Specification for Zinc (Hot-Galvanized) Coatings on Products

Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates,

Bars and Strip

ASTM A 153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel

Hardware

ASTM A 307 Specification for Carbon Steel Externally Threaded Standard

Fasteners

ASTM A 563 Specification for Carbon and Alloy Steel Nuts

ASTM A 575 Specifications for Steel Bars, Carbon, Merchant Quality, M-

Grades

ANSI/AWS D1.1 Structural Welding Code - Steel

NFPA 101 Life Safety Code
NAAMM Metal Stairs Manual

1.04 SUBMITTALS

- A. <u>Shop Drawings</u>: Shop drawings of all miscellaneous metalwork shall be submitted to the Engineer for review in accordance with **Section 01 33 00 Submittal Procedures**.
- B. <u>Welders Qualifications</u>: Welders shall submit certified qualifications for the type of welding being performed.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. <u>Standard</u>: All structural steel shapes, plates, bars and their products shall conform to the requirements of ASTM A 36.
- B. <u>Corrosion Protection</u>: Unless otherwise shown, miscellaneous metalwork of fabricated steel, which will be used in a corrosive environment and/or will be submerged in water/wastewater shall be coated in accordance with **Section 09 90 00 Painting and Coating**, and shall not be galvanized prior to coating. All other miscellaneous steel metalwork shall be hot-dip galvanized after fabrication as specified herein.
- C. <u>Stainless Steel</u>: Stainless steel metalwork shall by of Type 316 stainless steel.

2.02 STEEL PIPE HANDRAILS

A. Steel pipe handrails which may be partially or wholly submerged or which are located inside a hydraulic structure shall be entirely of Type 316 stainless steel. All other steel pipe handrails shall be standard 1-1/2-inch black steel pipe made up by welding and hot-dip galvanized after fabrication.

2.03 STEEL STAIRS AND ALUMINUM SAFETY TREADS

- A. <u>Steel Stairs</u>: Steel stairs shall be fabricated in accordance with standard practice of the National Association of Ornamental Metal Manufacturers, and as shown. Steel stairs shall be hot-dip galvanized after fabrication.
- B. <u>Safety Treads</u>: Safety stair treads shall be provided on all stairs and elsewhere where shown. The safety treads shall be 4-inches wide, shall be of aluminum and shall be <u>American Metals</u> Company, Style A; American Mason Safety Tread Company; or equal.

2.04 LADDERS

A. Ladders which may be partially or wholly submerged or which are located inside a hydraulic structure shall be entirely of Type 316 stainless steel. All other ladders shall be of carbon steel, hot-dip galvanized after fabrication.

2.05 METAL GRATING AND FLOOR HATCHES

- A. <u>General</u>: Metal grating and floor hatches shall be of the design, sizes and types shown.
- B. <u>Metal Grating</u>: Metal grating shall be of aluminum or stainless steel as shown. No single piece of grating shall weigh more than 80-lbs. unless specifically detailed otherwise. Aluminum shall

be 6061T6 Alloy Bearing Bars and 6063T5 Alloy Cross Bars. Stainless steel shall be Type 316. All grating shall be completely banded. Grating shall be rated at 150 lb/sq. ft.

2.06 SEAT ANGLES AND SUPPORTS

A. Seat angles for grating shall be aluminum or stainless steel. All support angles buried, submerged or below top of hydraulic structures shall be stainless steel.

2.07 BOLTS AND ANCHORS

- A. <u>Galvanized Bolts</u>: Except where otherwise shown or specified, all bolts, anchor bolts and nuts shall be steel, galvanized after fabrication as specified herein. Threads on galvanized bolts and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing.
- B. <u>Steel for Bolts</u>: Except as otherwise specified herein, steel for bolts, anchor bolts and cap screws shall be in accordance with the requirements of ASTM A 307 Grade B, or threaded parts of ASTM A 36 and shall meet the following additional requirements:
 - 1. The nut material shall be free-cutting steel.
 - 2. The nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. All bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.
 - 3. The length of all bolts shall be such that after joints are made up, each bolt shall extend through the entire nut, but in no case more than 1/2-inch beyond the nut.
- C. <u>Stainless Steel Bolts</u>: Unless otherwise shown, all bolts, anchor bolts, washers and nuts which are buried, submerged or below the top of the wall inside any hydraulic structure shall be of Type 316 stainless steel.
- D. Unless otherwise shown, expanding-type anchors shall be steel expansion type Phillips Drill Company "Red Head" anchors;; McCullock Industries "Kwick-Bolt"; or equal. Lead caulking anchors will not be permitted. Size shall be as shown. Expansion type anchors which are to be embedded in grout may be steel. Non-embedded buried, submerged or below top of hydraulic structure anchors shall be entirely stainless steel.

2.08 POWER-DRIVEN PINS

A. Power-driven pins shall not be used unless specifically approved by the Engineer.

PART 3 - EXECUTION

3.01 FABRICATION AND INSTALLATION REQUIREMENTS

- A. <u>Fabrication and Erection</u>: Except as otherwise shown, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction".
- B. Aluminum Railings: Aluminum railing is specified in Section 05 52 00.

C. <u>Steel Railings</u>: Field welding of steel pipe handrail joints will be permitted only if approved by the Engineer.

3.02 WELDING

- A. <u>Method</u>: All welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.
- B. Quality: In assembly and during welding, the component parts shall be adequately clamped, supported and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified for the AWS Code. Upon completion of welding, all weld splatter, flux, slag and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions. All burrs, spatter and sharp corners of material shall be ground smooth prior to coating.

3.03 GALVANIZING

A. All structural steel plates, shapes, bars and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A 123. Any galvanized part that becomes warped during the galvanizing operation shall be straightened. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153. Field repairs to galvanizing shall be made using "Galvinox", "Galvo-Weld", or approved equal.

END OF SECTION

SECTION 05 52 00 - HANDRAILS AND SAFETY CHAINS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes materials, fabrication, and installation of aluminum handrail and safety chains.

1.02 RELATED WORK

- A. Concrete: 03 30 00.
- B. Painting and Coating: 09 90 00.

1.03 DESIGN CRITERIA

A. Handrails, Walkways, Ladders, Personnel Platforms: OSHA, State Safety Standards and UBC.

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with the General Provisions and Section 01 33 00.
- B. Submit drawings of handrail and safety chains. Show dimensions and reference materials of construction by ASTM designation and grade. Show design criteria.
- C. Submit placing or erection drawings that indicate locations of handrail and safety chains. Reproductions of contract documents will not be accepted for this purpose.

PART 2 - PRODUCTS

2.01 ALUMINUM HANDRAILS

A. Construct aluminum handrails of clear anodized aluminum pipe conforming to ASTM B429, Alloy 6063-T6. Handrail shall be CV Pipe Rail by Craneveyor, Wesrail as manufactured by Moultrie Manufacturing Co., or equal.

2.02 STAINLESS STEEL HANDRAIL SAFETY CHAINS

A. Handrail safety chains shall be Type 316 stainless steel. Chains shall be proof coil style, 3/16 inch in diameter, with at least 12 links per foot and with snaphooks at each end. Snaphooks shall be Type 316 stainless steel.

2.03 WELDING ELECTRODES

- A. Welding electrodes for structural steel shall conform to AWS A5.5. Use electrodes in the E-70 series.
- B. Welding electrode for aluminum shall be ER4043 filler metal.

C. Welding electrodes for stainless steel shall conform to AWS 5.4. Use Electrodes E308 for Type 304 stainless steel and E316 for Type 316 stainless steel.

PART 3 - EXECUTION

3.01 STORAGE OF MATERIALS

A. Store material above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

3.02 FABRICATION AND ERECTION

- A. Clean the surfaces of metalwork to be in contact with concrete of rust, dirt, grease, and other foreign substances before placing concrete.
- B. Set embedded metalwork accurately in position when concrete is placed and support it rigidly to prevent displacement or undue vibration during or after the placement of concrete. Unless otherwise specified, where metalwork is to be installed in recesses in formed concrete, said recesses shall be made, metalwork installed, and recesses filled with dry-pack mortar in conformance with **Section 03 30 00**.

3.03 WELDING

- A. Perform welding on steel by the SMAW process. Welding shall conform to the AWS D1.1-2006, except as modified in AISC Section J2.
- B. Perform welding on aluminum by the gas metal arc (MIG) or gas tungsten arc (TIG) process. Welding shall conform to the AWS D1.2-2003.
- C. Perform welding on stainless steel by the gas tungsten arc (TIG) process. Welds shall be full penetration and smooth. Provide inert gas on the inside of pipe during welding to reduce oxidation.
- D. Provide a minimum of two passes for metal in excess of 5/16-inch thickness.
- E. Produce weld uniform in width and size throughout its length with each layer of weldment smooth; free of slag, cracks, pinholes, and undercuttings; and completely fused to the adjacent weld beads and base metal. Avoid irregular surface, nonuniform bead pattern, and high crown. Form fillet welds of the indicated size of uniform height and fully penetrating. Accomplish repair, chipping, and grinding of welds in manner that will not gouge, groove, or reduce the base metal thickness.

3.04 INSTALLING HANDRAILS

A. Provide handrail components to complete the installation for the various types of handrail.

3.05 INSTALLING SAFETY CHAINS

A. Provide two chains 4 inches longer than the access opening for each opening. Mount the top chain 3 feet 6 inches above the floor, and mount the lower chain 2 feet above the floor.

3.06 CORROSION PROTECTION FOR ALUMINUM SURFACES

- A. Coat aluminum surfaces to be embedded or which will be in contact with concrete or masonry per **Section 09 90 00**, System No. 54 before installation. Allow the coating to dry before the aluminum is placed in contact with the concrete.
- B. Where aluminum surfaces come in contact with dissimilar metals, keep the dissimilar metallic surfaces from direct contact by use of neoprene gaskets or washers.

END OF SECTION

SECTION 05 53 00 – GRATING, COVER PLATES, AND ACCESS HATCHES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes materials, fabrication, and installation of steel and aluminum grating, cover and floor plates, and access hatches.

1.02 RELATED WORK

- A. Concrete: 03 30 00.
- B. Painting and Coating: 09 90 00.

1.03 DESIGN CRITERIA

A. Grating, Floor Plates, and Miscellaneous Cover Plates: Design live load of 150 psf, maximum deflection of 1/240 of span.

1.04 SUBMITTALS

- A. Submit shop drawings in accordance with the General Provisions and Section 01 33 00.
- B. Submit drawings of grating, cover plates, and access hatches. Show dimensions and reference materials of construction by ASTM designation and grade. Show design criteria.
- C. Submit placing or erection drawings that indicate locations of fabricated items. Reproductions of contract documents will not be accepted for this purpose.

PART 2 - PRODUCTS

2.01 DESIGN OF GRATING, FLOOR PLATES, AND MISCELLANEOUS COVER PLATES

- A. Grating, floor plates, and miscellaneous cover plates shall be as detailed in the drawings or, if not detailed, shall be designed per subsection on "Design Criteria" in Part 1. No single piece of grating, floor plate, or miscellaneous cover plate shall weigh more than 80 pounds. Length of individual pieces shall not exceed one and one-half times the width, unless limited by the installation.
- B. Field measure grating and cover plates for proper cutouts and size.
- C. Grating shall be completely banded. For pipe and conduits (including electrical conduit) larger than 1 inch in diameter penetrating grating, cut and band grating.

2.02 STAINLESS STEEL PLATE AND MEMBERS

A. Except where otherwise specified, stainless steel plate and members shall be Type 316 or 316L, ASTM A240 or A666.

2.03 ALUMINUM SHEET

A. Aluminum sheet shall conform to ASTM B209, Alloy 3003, H 14 temper.

2.04 ACCESS HATCHES

- A. Access hatches shall be stainless steel or Bilco Type D of the size and configuration shown in the drawings and in Section 07 72 33. Latch and lifting mechanism assemblies, hold-open arms and guides, and brackets, hinges, pins, and fasteners shall be Type 316 stainless steel.
- B. Locking and Latching Devices: Recessed hasp covered by a hinged lid flush with the exterior surface.

2.05 GRATING

A. Grating shall be aluminum (Alloy 6061 or 6063, Temper T6). Main bars shall be of the thickness and of the depth indicated in the drawings.

2.06 CHECKERED COVER PLATES

A. Checkered cover plates shall be aluminum or stainless steel. Minimum thickness shall be 0.25 inch as shown in the drawings. Provide U-bolt lifting handles located at opposite ends on each removable section. Handles shall be recessed to reduce tripping hazards. Steel plates, including angle edgings, support angles, and lifting handles, shall be stainless steel. Aluminum plates shall comply with ASTM A786, Pattern 4, with material conforming to ASTM B209, Alloy 6061-T6. Stainless steel plates shall conform to ASTM A793, Pattern A, Grade S31600 or S31603.

2.07 FRAMES AND SUPPORTS FOR GRATING AND CHECKERED PLATES

A. Fabricated frames and supports for grating and checkered cover plates shall be stainless steel. Corners of embedded angle frames shall be mitered and welded with the welds ground smooth.

2.08 WELDING ELECTRODES

- A. Welding electrodes for structural steel shall conform to AWS A5.5. Use electrodes in the E-70 series.
- B. Welding electrode for aluminum shall be ER4043 filler metal.
- C. Welding electrodes for stainless steel shall conform to AWS A5.4. Use electrodes as follows:

Stainless Steel Material	Welding Electrode Material
Type 304	E 308
Type 304L	E 347
Type 316	E 316
Type 316L	E 318

PART 3 - EXECUTION

3.01 STORAGE OF MATERIALS

A. Store structural material, either plain or fabricated, above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

3.02 INSTALLATION AND ERECTION

- A. Clean the surfaces of metalwork to be in contact with concrete of rust, dirt, grease, and other foreign substances before placing concrete.
- B. Set grating seats and frames and checkered plate frames and supports accurately in position when concrete is placed and support it rigidly to prevent displacement or undue vibration during or after the placement of concrete. Unless otherwise specified, where metalwork is to be installed in recesses in formed concrete, said recesses shall be made, metalwork installed, and recesses filled with dry-pack mortar in conformance with **Section 03 30 00**.
- C. Set seat angles for grating so that the grating will be flush with the floor. Maintain the grating and floor plates flush with the floor. Seat angles and anchors shall be stainless steel.

3.03 FASTENING

A. Fasten grating panels to supporting members with two saddle clips at each end of each panel bolted to studs that are welded to supporting members. Bolt studs shall be 1/4 inch in diameter and of the same material as the supporting members. Saddle clips shall be the same material as the grating.

3.04 WELDING

- A. Perform welding on steel by the SMAW process. Welding shall conform to AWS D1.1-2006, except as modified in AISC Section J2.
- B. Perform welding on aluminum by the gas metal arc (MIG) or gas tungsten arc (TIG) process. Welding shall conform to AWS D1.2-2003.
- C. Perform welding on stainless steel by the gas tungsten arc (TIG) process. Welds shall be full penetration and smooth. Provide inert gas on the inside of pipe during welding to reduce oxidation.
- D. Provide a minimum of two passes for metal in excess of 5/16-inch thickness.
- E. Produce weld uniform in width and size throughout its length with each layer of weldment smooth; free of slag, cracks, pinholes, and undercuttings; and completely fused to the adjacent weld beads and base metal. Avoid irregular surface, non-uniform bead pattern, and high crown. Form fillet welds of the indicated size of uniform height and fully penetrating. Accomplish repair, chipping, and grinding of welds in manner that will not gouge, groove, or reduce the base metal thickness.

3.05 CORROSION PROTECTION OF ALUMINUM SURFACES

- A. Coat aluminum surfaces to be embedded or which will be in contact with concrete or masonry per **Section 09 90 00**, System No. 54 before installation. Allow the coating to dry before the aluminum is placed in contact with the concrete.
- B. Where aluminum surfaces come in contact with dissimilar metals, keep the dissimilar metallic surfaces from direct contact by use of neoprene gaskets or washers.

END OF SECTION

SECTION 05 56 00 - METAL CASTINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section includes the specifications for the vault watertight frames and covers.
- B. The CONTRACTOR shall furnish and install the frames and covers on the vaults described in **Section 03 41 00** and the DRAWINGS.
- C. The cove shall be level with the adjacent site shown in the plan.

1.02 REFERENCED SECTIONS

- A. Related Sections are shown below:
 - 1. Section 03 41 00 Pre Cast Structural Concrete

1.03 CITED STANDARDS

- A. All metal castings shall conform to the following standard specifications, of the latest revisions, as applicable:
 - 1. ASTM A-48, for Class 35B Gray Iron Castings.
- 1.04 NOTED RESTRICTIONS NO ADDITIONAL REQUIREMENTS
- 1.05 QUALITY CONTROL NO ADDITIONAL REQUIREMENTS

PART 2 - PRODUCTS

2.01 MANHOLE FRAMES AND COVERS

- A. Manhole frames, and covers shall be cast iron conforming to minimum requirements of latest ASTM A-48, for Class 35B Gray Iron Castings.
- B. Manhole frames, and covers shall be of heavy-duty watertight construction complete with cover gaskets glued to the frame and stainless steel bolts.
- C. Assembly shall be rated for AASHTO H-20, live loads of 16,000 lbs. with a 30% impact factor.
- D. Castings shall be made accurately to required dimensions, fully interchangeable, sound, smooth, clean and free from blisters or other defects. Defective castings which have been plugged or otherwise treated shall not be used.
- E. Contact surfaces of all manhole covers and corresponding supporting rings in rims shall be machined to provide full perimeter contact.
- F. Manhole frames and covers shall be of size and location as shown on DRAWINGS.

METAL CASTINGS 05 56 00 - 1

G. Manhole frame and cover assemblies shall be R-1916-H with 30" opening as manufactured by Neenah Foundry Co. or OWNER-approved equal.

PART 3 - EXECUTION

- 3.01 PREPARATION NONE
- 3.02 INSTALLATION
 - A. The CONTRACTOR shall install the manhole assemblies on the vault covers in accordance with DRAWINGS and the manufacturer's recommendations.
 - B. The CONTRACTOR shall provide a watertight seal between the manhole frame and the vault cover utilizing an approved gasket and/or joint compound.
- 3.03 TESTING NONE

PART 4 - MEASUREMENT AND PAYMENT - NOT USED

END OF SECTION

METAL CASTINGS 05 56 00 - 2

SECTION 05 80 00 - STRUCTURAL AND MISCELLANEOUS METALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section describes materials, fabrication, and installation of aluminum and miscellaneous nonferrous metals, anchor bolts, bolts, cast iron frames and covers, grating and frames, hatches, ladders, manhole frames and covers, metal fasteners and welding, metal roof decking, miscellaneous aluminum, miscellaneous cast iron, miscellaneous other metal items, miscellaneous structural steel, pipe handrails, pipe sleeves, inserts, and gates, structural steel, sheet metalwork, and tread plates and frames.

1.02 REFERENCED SECTIONS

- A. Related Sections are shown below:
 - 1. Section 01 33 00 Submittal Procedures.

1.03 CITED STANDARDS

- A. Structural Connections and Framing: AISC Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings (Eighth Edition), except delete Section 1.1, the last sentence of Sections 1.26.1 and 1.26.3, and Part 2 in its entirety.
- B. Handrails, Walkways, Ladders, Personnel Platforms: OSHA, California State Safety Standards or UBC, whichever is more stringent.
- C. Grating, Floor Plates, and Miscellaneous Cover Plates: Minimum design live load of 150 psf, maximum deflection of $^{1}/_{240}$ of span.

1.04 NOTED RESTRICTIONS

1.05 QUALITY CONTROL

A. For Welding, the CONTRACTOR shall provide for continuous inspection of welding by International Code Council certified inspector.

1.06 SUBMITTALS

- A. Submit shop DRAWINGS in accordance with Section 01 33 00 Submittal Procedures.
- B. Submit DRAWINGS of fabricated items, such as grating, bolts, handrail, ladders, concrete anchors, and access hatches. Show dimensions and reference materials of construction by ASTM designation and grade.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Unless otherwise specified or indicated on the DRAWINGS, structural and miscellaneous metals shall conform to the standards of the American Society for Testing and Materials (ASTM), including the following:

<u>Item</u>	ASTM Standard	Type or Alloy No.	Class, Grade, No.	
<u>Cast Iron</u>				
Cast Iron	A 48		Class 40B	
Steel				
Galvanized sheet iron or steel	A 446		Coating G90	
	A 525			
	A 526			
Black steel, sheet or strip	A 569			
Black steel, sheet of strip	A 570			
Coil (plate)	A 635			
Steel rolled shapes	A992			
Structural plate, bars, and miscellaneous steel items	A36			
Standard bolts, nuts, and washers	F1554		Grade 36	
High strength bolts, nuts, and hardened flat washers	A 325			
	A 490			
Eyebolts	A 489	Type 1		
Tubing, cold-formed	A 500		Grade B	
Tubing, hot-formed	A 501			
Steel pipe	A 53		Grade B	
Stainless steel				
Plate, sheet and strip	A 167	Type 316		
Bars and shapes	A 276	Type 316		
Aluminum				
Sheet aluminum-flashing, 0.032 inches min. thickness	B 209	Alloy 5005-H14,		
Sheet aluminum-structural	B 209	Alloy 6061-T6		
Structural aluminum	B 308	Alloy 6061-T6		
	B 209			
Extruded aluminum	B 221	Alloy 6063-T42		

Stainless steels are designated by type or series defined by AISI.

B. Metal Fastening

1. General

a. Unless otherwise indicated on the DRAWINGS or specified, metal fastening shall be as follows.

2. Bolting

- a. Bolts, except high strength bolts, shall be provided with flat washers and self-locking nuts, or lock washers and nuts.
 - 1) Bolt heads and nuts shall be hex-type.
 - 2) Bolts, nuts, and washers shall be of domestic manufacture.
- b. Bolts, including anchor bolts, nuts, washers, Simpson clips, hangers and similar fasteners in contact with PTDF are specified to be galvanized, shall be galvanized in accordance with ASTM A 153.
- c. After installation, bolts, including anchor bolts and concrete anchors, shall project a minimum of two threads but not more than ½-inch beyond the nut.
- d. Unless otherwise specified, bolts, including anchor bolts and concrete anchors, shall be tightened to the snug-tight condition. The snug-tight condition shall be defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench.

3. High Strength Structural Bolts

- a. High strength bolts, nuts, and hardened flat washers shall conform to ASTM A 325 or ASTM A 490, as indicated on the DRAWINGS.
- b. Connections with high strength bolts shall be considered to be slip critical structural connections unless otherwise indicated on the DRAWINGS.
 Connections with high strength bolts shall conform to the requirements of the AISC "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - 1) A hardened flat washer shall be provided under the element, nut or bolt head, turned in tightening. On outer plies for short slotted holes.
 - 2) CONTRACTOR shall notify OWNER in advance of the method selected for tightening and verification pursuant to the referenced AISC Specification.
- 4. Assembly Bolts Bolts, nuts, and washers for field assembled construction shall be as follows:
 - a. Type 316 stainless steel in wet and moist locations, including:
 - 1) Dry side of walls of water containing structures.
 - 2) Pump and equipment bases.
 - 3) Aluminum assemblies.
 - 4) Dry or exposed sides of walls of earth supporting structures.
 - 5) Buried locations.
 - b. A non-seize compound shall be applied at all times when attaching stainless steel bolts.

c. Hot-dip galvanized ASTM A 307 steel for galvanized assemblies and for applications other than those specified hereinbefore.

5. Eyebolts

a. Eyebolts shall be Type 316 stainless steel.

C. Fasteners for Use in Concrete

1. General

a. Fasteners for use in concrete shall be as specified hereinafter. "Slug-in," lead cinch, and similar systems relying on the deformation of lead alloy or similar materials in order to develop holding power shall not be used.

2. Anchor Bolts

- a. Anchor bolts shall be cast in place when concrete is placed. Anchor bolts embedded in concrete shall be accurately located and with bolts perpendicular to the surface from which they project.
- b. Anchor bolts, nuts, and washers shall be as follows:
 - 1) Type 316 stainless steel.
- c. Anchor bolts shall not touch reinforcing steel. Where anchor bolts are within 1/4 inch of reinforcing steel, anchor bolts shall be insulated with not less than four wraps of 10-mil PVC tape in the area adjacent to the reinforcing steel.
- d. In anchoring machinery bases subject to heavy vibration, two nuts shall be used, one serving as a locknut.
- e. Bolts, when indicated on the DRAWINGS for future use, shall be first coated thoroughly with non-oxidizing wax, followed by turning nuts down to the full depth of thread. Exposed thread shall then be neatly wrapped with a waterproof polyvinyl tape.
- f. Anchor bolts shall be embedded not less than 10 diameters and shall have a standard hex bolt head or a 90-degree hook not less than 4 diameters in length. Where indicated on the DRAWINGS, anchor bolts shall be set in metal sleeves having an inside diameter approximately 2 inches greater than the bolt diameter and not less than 10-bolt diameters in length. Sleeves shall be filled with grout when the machine or other equipment is grouted in place.

D. Concrete Inserts

1. Concrete inserts for supporting pipe and other applications shall be as specified elsewhere in these Specifications. Unless otherwise specified, concrete inserts shall be Type 316 Stainless Steel.

E. Preformed Channel Pipe Supports

- 1. Preformed channel pipe supports for pipe supports and other applications shall be as specified elsewhere in these Specifications.
- 2. Chemical anchors for installation in concrete shall contain vinyl ester resin in the composition of the adhesive. Chemical anchors shall be Hilti HVA Adhesive Anchor System manufactured by Hilti, or equal. The adhesive shall be packaged in pre-measured capsules. The chemical anchor shall have a current ICBO Evaluation Report.

Installation shall be in accordance with manufacturer's recommendations. Special inspection of the installation of the chemical anchors is required and shall be in accordance with UBC 306. Thread rods shall conform to ASTM A 36 and shall be zinc plated or hot-dip galvanized. Stainless steel all-thread-rods conforming to ASTM F 593 shall be used for corrosive conditions where indicated on the DRAWINGS. Reinforcing bars shall be used in lieu of the all-thread-rods where indicated on the DRAWINGS. All-thread-rods and reinforcing bars used with the adhesive capsules shall have a chisel point and shall be free of oil or other coatings that may reduce bond. Chemical anchors shall not be used to resist tension in overhead installations.

F. Miscellaneous Metal

1. Miscellaneous Aluminum

- a. Structural and other metal items fabricated from aluminum, not covered separately herein shall be fabricated in accordance with the best practices of the trade and shall be field assembled by riveting or bolting with no welding or flame cutting permitted.
- b. Aluminum in contact with other metal or concrete shall have the contact surface shop-painted as specified under **Section 09 00 00 Finishes**.

2. Miscellaneous Stainless Steel

a. All stainless steel unless noted otherwise in the Specifications or on the Plans, shall be stainless steel 316L.

3. Miscellaneous Structural Steel

a. Miscellaneous steel items not specified herein shall be as indicated on the DRAWINGS or specified elsewhere in these Specifications and shall be fabricated and installed in accordance with the best practices of the trade.

G. Sheet Metal

1. General

- a. Sheet metal flashing, counterflashing, facia, gravel stops, and other roofing accessories shall be in accordance with these Specifications.
- b. Sheet metal items not covered elsewhere shall be as indicated on the DRAWINGS and as required to provide a watertight installation. Formed sheet metal for metal covered work shall accurately reproduce the detail as indicated on the DRAWINGS; profiles, bends, and intersections shall be sharp, even, and true.

2. Aluminum Sheet Metal Work

a. Except as otherwise specified or indicated on the DRAWINGS, sheet aluminum shall be alloy 5005-H14 conforming to the requirements of ASTM B 209 and shall be not less than 0.032-inch in thickness. Extruded aluminum shall be 6063-T4, conforming to the requirements of ASTM B 221.

PART 3 - EXECUTION

3.01 PREPARATION – NONE

3.02 INSTALLATION

A. Fabrication and Erection

- 1. Fabrication and erection of steel items shall conform to AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings wherever applicable, except as the same may be modified by applicable building codes and these Specifications. Where anchors, connections or other details of miscellaneous metalwork are not definitely indicated on the DRAWINGS, or specified in the Specifications, their material, size, form, attachment, and location shall be equivalent in quality and workmanship to items specified herein.
- 2. Structural members such as W shapes, S shapes, channels, angles, and similar members which are not available in the quantity, size, and type of stainless steel specified or indicated on the DRAWINGS, shall be fabricated by welding together pieces of stainless steel plate. The stainless steel plate shall be low carbon stainless steel plate such as 316L. All welds between pieces of plate shall be full penetration welds. The fabricated members shall have the same or higher section modulus and moment of inertia as the indicated members. Submit the design of the fabricated members before fabricating of the members.
- 3. Galvanized structural steel or iron shall be hot-dip galvanized after fabrication in accordance with ASTM A 123. Electro-galvanizing shall not be used unless specified. Galvanized items that bend or twist during galvanizing shall be restraightened. Cut or otherwise damaged galvanized surfaces shall be field repaired to equivalent original condition using Galvinox; Galvo-Weld; or equal.
- 4. The CONTRACTOR shall take all measurements necessary to properly fit his work in the field, and he shall be governed by and be responsible for these measurements and the proper working out of all details. The CONTRACTOR shall be responsible for the correct fitting of all metalwork in the field. Sharp or hazardous projections shall be rounded off and ground smooth. The CONTRACTOR shall paint steel and miscellaneous ferrous metal items in accordance with these Specifications.
- 5. Where aluminum comes in contact with dissimilar metals, except stainless steel, it shall be bolted with stainless steel bolts and separated or isolated from the dissimilar metals, with neoprene gaskets, sleeves, and washers. Those parts of aluminum which will be cast into concrete or which will be in contact with concrete, masonry, or wood shall be coated as specified elsewhere in these Specifications.
- 6. The threads of stainless steel bolts shall be coated, prior to installing the nut, with Never-Seez manufactured by Never Seez Compound Corporation; WLR No. 111 manufactured by Oil Research, Inc.; or equal.

B. Welding

1. General

a. Welding of structural metals shall be done by welders who have a current American Welding Society (AWS) certificate for the type of welding to be done by the welder. The CONTRACTOR shall notify the OWNER at least 24 hours before

- starting shop or field welding. The ENGINEER may check the materials, the equipment, and the qualifications of the welders. Welders doing unsatisfactory work shall be removed from the Work, or may be required to requalify.
- b. The OWNER may use gamma ray, magnetic particle, dye penetrant, trepanning, or any other aid to visual inspection which he may deem necessary on any part or all welds to examine the welds.
- c. The cost of retests on defective welds shall be borne by the CONTRACTOR. Cost in connection with qualifying welders shall also be borne by the CONTRACTOR.
- d. Welds shall be full penetration welds unless otherwise indicated on the DRAWINGS.

2. Welding Aluminum

- a. Welding of aluminum shall be in accordance with AWS D1.2, Structural Welding Code Aluminum. Detail requirements for welding aluminum alloy 6061-T6 shall be as specified in the following paragraphs.
- b. Filler metal for welding aluminum shall be aluminum alloys conforming to the requirements of AWS A5.10 and shall be AWS classification ER 4043, ER 5654, ER 5554, ER 5183, ER 5356, or ER 556.
- c. Welding of structures which are to be anodized shall be done using filler alloys which will not discolor when anodized. ER 5654, ER 5554, ER 5183, ER 5356, or ER 5556 filler alloys shall be used.
- d. Dirt, grease, forming or machining lubricants, and organic materials shall be removed from the areas to be welded by cleaning with a suitable solvent or by vapor degreasing. Additional operations to remove the oxide coating just prior to welding shall be performed when the inert gas tungsten arc welding method is used. This may be done by etching or by scratch brushing. The oxide coating may not need to be removed if the welding is done with the automatic or semi-automatic inert gas shielded metal arc.
- e. Suitable edge preparation to assure 100 percent penetration in butt welds shall be used. Oxygen cutting shall not be used. Sawing, chipping, machining, or shearing may be used.
- f. Welding of aluminum shall be done using a non-consumable tungsten electrode with filler metal in an inert gas atmosphere (TIG) or using a consumable filler metal electrode in an inert gas atmosphere (MIG). No welding process that requires the use of a welding flux shall be used.

3. Welding Stainless Steel

a. The general requirements of AWS D1.1, Structural Welding Code - Steel, shall apply to the welding of stainless steel. Welding of stainless steel shall be done with electrodes and techniques recommended in "Welded Austenitic Chromium-Nickel Stainless Steel - Techniques and Properties" distributed by the Nickel Development Institute, Toronto, Canada, and in accordance with AWS D10.4 Recommended Practice for Welding Austenitic Chromium - Nickel Stainless Steel Piping and Tubing.

4. Welding Steel

a. Welding of steel shall conform to AWS D1.1 "Structural Welding Code - Steel."

b. Welding of ASTM A 36 structural steel, ASTM A 500 and A 501 structural tubing, and ASTM A 53 pipe shall be with electrodes conforming to AWS A5.1 "Specification for Carbon Steel Covered Arc Welding Electrodes," using E70XX electrodes; AWS A5.17 "Specifications for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding," using F7X-EXXX electrodes; or AWS A5.20 "Specifications for Carbon Steel Electrodes for Flux Cored Arc Welding," using E7XT-X electrodes.

C. Structural Metals

1. General

- a. Structural or foundry items shall be carefully fabricated to true dimensions without warp or twist. Welded closures shall be neatly made; and where weld material interferes with fit or is unsightly in appearance, it shall be ground off smooth.
- b. Structural items shall be installed accurately and securely, true to level, plumb, in correct alignment and grade, with all parts bearing or fitting the structure or equipment for which intended. Cocking out of alignment, redrilling, reshaping, or forcing to fit fabricated items will not be permitted. CONTRACTOR shall place anchor bolts or other anchoring devices accurately and shall make surfaces which bear against structural items smooth and true to level to preclude the necessity of springing, redrilling, or reshaping.
- c. Structural items needing a special alignment to preserve straight, level, even, smooth lines shall be rigidly supported and braced and kept braced until concrete, grout, or dry pack mortar has hardened for a period of not less than 48 hours.
- d. The CONTRACTOR shall submit certified copies of mill tests or reports from a recognized commercial laboratory and they shall include chemical and tensile properties of each shipment of structural metal or part thereof having common properties. Tests and analyses shall be made in accordance with the applicable ASTM Standards.

2. Structural Aluminum

- a. The CONTRACTOR shall furnish and install structural aluminum items as indicated on the DRAWINGS and as specified. He shall provide supplementary parts necessary to complete each item even though such work is not definitely indicated on the DRAWINGS and specified in the Specifications. Their size, form, attachment, and location shall be such as to conform to the best of current practice.
- b. Materials not otherwise specified shall conform to the applicable ASTM Standards.
- c. Hole centers may be center punched and cutoff lines may be punched or scribed. Center punching and scribing shall not be used where such marks would remain on fabricated material.
- d. A temperature correction shall be applied where necessary in the layout of critical dimensions. The coefficient of expansion shall be considered to be 0.000013 per degree F.
- e. Material ½-inch thick or less may be sheared, sawed, or cut with a router. Material more than ½-inch thick shall be sawed or routed. Cut edges shall be true and smooth, and free from excessive burrs or ragged breaks. Reentrant cuts shall be

- avoided wherever possible. If used, they shall be filleted by drilling prior to cutting. Flame cutting of aluminum alloys is not permitted.
- f. Rivet or bolt holes may be punched or drilled to finished size before assembly. The finished diameter of holes for bolts shall be not more than \$^1/_{16}\$ inch larger than the nominal bolt diameter. Holes shall be cylindrical and perpendicular to the principal surface. Holes shall not be drifted in such a manner as to distort the metal.
- g. Structural material shall not be heated, with the following exceptions:
- h. Aluminum material may be heated to a temperature not exceeding 400 degrees F for a period not exceeding 30 minutes to facilitate bending or welding. Such heating shall be done only when proper temperature controls and supervision are provided to ensure that the limitations on temperature and time are observed.
- i. Chips lodged between contacting surfaces shall be removed before assembly.

3. Structural Steel

a. Structural steel shall be delivered free from mill scale, rust, or pitting. Items not galvanized or protected by a shop coat of paint shall be protected from the weather until erection and painting. CONTRACTOR shall provide supplementary parts required for a complete structural steel erection even where such supplementary parts and work are not specified in detail in the Specifications or indicated on the DRAWINGS.

3.03 TESTING – NONE

PART 4 - MEASUREMENT AND PAYMENT - NOT USED

END OF SECTION

SECTION 07 05 00 – COMMON WORK RESULTS FOR THERMAL AND MOISTURE PROTECTION

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. The General Conditions apply to all work of this specification, which shall be done as shown on the plans, and as specified, and shall be properly coordinated with work in other Specifications.
- B. The DRAWINGS and these Specifications are complementary to each other; what is called for by one shall be as binding as if called for by both. If there is any conflict between what is shown on the DRAWINGS and what is written in the Specifications, the details described on the DRAWINGS shall take precedence and the CONTRACTOR shall communicate the conflicts to the ENGINEER in a timely manner.

C. Safety

1. The CONTRACTOR shall be familiar with, and shall at all times conform to, the regulations of the "OSHA General Industry Occupational Safety and Health Standards," "OSHA Safety and Health Regulations for Construction," and other applicable state and municipal standards and regulations.

PART 2 - PART 2 PRODUCTS - NOT USED

PART 3 - PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 07 21 00 – THERMAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.02 DESCRIPTION OF WORK

- A. Extent of insulation work is shown on drawings and indicated by provisions of this section.
- B. Applications of insulation specified in this section include the following:
 - 1. Rigid insulation.
 - 2. Foundation wall insulation (supporting backfill).
 - 3. Safing Insulation.
 - 4. Blanket-type building insulation.
 - 5. Roof Corner insulation.
- C. Roof insulation is specified in the Division 07 section in which other roofing products, including roofing membrane is covered.

1.03 QUALITY ASSURANCE

- A. <u>Thermal Resistivity</u>: Where thermal resistivity properties of insulation materials are designated by r-values they represent the rate of heat flow through a homogenous material exactly 1" thick, measured by test method included in referenced material standard or otherwise indicated. They are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.
- B. <u>Fire Performance Characteristics</u>: Provide insulation materials which are identical to those whose fire performance characteristics, as listed for each material or assembly of which insulation is a part, have been determined by testing, per methods indicated below, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction.
- C. <u>Surface Burning Characteristics</u>: ASTM E 84.
- D. <u>Fire Resistance Ratings</u>: ASTM E 119.
- E. Combustion Characteristics: ASTM E 136.
- F. <u>Maximum Allowable Asbestos Content of Inorganic Insulations</u>: Provide insulations composed of mineral fibers or mineral ores which contain less than 0.25% by weight of asbestos of nay type or mixture of types occurring naturally as impurities as determined by polarized light microscopy test per Appendix A of 40 CFR 763.

1.04 SUBMITTALS

- A. <u>Product Data</u>: Submit manufacturer's product literature and installation instructions for each type of insulation and vapor retarder material required.
- B. <u>Certified Test Reports</u>: With product data, submit copies of certified test reports showing compliance with specified performance values, including r-values (aged values for plastic insulations), densities, compression strengths, fire performance characteristics, perm ratings, water absorption ratings and similar properties.

1.05 DELIVERY, STORAGE AND HANDLING

- A. <u>General Protection</u>: Protect insulation from physical damage and from becoming wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation.
- B. Protection for Plastic Insulation:
 - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver plastic insulating materials to project site ahead of installation time.
 - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of work.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. <u>Manufacturers</u>: Subject to compliance with requirements, provide products of one of the following:
 - 1. Manufacturers of Extruded Polystyrene Board Insulation:
 - a. Amoco Foam Products Co.
 - b. Dow Chemical U.S.A.
 - c. Minnesota Diversified Products, Inc.
 - d. UC Industries
 - 2. Manufacturers of Glass Fiber Insulation:
 - a. CertainTeed Corp.
 - b. Owens Corning
 - 3. Manufacturers of Semi-Refractory Fiber Insulation:
 - a. Manville Corp.
 - b. United States Gypsum Co.

2.02 INSULATING MATERIALS

- A. <u>General</u>: Provide insulating materials which comply with requirements indicated for materials, compliance with referenced standards, and other characteristics.
- B. <u>Preformed Units</u>: Sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths and lengths.
- C. <u>Extruded Polystyrene Board Insulation</u>: Rigid, cellular thermal insulation with closed-cells and integral high density skin, formed by the expansion of polystyrene base resin in an extrusion process to comply with ASTM C 578 for Type indicated; with 5-year aged r-values of 5.4 and 5 at 40 and 75 deg. F (4.4 and 23.9 deg. C), respectively; and as follows:
 - 1. Type IV, 1.6 lb./cu. ft. min. density, unless otherwise indicated.
- D. <u>Surface Burning Characteristics</u>: Maximum flame spread and smoke developed values of 5 and 165, respectively.
- E. <u>Unfaced Mineral Fiber Blanket/Batt Insulation</u>: Thermal insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665 for Type I (blankets without membrane facing); and as follows:
 - 1. Mineral Fiber Type: Fibers manufactured from glass or slag.
 - 2. Combustion Characteristics: Passes ASTM E 136 test.
 - 3. Surface Burning Characteristics: Maximum flame spread and smoke developed values of 25 and 50, respectively.
- F. Faced Mineral Fiber Blanket/Batt Insulation: Thermal insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 655 for Type III, Class A (blankets with reflective vapor-retarder membrane facing with flame spread of 25 or less); foil-scrim-kraft vapor-retarder membrane on one face, respectively; and as follows:
 - 1. Mineral Fiber Type: Fibers manufactured from glass or slag.
 - 2. Combustion Characteristics: Unfaced blanket/batt passes ASTM E 136 test.
 - 3. Surface Burning Characteristics: Maximum flame spread and smoke developed values of 25 and 50, respectively.

G. Roof Corner Joint Sealant:

- 1. At junction of all metal roof deck and exterior masonry walls, apply urethane foam insulation to a maximum depth of 3" in the corner to uniformly seal this junction air tight. Use 2 lbs. density foam.
- 2. Apply over foam after proper curing a coating of U.L. approved fire proofing of a tested thickness to achieve a one-hour fire protection rating.

2.03 AUXILIARY INSULATING MATERIALS

A. <u>Mechanical Anchors</u>: Type and size indicated or, if not indicated, as recommended by insulation manufacture for type of application and condition of substrate.

B. <u>Mastic Sealer</u>: Type recommended by insulation manufacturer for bonding edge joints between units and filling voids in work.

PART 3 - EXECUTION

3.01 INSPECTION AND PREPARATION

- A. Require installer to examine substrates and conditions under which insulation work is to be performed. A satisfactory substrate is one that complies with requirements of the section in which substrate and related work is specified. Obtain Installer's written report listing conditions detrimental to performance of work in this section. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.
- B. Clean substrates of substances harmful to insulations or vapor retarders, including removal of projections which might puncture vapor retarders.

3.02 INSTALLATION, GENERAL

- A. Comply with manufacturer's instructions for particular conditions of installation in each case. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with work.
- B. Extend insulation full thickness as shown over entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections which interfere with placement.
- C. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

3.03 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

A. On vertical surfaces, set units in adhesive applied in accordance with manufacturer's instructions. Use type of adhesive recommended by manufacturer of insulation.

3.04 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrate by method indicated, complying with manufacturer's recommendations. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Seal joints between closed-cell (non-breathing) insulation units by applying mastic or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with mastic or sealant.
- C. Set vapor retarder faced units with vapor retarder to war side of construction, except as otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
- D. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure air-tight installation.

E. Set reflective foil-faced units accurately with air pace in front of foil as shown. Provide not less than 0.75" air space where possible.

3.05 INSTALLATION OF SAFING INSULATION

A. Cut safing insulation wider than gap to be filled to ensure compression fit and seal joint between insulation and edge of wall and metal deck or other material with caulking approved by safing insulation manufacturer for this purpose. Leave no voids in completed installation.

3.06 PROTECTION

A. <u>General</u>: Protect installed insulation and vapor retarders from harmful weather exposures and from possible physical abuses, where possible by non-delayed installation of concealing work or, where that is not possible, by temporary covering or enclosure.

END OF SECTION

SECTION 07 41 13 – METAL ROOF PANELS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Metal roof panels, metal flashings, accessories, fasteners, closures, and sealants.

1.02 RELATED SECTIONS

A. Section 07 60 00 - Sheet Metal Flashing and Trim

1.03 REFERENCES

- A. General: Reference latest edition of applicable codes and standards.
- B. American Society for Testing and Materials (ASTM):
 - 1. ASTM A792/A792M-Standard Specification for Steel Sheet, 55% Aluminum-Zinc-Alloy-Coated by the Hot-Dip Process.
- C. AISI Cold-Formed Steel Design Manual, American Iron and Steel Institute (AISI).
- D. AISC Manual of Steel Construction, American Institute of Steel Construction (AISC).
- E. Underwriters Laboratories, Inc. (UL).
 - 1. UL 580-Standard Safety Tests for Uplift Resistance of Roof Assemblies.
- F. Building Codes and Design Standards:
 - 1. ASCE-7, Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers (ASCE).
 - 2. BOCA National Building Code, Building Officials and Code Administrators, International (BOCA).
 - 3. Uniform Building Code (UBC), International Conference of Building Code Officials (IBCO).
 - 4. Standard Building Code (SBC), Southern Building Code Congress International (SBCCI).
 - 5. International Building Code (IBC), International Code Council (ICC).

1.04 SYSTEM DESCRIPTION

A. Design Requirements:

- 1. Provide exposed fasteners metal roof panel.
- 2. Provide metal panel which has been manufactured and installed to withstand specified design loads and maintains performance requirements without defects, damage, or failure.

B. Performance Requirements:

- 1. Design Loads: Design loads shall be as specified by building code, design standard, or as indicated on the contract drawings.
- 2. Deflections shall be limited L/120.

C. Performance Testing:

1. Roof panel shall be tested in accordance with UL Standard 580 and have a Class 90 rating.

1.05 SUBMITTALS

- A. Product Data: Submit manufacturer's product Data.
- B. Shop Drawings: Submit panel shop drawings consisting of design and erection drawings, finish specifications, and other data necessary to clearly describe design, materials, sizes, layouts, construction details, fasteners, and erection. Submit small scale layouts of panels and large scale details of edge conditions, joints, fastener and sealant placement, flashings, penetrations and curbs, and special details. Distinction must be made between factory and field assembled work. Drawings must be approved and field verification of all dimensions must occur prior to fabrication.

C. Samples:

- 1. Panel: Two (2) required, Full panel width by 12" long.
- 2. Fasteners: Two (2) of each type with a statement of intended use.
- 3. Closures: One (1) foam closure.
- 4. Sealants: One (1) sample of each type, with a statement of intended use.
- D. Warranties: Submit manufacturer's applicable sample warranties of products.
- E. Quality Assurance Submittals:
 - 1. Certificates:
 - a. A written statement from the manufacturer certifying conformance with the specified manufacturers qualifications listed in article 1.05 QUALITY ASSURANCE.
 - b. A written statement from the installer certifying conformance with the specified installer qualifications listed in article 1.05 QUALITY ASSURANCE.

1.06 QUALITY ASSURANCE

A. Qualifications:

- 1. Manufacturers Qualifications: The manufacturer shall have had at least fifteen (15) years in metal roof and wall design and installation. The manufacturer shall have a permanent, stationary, indoor, production facility.
- 2. Installer Qualifications:

a. The installer shall have had a minimum of five (5) years experience in the installation of metal roof and wall systems.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Material shall be delivered to the site in a dry and undamaged condition and unloaded per the manufacturers instructions. The installer shall inspect materials for damage and stains upon arrival at the site.
- B. Storage: Materials shall be stored out of contact with the ground in weathertight coverings to keep them dry per the manufacturer's recommendations. Storage accommodations shall provide good air circulation and protection from surface staining.
- C. Handling: Exercise care in unloading, storing, and handling of panels to prevent bending, warping, twisting, or surface damage. Follow manufacturer's recommendations for material handling.

1.08 WARRANTIES

A. Manufacturer's Warranties

- 1. Material Warranty: The manufacturer shall warrant that the material furnished will remain free from defects in material and workmanship for a period of one (1) year from date of shipment.
- 2. Metal Substrate Warranty: The manufacturer shall warrant that the metal roof panel substrate will not rupture or perforate due to corrosion within a period of twenty (20) years from date of shipment.
- 3. Finish Warranty: The manufacturer shall warrant against fading, chalking, peeling, cracking, checking, chipping, or erosion to base metal of the roof panel paint finish for a period of twenty (20) years from date of shipment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The Mueller MLK Standing Seam Panel metal roof system as manufactured by Mueller, Inc., 1915 Hutchins Avenue, Ballinger, TX 76821, or equal
- B. Requests to use alternate systems must be submitted in writing at least ten (10) days prior to the bid date. Product data, samples, test reports, and required certificates shall be included for product review and approval.
- C. Being listed as a pre-qualified manufacturer does not release the manufacturer from providing complete and acceptable submittal requirements.

2.02 MATERIALS

- A. Metal Panels: MLK Standing Seam Panel as manufactured by Mueller or equal.
 - 1. Fabricate metal panels from Mueller #1 Grade Material, galvalume plus. Thickness shall be a minimum of 24 gage.

2. Panels shall be a min. of 16" wide coverage with 2" deep ribs 16" on center.

2.03 FINISHES

- A. Paint Finishes: Coating systems shall have been tested in accordance with ASTM standard test methods for factory color finish. Exterior color shall be chosen from manufacturer's standard colors by the owner.
 - 1. Polyvinylidene Fluoride (PVDF): Two-coat system consisting of a nominal 0.2 mil corrosion inhibitive primer on both sides with a 0.75 mil fluoropolymer exterior topcoat and 0.30 mil backer finish.

OR

- 2. Silicone Modified Polyester (SMP): Two-coat system consisting of a nominal 0.2 mil primer on both sides with 0.80 exterior topcoat and 0.30 mil backer finish.
- B. Texture: Panel finish shall be smooth.

2.04 ACCESSORIES

- A. Fasteners: Use only high quality fasteners as recommended or approved by the manufacturer. Follow fastener manufacturer's recommendations for fastener installation.
 - 1. Screws: Screws shall be min. #12 diameter. Self-tapping screws shall be min. #14 diameter.
 - a. Exposed self-drilling and self-tapping screws shall be carbon steel with corrosion resistant coating and neoprene washer or be 300 series stainless steel with neoprene washer. All exposed fasteners shall be painted to match panel color.

2. Rivets:

- a. Trim rivets shall be min. 5/32" diameter, stainless steel body and stem with open end or aluminum body and stem with closed end.
- b. Rivets shall be painted to match panel color.

B. Closures

- 1. Pre-cut profile closure shall be cut from cross-linked, closed-cell form.
- C. Sealants: Use only high quality sealants as recommended or approved by the manufacturer. Sealants must not contain oils, asbestos, or asphalts.
 - 1. Non-Curing Butyl: One-part, non-skinning, non-drying, synthetic butyl elastomer. Used for metal-to-metal sealing or bedding of panel and flashing seams or joints.
 - 2. Urethane: One-part moisture curing, gun grade polyurethane sealant. Used for sealing in all exposed conditions.

2.05 FLASHING

A. All flashing shall be of the same material, gage, finish, color, and texture as the panels unless otherwise noted.

B. Flashing design shall conform to details submitted and approved by the Engineer and, if required, the panel manufacturer.

2.06 FABRICATION

A. Where possible panels shall be manufactured in continuous lengths, full length of panel runs.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. The installer shall inspect the building to verify that the structure is ready for metal panel installation.
 - 1. All supports shall be in place with all bracing and connections tightened before work proceeds.
 - 2. Field-check dimensions and check support alignment with a taut string or wire; support misalignment may cause the metal panels to appear wavy.
 - 3. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

- A. Install metal panels in accordance with approved erection drawings and manufacturer's installation instructions.
- B. Install metal panels so that it is weather-tight, without waves, warps, buckles, fastening stress or distortion.
- C. Protect installed panels from abuse by other trades. The general contractor shall be responsible for protecting metal panels from wet cement, plaster, and paint operations.

3.03 DAMAGED MATERIAL AND CLEANING

- A. Replace panels and other components of work which have been damaged beyond repair.
- B. To prevent rust staining, remove immediately from finished surfaces any filings caused by drilling or cutting.
- C. Wipe down each area after erection is complete for final acceptance.

END OF SECTION

SECTION 07 60 00 - FLASHING AND SHEET METAL

PART 1 - GENERAL

1.01 REQUIREMENT

- A. The Contractor shall furnish and install all sheet metal and appurtenant work, complete and in accordance with the requirements of the Contract Documents.
- B. The principal items of sheet metal work shall include, but not be limited to, the following: sheet metal flashings, and collars all roof penetrations.

1.02 RELATED WORK

- A. Section 09 96 00 High-Performance Coatings
- B. Section 09 90 00 Paint and Coating

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. All work specified herein shall conform to or exceed the requirements of the Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.
- B. Products and their installation shall be in accordance with the following trade standards, as applicable.
 - 1. Manufacturer's printed recommendations and specifications
 - 2. Sheet Metal and Air Conditioning Contractors National Association "Architectural Sheet Metal Manual" (ASMM)
 - 3. The Aluminum Association "Specifications for Aluminum Sheet Metal Work in Building Construction"
 - 4. American Society for Testing and Materials (ASTM)
 - 5. American Welding Society (AWS)

1.04 SUBMITTALS

- A. Shop drawings showing materials, gages, finishes, layout, jointing, profiles, fasteners, fabrication of special shapes and method of attachment to adjacent construction shall be submitted in accordance with Section 01 33 00 Submittal Procedures.
- B. Material and color samples shall be submitted where required for appearance and color selections by the Engineer.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Sheet metal shall be galvanized steel unless otherwise indicated. Sheet metal work in connection with roofing shall be in accordance with roofing manufacturer's published specifications and as shown on the Drawings.
- B. All sheet metal flashings necessary to make building weathertight shall be provided, whether or not shown or specified.

2.02 FERROUS METALS

A. Galvanized steel shall be 24-gage minimum thickness conforming to ANSI/ASTM A 526 with coating designation conforming to G90, ANSI/ASTM A 525M.

2.03 LEAD AND SOLDERING MATERIALS

- A. Lead shall be 4-6% antimony and remainder shall be lead. Lead sheet shall be soft temper, except hard temper for flanges. Weight shall be not less than 4-lb. per sq. ft. unless shown otherwise.
- B. Solder shall conform to ANSI/ASTM B 32-76 Alloy 5b, 50% tin, 50% lead.
- C. Soldering flux shall meet FS O-F-506c, or a type not injurious to metal surface being treated.

2.04 FASTENERS

A. Fastening devices shall be galvanized or stainless steel. Fasteners shall have neoprene washers where water tightness is required.

2.05 PLASTIC CEMENT

A. Plastic cement shall conform to ANSI/ASTM D 2822.

2.06 SHOP FABRICATION REQUIREMENTS

- A. Galvanized steel corner joints and other joints where specified or shown shall be soldered.
- B. All reglets and counter-flashing and associated flashings shall be fabricated by the same manufacturer and be installed as a complete flashing system. All flashings shall be creased longitudinally or otherwise formed with sufficient spring action to hold bottom edges firmly against base flashing or similar material.
- C. Intersecting corners of coping shall be accurately fitted and soldered. Coping shall be per ASMM Plate 68, except modified as shown.
- D. Dryer vents shall be fabricated or stainless steel and be provided with rainhood and self closing flap and interior and exterior escutcheon plates.

- E. Flashing required through concrete or clay tile shall be flexible flashing in order to assure against undue separation between tiles on account of rigidity or the flashing material.
- F. Flashing around pipes, drains, vents, flues, chimneys, etc. shall be of lead or galvanized steel.

2.07 FABRICATED SHEET METAL WORK

- A. Scuppers in walls shall be constructed of 20-gage galvanized steel with all joints soldered.
- B. Pitch pockets and equipment supports conforming to reference standards shall be provided where required or necessary and may be of galvanized steel construction unless shown otherwise. Pitch pockets shall be designed per ASMM Plate 61. Equipment support (sleeper) caps shall be designed per ASMM Plate 61, Figure B.
- C. The roof penetrations shall be provided with the following flashing:

Vent Pipes or Multi-Pipes: Sheet metal with w/Curb: sealant and draw

bands. Ref. ASMM 59.

Equipment Support: Sheet metal. Ref. ASMM Plate 60 & 61. Sleeper Covers: Sheet metal. Ref. ASMM Plate 60, Figure C

& D.

Pitch Pockets for Supports: Sheet metal with all joints welded or soldered.

Ref. ASMM Plate 61, Figure E.

Ducts w/Curb: 113 (similar) Sheet metal. Ref. ASMM

Equipment Platform: Sheet metal. Ref. ASMM Plate 101, Figure

B (similar).

PART 3 - EXECUTION

3.01 GENERAL

- A. The Contractor shall coordinate the flashings necessary with the different trades to make sure all items which penetrate the roof are provided with all necessary sheet metal items and work, such as, but not limited to, the following: pipes, ducts, support racks, equipment platforms or sleepers and supports.
- B. All work shall conform to reference standards. Flashing work shall be coordinated with roofing work. Sheet metal and roofing shall provide a weather-tight and watertight assembly.

3.02 INSTALLATION

A. Sheet metal work shall be accurately formed to dimensions and shapes shown. Work shall be fitted snugly, with straight, true lines with exposed faces aligned in proper plane, free from waves and buckles. Arises and angles shall have true and sharp lines and surfaces shall be free from waves and buckles. All exposed edges shall be hemmed. Holes for fasteners within sheet metal work exposed to temperature changes shall be elongated holes for material expansion and movement.

- B. All sheet metal work shall be furnished complete with supports, hangers, bracing, anchors and other devices as required for reinforcement and proper attachment to adjacent construction. Fastenings shall be concealed wherever possible. Joints, fastenings, reinforcements and supports shall be sized and located as required to preclude distortion or displacement due to thermal expansion and contraction.
- C. Dissimilar materials shall be isolated with two (2) coats of asphaltic paint, asphaltic coating compound or sealer tape. Only stainless steel fasteners shall be used to connect isolated dissimilar metals.
- D. Joints shall be sized and spaced to permit sheet movement for thermal expansion and contraction of 1/4-inch per 10-foot length on 100 deg. F temperature difference. Holes for fasteners or anchors shall be elongated to provide for movement.
- E. Flashings shall be installed at intersections of roof with vertical surfaces and at projections through roof. Corner units shall be factory-fabricated and shall have mitered soldered or welded corner joints and shall be installed with 3-inch (min) lap joint over flashings on each side.

END OF SECTION

SECTION 07 72 33 – ROOF HATCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Provide factory-fabricated roof hatches for ladder access.

1.2 RELATED WORK

A. 05 53 00: Grating, Cover Plates and Access Hatches.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data.
- B. Shop Drawings: Submit shop drawings including profiles, accessories, location, adjacent construction interface, and dimensions.
- C. Warranty: Submit executed copy of manufacturer's standard warranty.

1.4 QUALITY ASSURANCE

- A. Manufacturer: A minimum of 5 years experience manufacturing similar products.
- B. Installer: A minimum of 2 years experience installing similar products.
- C. Manufacturer's Quality System: Registered to ISO 9001 Quality Standards including in-house engineering for product design activities.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturer's original packaging. Store materials in a dry, protected, well-vented area. Inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

1.6 WARRANTY

A. Manufacturer's Warranty: Provide manufacturer's standard warranty. Materials shall be free of defects in material and workmanship for a period of five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis-of-Design Manufacturer: Type D Roof Hatch by The BILCO Company, P.O. Box 1203, New Haven, CT 06505, 1-800-366-6530, Fax: 1-203-535-1582, Web: www.BILCO.com.

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2.2 ROOF HATCH

A. Furnish and install where indicated on plans metal roof hatch Type D, size 6 ft x 6ft. Length denotes hinge side. The roof hatch shall be double leaf. The roof hatch shall be pre-assembled from the manufacturer.

B. Performance characteristics:

- 1. Covers shall be reinforced to support a minimum live load of 40 psf (195kg/m²) with a maximum deflection of 1/150th of the span or 20 psf (97 kg/m²) wind uplift.
- 2. Operation of the covers shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
- 3. Operation of the covers shall not be affected by temperature.
- 4. Entire hatch shall be weather tight with fully welded corner joints on covers and curb
- C. Covers: Shall be 11 gauge (2.3mm) aluminum with a 3" (76mm) beaded flange with formed reinforcing members. Covers shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.
- D. Cover insulation: Shall be fiberglass of 1" (25mm) thickness, fully covered and protected by a metal liner 18 gauge (1mm) aluminum.
- E. Curb: Shall be 12" (305mm) in height and of 11 gauge (2.3mm) aluminum. The curb shall be formed with a 3-1/2" (89mm) flange with 7/16" (11mm) holes provided for securing to the roof deck. The curb shall be equipped with an integral metal cap flashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip® flashing system, including stamped tabs, 6" (153mm) on center, to be bent inward to hold single ply roofing membrane securely in place.
- F. Curb insulation: Shall be rigid, high-density fiberboard of 1" (25mm) thickness on outside of curb.
- G. Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe welded to the curb assembly.

H. Hardware

- 1. Heavy pintle hinges shall be provided.
- 2. Covers shall be equipped with an enclosed two point spring latch with interior and exterior turn handles.
- 3. Roof hatch shall be equipped with <u>interior and exterior padlock</u> hasps.
- 4. The latch strike shall be a stamped component bolted to the curb assembly.

ROOF HATCHES 07 72 33 - 2

- 5. Covers shall automatically lock in the open position with a rigid hold open arm equipped with a 1" (25mm) diameter red vinyl grip handle to permit easy release for closing.
- 6. Hardware: All hardware shall be zinc plated and chromate sealed.
- 7. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.
- I. Finishes: Factory finish shall be mill finish aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install products in strict accordance with manufacturer's instructions and approved submittals. Locate units level, plumb, and in proper alignment with adjacent work.
 - 1. Test units for proper function and adjust until proper operation is achieved.
 - 2. Repair finishes damaged during installation.
 - 3. Restore finishes so no evidence remains of corrective work.

3.3 ADJUSTING AND CLEANING

A. Clean exposed surfaces using methods acceptable to the manufacturer which will not damage finish.

END OF SECTION

ROOF HATCHES 07 72 33 - 3

SECTION 07 92 00 – JOINT SEALANTS

PART 1 - GENERAL

1.01 REQUIREMENT

A. The Contractor shall perform all caulking, sealing, moisture protection and appurtenant work complete and in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK

A. Section 03 16 10 - Joints in Concrete

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Federal Specifications:

TT-S-00230C(2)	Sealing Compound, Elastomeric Type, Single Component, (For Caulking,
	Sealing and Glazing in Buildings and Other Structures).

TT-S-001543A Sealing Compound, Silicone Rubber Base, (For Caulking, Sealing and Glazing in Building and Other Structures).

B. Commercial Standards:

ASTM D 41	Specification for Asphalt Primer Used in Roofing and Waterproofing.
ASTM D 226	Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
ASTM D 312	Specification for Asphalt Used in Roofing.
ASTM D 4551	Standard for PVC Flexible Sheeting for Concealed Water Containment

1.04 SUBMITTALS

- A. Samples: The Contractor shall submit to the Engineer for review, samples, including color samples of all the caulking and sealant materials and other moisture protection materials he proposes to use. The samples shall be clearly marked with the manufacturer's name and product identification and shall be submitted along with the manufacturer's technical data and application instructions.
- B. The Contractor shall submit copies of the manufacturer's technical literature, specifications, warranty and installation instructions.

JOINT SEALANTS 07 92 00 - 1

PART 2 - PRODUCTS

2.01 SEALANTS AND CAULKING MATERIALS

- A. All caulking and sealing materials shall conform to the following requirements:
 - 1. Sealant for joints in concrete is specified under Section 03 16 10 Joints in Concrete.
 - 2. Sealant for general exterior and/or interior architectural use shall be 2-part polyurethane, gun grade, such as <u>Products Research Corp "210"</u>; <u>Progress Unlimited "Iso-Flex 2000"</u>; <u>or equal</u>. Sealant for interior use may be 1-part acrylic trypolymer sealant, such as <u>Tremco's "Mono"</u>; <u>Dap One-Part Acrylic</u>; <u>or equal</u>.
 - 3. The sealants used with aluminum doors, windows, storefronts and frames shall be silicone sealant conforming to Federal Specifications TT-S-001543A (Class A) and TT-S-00230C(2) (Type II, Class A).
 - 4. Filler material shall be resilient, closed-cell polyethylene foam and/or bond breakers of proper size for joint widths. It shall be compatible with sealant manufacturer's product.
 - 5. Primers shall be as recommended in the manufacturer's printed instructions for caulking and sealants.
 - 6. Cleaning and cleanup solvents shall be as recommended in the manufacturer's printed instructions for caulking and sealants.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. All work under this Section and all testing, where applicable, shall be performed in accordance with manufacturer's printed recommendations, specifications and installation instructions except where more stringent requirements are shown or specified herein; and, except where project conditions require extra precautions or provisions to assure performance of the waterproofing system.
- B. Authorized Installers: Caulking, sealants and moisture protection shall be complete systems and installed only by installers authorized and approved by the respective manufacturers.
- C. Sub-Slab Membrane: A sub-slab membrane shall be installed under all new building floor slabs with vinyl composition tile finishes and at other locations designated in the Contract Documents.
- D. Showers: Showers shall be provided with a shower pan membrane waterproofing system as specified herein for moisture protection.

3.02 SEALANT FILLED JOINTS

A. The Contractor shall be responsible for providing the on-site services of the sealant manufacturer's representative prior to sealant work to inspect the joints to be sealed and to instruct the installer in the proper use of the materials. Joints and spaces to be sealed shall be clean, dry and free of dust, loose mortar and other foreign materials. Ferrous metal surfaces shall be cleaned of all rust, mill scale and other coatings by wire brush, grinding or sandblasting. Oil and grease shall be removed by cleaning in accordance with sealant manufacturer's printed

JOINT SEALANTS 07 92 00 - 2

- recommendations. Protective coatings shall be removed from all aluminum surfaces against which caulking or sealing compound is to be placed. Bituminous or resinous materials shall be removed from surfaces to receive caulking or sealants. Where required by the manufacturer, sides of joints of porous materials shall be primed immediately prior to caulking or sealing.
- B. Sealant depth in expansion joints shall be 1/2 the width of joint, but not less than 1/8-inch deep and 1/4-inch wide nor more than 1/2-inch deep and 1-inch wide. All joints shall have a rigid filler material installed to proper depth prior to application of sealant.
- C. A full bead of sealant shall be applied into the joint under sufficient pressure with the nozzle drawn across sealant to completely fill the void space and to ensure complete wetting of contact area to obtain uniform adhesion. Sealants shall be tooled immediately after exposure with caulking tool or soft bristled brush moistened with solvent. The finished sealant filled joint shall be slightly concave unless detailed otherwise.
- D. After application of sealant and caulking materials, adjacent materials which have been soiled shall be cleaned and left in a neat, clean, undamaged or discolored condition. On porous surfaces, excess sealant shall be removed per sealant or caulking manufacturer's printed instructions.

END OF SECTION

JOINT SEALANTS 07 92 00 - 3

SECTION 07 92 22 - SEALANTS, CAULKING AND BELOW GRADE WATERPROOFING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The CONTRACTOR shall perform all caulking, sealing, moisture protection and appurtenant work complete and in accordance with the requirements of the Contract Documents.

1.02 REFERENCED SECTIONS

- A. Related Sections are shown below.
 - SECTION 03 15 15 MISCELLANEOUS JOINT AND CRACK FILLERS

1.03 CITED STANDARDS

- A. All sealants, caulking and below-grade waterproofing shall conform to the requirements of the following standard specifications, of the latest revisions, as applicable:
 - 1. Federal Specifications:
 - a. TT-S-00230C(2) Sealing Compound, Elastomeric Type, Single Component, (For Caulking, Sealing and Glazing in Buildings and Other Structures).
 - b. TT-S-001543A Sealing Compound, Silicone Rubber Base, (For Caulking, Sealing and Glazing in Building and Other Structures).
 - 2. Commercial Standards:
 - a. ASTM D41 05 Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
 - b. ASTM D226 06 Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
 - c. ASTM D312 00(2006) Standard Specification for Asphalt Used in Roofing
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL NONE
- 1.06 SUBMITTALS
 - A. Samples
 - 1. The CONTRACTOR shall submit samples to the ENGINEER for review, including color samples of all the caulking and sealant materials and other moisture protection materials he proposes to use. The samples shall be clearly marked with the manufacturer's name and product identification and shall be submitted along with the manufacturer's technical data and application instructions.
 - 2. The CONTRACTOR shall submit copies of the manufacturer's technical literature, specifications, warranty, and installation instructions.

PART 2 - PRODUCTS

2.01 SEALANTS AND CAULKING MATERIALS

- A. All caulking and sealing materials shall conform to the requirements of sealant for joints in concrete as specified under Section 03 15 15 Miscellaneous Joint and Crack Fillers
- B. Sealant for general exterior and/or interior architectural use shall be 2-part polyurethane, gungrade, such as Products Research Corp "210"; Progress Unlimited "Iso-Flex 2000"; or equal. Sealant for interior use may be 1-part acrylic trypolymer sealant, such as Tremco's "Mono"; Dap One-Part Acrylic; or equal.
- C. The sealants used with aluminum doors, windows, storefronts and frames shall be silicone sealant conforming to Federal Specifications TT-S-001543A (Class A) and TT-S-00230C(2) (Type II, Class A).
- D. Filler material shall be resilient, closed-cell polyethylene foam and/or bond breakers of proper size for joint widths. It shall be compatible with sealant manufacturer's product.
- E. Primers shall be as recommended in the manufacturer's printed instructions for caulking and sealants.
- F. Cleaning and cleanup solvents shall be as recommended in the manufacturer's printed instructions for caulking and sealants.

PART 3 - EXECUTION

3.01 PREPARATION

- A. All work under this Section and all testing, where applicable, shall be performed in accordance with manufacturer's printed recommendations, specifications and installation instructions except where more stringent requirements are shown or specified herein; and, except where project conditions require extra precautions or provisions to assure performance of the waterproofing system.
- B. Authorized Installers: Caulking, sealants and moisture protection shall be complete systems and installed only by installers authorized and approved by the respective manufacturers.

3.02 INSTALLATION

- A. The CONTRACTOR shall be responsible for providing the on-site services of the sealant manufacturer's representative prior to sealant work to inspect the joints to be sealed and to instruct the installer in the proper use of the materials. Joints and spaces to be sealed shall be clean, dry and free of dust, loose mortar and other foreign materials. Ferrous metal surfaces shall be cleaned of all rust, mill scale and other coatings by wire brush, grinding or sandblasting.
- B. Oil and grease shall be removed by cleaning in accordance with sealant manufacturer's printed recommendations. Protective coatings shall be removed from all aluminum surfaces against which caulking or sealing compound is to be placed. Bituminous or resinous materials shall be

- removed from surfaces to receive caulking or sealants. Where required by the manufacturer, sides of joints of porous materials shall be primed immediately prior to caulking or sealing.
- C. Sealant depth in expansion joints shall be 1/2 of the width of joint, but not less than 1/8-inch deep and 1/4-inch wide nor more than 1/2-inch deep and 1-inch wide. All joints shall have a rigid filler material installed to proper depth prior to application of sealant.
- D. A full bead of sealant shall be applied into the joint under sufficient pressure with the nozzle drawn across sealant to completely fill the void space and to ensure complete wetting of contact area to obtain uniform adhesion. Sealants shall be tooled immediately after exposure with caulking tool or soft bristled brush moistened with solvent. The finished sealant filled joint shall be slightly concave unless detailed otherwise.
- E. After application of sealant and caulking materials, adjacent materials which have been soiled shall be cleaned and left in a neat, clean, undamaged or discolored condition. On porous surfaces, excess sealant shall be removed per sealant or caulking manufacturer's printed instructions.

3.03 TESTING – NONE

END OF SECTION

SECTION 08 05 00 – COMMON WORK RESULTS FOR OPENINGS

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. The General Conditions apply to all sections of this specification, which shall be completed as shown on the plans and as specified, and shall be properly coordinated with work in other Specifications.
- B. The DRAWINGS and these Specifications are complementary to each other; what is called for by one shall be as binding as if called for by both. If there is any conflict between what is shown on the DRAWINGS and what is written in the Specifications, the details described on the DRAWINGS shall take precedence and the CONTRACTOR shall communicate the conflicts to the Design ENGINEER in a timely manner.

C. Safety

1. The CONTRACTOR shall be familiar with, and shall at all times conform to, the regulations of the "OSHA General Industry Occupational Safety and Health Standards," "OSHA Safety and Health Regulations for Construction," and other applicable state and municipal standards and regulations.

1.02 REFERENCED SECTIONS – NONE

1.03 CITED STANDARDS

- A. All openings shall conform to the requirements of the following standard specifications, of the latest revisions, as applicable:
 - 1. NFPA 704: Standard System for the Identification of the Hazards of Materials for Emergency Response
 - 2. NFPA 80 Standard for Fire Doors and Other Opening Protectives

1.04 NOTED RESTRICTIONS

PART 2 - PART 2 PRODUCTS - NOT USED

PART 3 - PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 08 11 00 - METAL DOORS AND FRAMES

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section specifies the furnishing and installing of doors and hardware.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL NONE
- 1.06 SUBMITTALS
 - A. Submittals shall be in accordance with **Section 01 33 00** and shall include manufacturers' literature on door construction, installation details, and a schedule showing quantity, size and location of doors and frames to be provided. Manufacturer must be a current member of the Steel Door Institute.
 - B. A full range of color samples shall be provided for the City's selection; 2 samples, 6-inch square minimum, of each color and texture selected for factory-finished doors and frames.

PART 2 - PRODUCTS

2.01 HOLLOW METAL DOORS AND FRAMES

A. General

1. Hollow metal doors and frames shall conform to the standards of the National Association of Architectural Metal Manufacturers Specification CHM-l; the standards and specifications of the Steel Door Institute for Grade 3, Model 2 – seamless hollow steel construction; and the project requirements detailed on the DRAWINGS and specified herein.

B. Materials

1. Material for doors and frames shall be commercial quality, level, cold-rolled steel conforming to ASTM A366 or hot-rolled, pickled and oil-rolled steel conforming to ASTM A569. Face sheets of exterior doors and frames shall have a zinc coating applied by the hot-dip process conforming to ASTM A526 (A60 or G60) with a coating weight of not less than 0.60 ounces per square foot (0.30 ounces per square per side). Internal stiffeners and anchors may be plain sheet steel.

C. Doors

1. Steel doors shall be 1 3/4-inch thick flush type, constructed of two steel sheets not less than 16-gauge steel for interior doors and 16-gauge steel for exterior doors. Face sheets shall be stiffened by vertical steel ribs. Stiffeners shall be formed from not less than 22-

gauge steel, spaced not more than 6 inches apart and securely attached to the face sheets by spot welds, not more than 5 inches on center (O.C.). The spaces between the stiffeners shall be insulated the full height of the door with a minimum 0.6 pound density, non-combustible insulation. Doors shall be fully welded seamless construction with no visible seams or joints on their faces or vertical edges. Top and bottom edges of all doors shall be closed with a continuous recessed steel channel not less than 16-gauge, extending the full width of the door and spot-welded to both faces. Exterior doors shall have additional flush closing channels at the top edge. Hinge reinforcements shall be 7-gauge; lock, closer and flush bolt reinforcements shall be 12-gauge; and reinforcement for all other surface mounted hardware shall be 16-gauge. Loose stops for glazing shall be not less than 20-gauge; secured to the opening by cadmium or zinc-coated countersunk screws. Louvers shall be of the welded blade, sightproof type. Doors scheduled as being labeled to meet specific fire rating requirements shall bear the appropriate UL label.

D. Fire-Rated Door Assemblies

- 1. Where fire-rated door assemblies are indicated or required, provide fire-rated door and frame assemblies that comply with NFPA 80 "Standard for Fire Doors and Windows", and have been tested, listed, and labeled in accordance with ASTM E 152 "Standard Methods of Fire Tests of Door Assemblies" by a nationally recognized independent testing and inspection agency acceptable to authorities having jurisdiction.
- 2. Door Assemblies shall be rated for a minimum of 3 hours (180 minutes).

E. Frames

- 1. Frames for doors, windows, transoms, sidelights and louvers shall be of pressed steel construction. Frame profiles shall be as indicated on DRAWINGS. Where not otherwise indicated, frame depth shall be 6 inches, frame width shall be 2 inches and stop depth shall be 5/8 inch. Frames for interior doors shall be constructed of not less than 16-gauge steel. Frames for exterior doors and for frames in openings greater than 4 foot 0 inches in width shall be constructed of 14-gauge steel. Frames shall be of welded unit construction, assembled and welded in the shop. Welding shall be to a hairline joint with all exposed heads ground smooth. Concealed reinforcing of frames for mortised hardware shall be not less than 7-gauge at hinges and 12-gauge at strikes, flush bolts, closers, panic devices and all other applied hardware. Floor anchors of 14-gauge steel shall be securely welded inside each jamb and secured to floor with two fasteners. Frames for installation in masonry walls shall be provided with adjustable jamb anchors of the strap and stirrup type. Anchors shall be not less than 16-gauge steel spaced at a maximum of 30 inches O.C. Frames in masonry shall be fully grouted as the Work progresses. Provide for installation of door mutes (silencers) minimum of 3 per frame.
- 2. All frames shall be provided with a steel spreader temporarily attached to the feet of both jambs to serve as a brace during shipping and handling. Frames scheduled as being labeled to meet specific fire rating requirements shall bear the appropriate UL label.

2.02 HARDWARE

A. General

1. Items of hardware required for completion of work, but not specifically mentioned herein, shall be provided by the CONTRACTOR, and shall be suitable for the required service and comparable to those specified. The CONTRACTOR shall provide any auxiliary or interconnecting devices necessary to the proper function of items specified.

- 2. Necessary screws, bolts or other fastenings of suitable size and type to secure hardware in position shall be provided by the CONTRACTOR and shall match hardware in material and finish. Where screws are required, Phillips head type shall be provided. The CONTRACTOR shall provide expansion bolts, sex bolts, toggle bolts or other approved anchors as applicable to each setting condition.
- 3. Hardware finish shall be as indicated in the Hardware List which follows. Fasteners shall be stainless steel unless otherwise required to match a plated finish.
- 4. The CONTRACTOR shall submit a complete hardware list for the OWNER's review. Masonry Door openings shall be identified with numbers corresponding to those on the DRAWINGS.
- 5. The CONTRACTOR shall require hardware supplier to furnish the proper templates to the door and frame manufacturer, along with a complete hardware schedule, so that he may prepare doors and frames to suit the scheduled hardware.

B. Hardware Description

- 1. Hardware shall be as indicated below and shall be the product of the following named manufacturers; or equal. Some items listed below may not apply to this project. Specific hardware requirements are given in the Door Schedule on the DRAWINGS and the Hardware List hereinafter. Only one manufacturer's model number is listed. Other manufacturers to match.
- 2. PANIC style hardware (also known as "CRASH BAR") shall be installed for egress on all doors in accordance with Uniform Statewide Building Code (USBC) and Statewide Fire Prevention Code (SFPC).

C. Hinges

1. Hinges shall be full mortise type with non-rising pins, ball or oilite bearings and flat button tips. Hinge height shall be 4½-inch to 36-inch door width, 5 inch over 36 inch to 48 inch, and 6 inch over 48 inch door width. Provide one hinge for each 2ft-6in. part thereof of door height. Hinge width shall allow door swing to 180 degrees. Provide non-removable pins at exterior doors opening out. Hinges shall be as manufactured by Hager; McKinney; or equal.

D. Door Closers

- 1. Closers shall have fully hydraulic, full rack and pinion action with high strength cast iron cylinder. Closers shall be non-handed and adjustable from size 2 to 6.
- 2. Provide both standard and parallel arm-type closers per Hardware List. Include hold-open feature where indicated. All fire rated doors shall be provided with closers. Where the hold-open feature is indicated at fire rated doors, they shall be provided with a fusible link. Door closers shall be as manufactured by Norton; LCN; Corbin; Yale; or equal.

E. Thresholds

1. Thresholds shall be extruded aluminum fastened to concrete by means of 5/16-inch stainless steel flat head countersunk machine screw and expansion anchors into the concrete slab at 8-inch centers. Unless indicated to be set in grout, thresholds shall be set in a double bead of sealant. Cope thresholds to fit door frame profile and drill to suit required flush bolts and panic bolts. Thresholds shall not be installed until construction

of the project is substantially complete, unless satisfactory precautions can be taken against damage by heavy traffic during construction. Thresholds shall be as manufactured by Pemko; Reese; or equal.

F. Weatherstripping

1. Weatherstripping shall be shop applied at door jambs and head. Assembly shall consist of a continuous silicone rubber seal retained and fastened to the stop through a continuous aluminum extrusion. Size shall be as required to suit door size. Weatherstripping may also be used on interior doors to seal for light, sound or smoke. Weatherstripping shall be as manufactured by Pemko; Reese; or equal.

G. Stops

1. Wall stops shall be provided except where they cannot be satisfactorily used, then floor stops shall be provided. Machine screws in threaded expansion anchors shall be provided for installation in concrete or masonry and self-tapping screws shall be provided for installation in stud walls. Height of floor stop shall be as required to suit specific floor conditions. Stops shall be as manufactured by Quality; Ives; Glynn-Johnson; or equal.

H. Overhead Door Holders

1. Door holder shall include an integral spring which shall absorb and dampen shock. Holder shall be surface-mounted to the door with machine screws and shall be as manufactured by Sargent; or equal.

I. Flush Bolts

1. Flush bolts shall be mortise type and shall be provided at top and bottom of inactive leaf of double doors when not equipped with exit devices. Provide dustproof strike at floor and standard strike at head. Rod length shall be provided so that top lever in door edge is not more than 6 feet 6 inches above the floor. Flush bolts shall be as manufactured by Quality; Ives; or equal.

J. Astragals

1. Astragals at meeting edge of double doors shall be full length extruded aluminum with vinyl insert, except at fire rated doors where astragal shall be steel 2-inch wide by 3/16-inch thick screw attached to door. Astragal shall be as manufactured by Pemko; or equal.

K. Exit devices

1. Exit devices at single door shall be rim type (Panic/Fire Exit Device). At double steel doors with both doors active, provide two vertical rod type exit devices with two-part locking and no astragal. Function and trim shall be as indicated on the hardware list. Exit devices shall be as manufactured by Sargent, Von Duprin; Corbin or equal.

L. Door Bottoms

1. Door bottom shall be extruded aluminum with a vinyl insert. Length shall be equal to door width minus 2 inches. Automatic door bottoms shall be provided where indicated. Door bottoms shall be as manufactured by Pemko; Reese; or equal.

M. Locksets

1. Locksets shall be bored type with function as indicated on the Hardware List. Backset shall be 2-3/4 inches. Lockset shall be completely reversible and shall include anti-friction and guarded latch bolt, seamless brass latch tube and stainless steel springs and retractors. Latch bolt shall be 1/2-inch throw except where 3/4-inch throw is required for labeled doors. Locksets shall be Cyer Locks.

2.03 HARDWARE LIST

- A. The various hardware items required for the doors on this project shall be as tabulated below. See DRAWINGS for information regarding material quantities.
- B. Manufacturer's names are listed to establish a standard of quality, appearance and function for hardware required on this project. Equal products by alternate manufacturers may be submitted for OWNER's review.

for OWNER's review.						
SET #01						
Doors: 1(Per Each)						
4 Hinges	TA2714 4 1/2 X 4 1/2 NRP	26D	MC KINNEY			
1 Entrance Lock	PBR 8847FL ADA LEVER	626	YALE			
1 Closer	7500	689	NORTON			
1 Kick Plate	K1050 10" X 2" LDW	US32D	ROCKWOOD			
1 Wall Stop	406 (Convex)	US32D	ROCKWOOD			
1 Raindrip	303 APK (Head & Jamb)		PEMKO			
1 Weatherstrip	18062 CNB		PEMKO			
1 Sweep	346C		PEMKO			
1 Threshold	272A MS&A ADA COMPLIANT		PEMKO			
VERIFY HANDING						
SET #02						
PAIR OF Doors: $2 = 3'-0$)" X 8'-0" X 2 1/2" HM INS DR	. (STC52)				
8 Hinges	TA2714 4 1/2 X 4 1/2 NRP	26D	MC KINNEY			
1 Set Automatic Bolts	1848	US26D	ROCKWOOD			
1 Entrance Lock	PBR 8847FL ADA LEVER	626	YALE			
Panic Hardware	Series 99 Touch-bar w/		VON DUPRIN			
concealed vert. rod w/ LHR						
	or RHR outside trim #3721					
1 Astragal	357SP		PEMKO			
1 Coordinator	1600	BLK	ROCKWOOD			
1 Closer	7500	689	NORTON			
2 Kick Plate	K1050 10" X 2" LDW	US32D	ROCKWOOD			
2 Wall Stop	406 (Convex)	US32D	ROCKWOOD			
1 Raindrip	303 APK (Head & Jamb)		PEMKO			
1 Weatherstrip	18062 CNB		PEMKO			
2 Sweep	346C		PEMKO			
1 Threshold	272A MS&A ADA COMPLIANT		PEMKO			
	COMILIMINI					

VERIFY HANDING						
SET #03						
Door: 3 (Per Each)						
3 Hinges	TA2714 4 1/2 X 4 1/2 NON REMOVABLE	26D	MC KINNEY			
1 Storeroom Lock	PBR 5405LN ADA LEVER	626	YALE			
1 Closer	7500	689	NORTON			
1 Kick Plate	K1050 10" X 2" LDW	US32D	ROCKWOOD			
1 Wall Stop	406 (Convex)	US32D	ROCKWOOD			
3 Door Silencers	608	GRAY	ROCKWOOD			
VERIFY HANDING						

PART 3 - EXECUTION

3.01 PREPARATION

A. General

- 1. Doors and door frames shall be fabricated and installed in a workmanlike manner. Doors and hardware shall be adjusted so that operation will be smooth, free, and easy, and with no binding in the hardware, or between doors and frames. Doors shall be set plumb, square, and level at their proper elevation and in their proper plane. Hardware shall be adjusted to operate smoothly, freely, and properly. Doors and frames shall be protected during shipment and storage to prevent warping, bending, or corrosion.
- 2. Doors and frames shall be prepared and reinforced for hinges, locksets, strikes, closers, and other items as required. Doorknobs or levers shall be 40 inches above the floor to the center line of the knob. Preparations in pressed steel frames for hinges, strikes, flush bolts, and other items shall be protected with dust boxes.
- Door sizes, leaf types, door frames, and window type and size shall be as indicated or scheduled on the DRAWINGS. Aluminum shall be insulated as specified under Section 05 80 00 Structural and Miscellaneous Metals. Shop DRAWINGS shall be submitted to the OWNER for review

3.02 INSTALLATION

A. Hollow Metal Doors and Frames

1. Finish

a. Doors and frames shall be mortised, drilled and tapped to template requirements in preparation for finish hardware. After shop assembly, doors and frames shall have all tool marks and surface imperfections dressed, filled and sanded as required to make faces and vertical edges smooth, level and free of irregularities. They shall then be chemically treated for maximum paint adhesion and shall be coated, on all exposed surfaces, with a rust-inhibitive primer which shall be fully cured before shipment. Doors and frames shall be shop painted.

2. Shop Painting

- a. Clean, treat, and paint exposed surfaces of steel door and frame units, including galvanized surfaces.
- b. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.
- c. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.

3. Installation

- a. Doors and frames shall be installed per manufacturers' recommendations and shop DRAWINGS. Doors shall operate smoothly and with no binding. Clearance between door and frame at head and jambs shall be 1/8 inch. Clearance between meeting edges of pairs of doors shall be 1/8 inch. At door sills where no threshold is used, clearance shall be 3/8 inch above finished floor. Where threshold is used, sill clearance shall be 3/4 inch above finished floor.
- b. Doors and frames installation shall conform to National Fire Protection, NFPA 80
 "Standard for Fire Doors and Fire Windows"

B. Hardware

1. Installation

- a. Hardware installation shall be coordinated with other work requiring door hardware or attaching to it. The CONTRACTOR shall submit necessary copies of schedules, templates, etc. in ample time to avoid fabrication and construction delays. Hardware shall be delivered to the site in unopened packages bearing the manufacturers' labels. Each item or group of items shall be identified according to the accepted submittal schedule, and shall be installed per manufacturers' recommendations.
- b. Each hardware item shall be fitted, adjusted and secured neatly and firmly in place and shall be in perfect working order. Latch bolts shall be adjusted to automatically engage in keepers, whether activated by closers or by a manual push. In no case shall additional manual pressure be required to accomplish positive latching. Closers shall be carefully adjusted to operate noiselessly and evenly.
- c. Hardware shall be dismantled and rehung as required to complete finish painting. Protect hardware from finish painting by use of a strippable coating, removable tape or other means to prevent damage or staining. Protective measures shall be removed prior to final inspection for OWNER's acceptance of project.
- d. All work shall be guaranteed for two years from date of acceptance of the work, against defects in materials and workmanship in accordance with the General Provisions.

2. Keying

- a. All door locks shall be cyber locks.
- b. The hardware supplier shall prepare and submit a lock schedule which complies with the above directions.

END OF SECTION

SECTION 08 34 73 - STC 52 METAL SOUND CONTROL DOORS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including general and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 **SUMMARY:**

- A. Furnish and install Sound Control Doors specified herein and per the locations and orientations shown on the Contract Documents. Verify all dimensions and requirements and coordinate with other trades as necessary
 - 1. Swing Sound Control Doors, Frame and Seals
 - 2. Glazing of Sound Control Doors (Where Applicable)
 - 3. Supply and Installation of hardware for Sound Control Doors.

1.3 RELATED SECTIONS:

- A. Specified elsewhere:
 - 1. Section 01 33 00: Submittal Procedures
 - 2. Section 01 33 23: Shop Drawings, Product Data and Samples
 - 3. Section 09 90 00: Painting and Coting

1.4 SUBMITTALS:

- A. Submit shop drawings, manufacture's data, and product performance certification in accordance with General Conditions.
- B. Shop drawings:
 - a. Provide full size details of frames and sound gasket components.
 - b. Provide installation details applicable to the construction in which the Sound Control Doors and frames will be installed.
 - c. Indicate construction, sizes, thicknesses, reinforcing, anchoring, and finishes of all materials.
 - d. Where applicable, doors requiring veneering or special finishes should note type, species, and finish on the drawings.
- C. Manufacturer's data:

- a. Provide illustrations and descriptions of all seals and hardware items which will be exposed on doors and frames for design review by Architect and project Acoustics Consultant.
- b. Provide complete installation and adjustment information

D. Certification:

- a. Provide certified laboratory test reports from an independent NVLAP certified acoustics laboratory showing that a fully operating installation of the specific Sound Control Door/Frame assembly proposed for installation has been measured in accordance with ASTM E 90-09 and has met or exceeded the scheduled STC ratings. The test results shall be representative of the performance of the proposed Sound Control Door/Frame assembly.
- b. Provide written evidence of at least two acoustic field tests showing that comparable installations have been measured in excess of a Noise Isolation Class (NIC) which is not more than six (6) points below the specified STC rating following the procedures set forth in ASTM E 336-90.

1.4 QUALITY ASSURANCE:

- A. Regulatory Requirements:
 - 1. Acoustical performance: STC (Sound Transmission Class) of 52.
 - 2. Reference Standards:
 - a. ASTM E90-99 or ASTM E90-09 and E413-87 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
 - 3. All laboratory testing shall be performed within the last five (5) years to assure product integrity.

1.5 DELIVERY, STORAGE AND HANDLING:

- A. Upon award of contract and before commencement of building construction, submit to the Architect any special requirements (scheduling, flatness of floor, etc.) which are necessary to assure successful installation.
- B. Protect door systems during transit, handling and storage to prevent damage, soiling, and deterioration.
- C. Deliver frames to General Contractor with complete installation drawings and instructions for installation by the General Contractor.
- D. Deliver doors to project site only after the building has been closed in. Store doors in the building in a dry location and stack in accordance with manufacturer's instructions.
- E. Protect door assemblies, especially sound gaskets, from damage before, during and after their installation.

- F. Note any special conditions for unloading the doors.
- G. Swing doors shall be stored off the ground in an upright position and shall be protected from weather and damage.

1.6 WARRANTY:

- A. Provide a sound control door manufacturer's warranty covering failures of materials (excluding wear and tear on sound seals) and workmanship for a period of five (5) years from installation.
- B. Finish warranty: Furnish sound control door manufacturer's written warranty covering failure of the factory-applied finish on metal panels within the warranty period. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.

Warranty Period: 5 years on door/frame assembly 2 years on hardware 1 year on wood veneer

1.7 ACOUSTICAL PERFORMANCE

A. All tests for validation of swing door performance for compliance with these specifications shall be conducted by an independent NVLAP certified testing laboratory, National Institute of Standards (NIST) accredited to the most current standard of testing. At a minimum the testing results must conform and be tested to ASTM E90-09 and ASTM E413-87.

Sound Transmission Loss, db

Octave Band Center Frequency, Hz

Door Type 125 250 500 1K 2K 4K STC **OS-52** 40 44 50 53 54 56 52

B. The complete door/frame assembly, if tested in the field, shall meet the FSTC ASTM E336-97 within 6 dB of the specified STC rating.

1.8 EXPERIENCE:

A. Swinging Sound Control Door supplier must provide a list of ten (10) similar successful installations supplied within the last five years.

B. Materials requiring testing shall be manufactured in the same location, with the same equipment for at least five (5) years and have 3rd party, independent testing results no more than five (5) years old.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. The Sound Control door/frame assemblies shall be a 2 ½" thick, "QuietSwing" Model QS-52 doors as manufactured by Noise Barriers or equal.

Manufacturer:

Noise Barriers Phone: (847) 843-0500

www.noisebarriers.com

Contact:

John Finnegan Phone: (315) 682-3821

Email: info@noisebarriers.com

B. Source Limitations: Obtain pre-hung, pre-swung steel sound control door assemblies, including doors, frames, sound control seals, hinges, thresholds, and other items essential for sound control, from single source from single manufacturer.

2.2 MATERIALS of CONSTRUCTION

- C. Door leaf shall be fabricated from one skin a minimum of 12 gauge steel. Door shall be filled with sound-absorbing and dampening elements.
- D. Door frame shall be fabricated from minimum 14 gauge steel. Provide frames with anchors and attachments as necessary to transfer loads to surrounding wall construction. "Split" door frames are designed to be installed after the walls are constructed.
- E. Acoustic seals: Side and head of door and frame shall be provided with two (2) sets of <u>factory installed</u> self-aligning magnetic-compression seals to hold door in closed position by the magnetic force of perimeter seals. Corners must be mitered and sealed.
- F. Door Bottom: Bottom of door shall be provided with a <u>factory installed</u> continuous, adjustable, Teflon coated, neoprene compression seal mortised into the door bottom and designed to compress against floor as door is closed. Automatic door bottom seals will not be accepted.
- G. Vision Lights: <u>Factory installed</u> double-glazed windows in dimensions per the door schedule. All glazing shall be installed by skilled workmen at the manufacturer's facility.
- 1. Where noted on drawings provide a 12" x 12", 4" x 30", 24" x 36 " or 22" x 60" STC 52 METAL SOUND CONTROL DOORS 08 34 73 4

double glazed window with glazing thicknesses required to maintain the specified acoustical performance of the doors. Glazing is <u>factory installed</u>.

H. Hardware:

- 1. Provide minimum two (2) <u>factory installed</u> cam-lift type hinges for each door. Finish of hinges shall be US26D.
- 2. Locks, pull handles, push plates, and other door hardware as specified in the hardware schedule will be furnished and <u>factory installed</u> by the sound door supplier. Door leaf and frame for each unit shall be prepared to receive security locks as specified in the hardware schedule.
- 3. Other Hardware: Comply with requirements in Section 08 05 00 "Common Work Results for Openings," and Section 08 11 00 "Metal Doors and Frames."

2.3 FABRICATION:

- A. Assemble doors using all welded construction conforming to pertinent requirements of AWS D1-1. Assembly and adjustment of door, frame, acoustic seals and hinges shall be performed at the factory. Each entire unit shall be shipped to the job site ready for installation and subsequent operation. No field assembly of doors or frames shall be permitted.
- B. Reinforce as required to withstand operating loads.
- C. Using templates furnished by finish hardware.
- D. Painting and cleaning:
 - 1. On surfaces which are inaccessible after assembly, apply protective coating of the manufacture's standard rust-inhibitive primer.
 - 2. After assembly, and prior to inspection, thoroughly clean all surfaces.
 - 3. After inspection, and completion of repairs and revisions required by the inspection, apply a shop coat of rust inhibitive primer to exposed surfaces.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Assure that all door openings conform to all dimensions and tolerances shown on architectural plans and sound control door manufacturer's approved shop drawings. Check that surfaces in contact with sliding doors are free of debris and that wall openings and adjoining air and vapor seal materials are ready to receive work of this section. All work must be plumb, flat, and square to accept the door system.
 - a. Installation shall not proceed until unsatisfactory conditions are corrected.

b. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

- A. Installation of door frames, doors perimeter seals, and final adjustments for door operation and for the design attenuation shall be performed by factory trained personnel under the supervision of the manufacturer.
- B. Comply with manufacturer's instructions and approved shop drawings.
- C. Install items plumb (or as indicated on the contract documents), straight, square, level, and in their proper elevation, plane and location.
- D. At fire-rated openings, install frames according to NFPA 80.
- E. At openings requiring smoke and draft control, install frames according to NFPA 105.
- F. Adjust bottom seal per manufacturer's instructions.
- G. After installation, adjust doors and hardware for smooth and easy operation.
- H. Once the facility is deemed complete all work shall be completed in every detail including the final adjustment of the bottom seal and the finished work shall be clean for Architect prior to final acceptance.

3.3 ADJUST AND CLEAN

- A. Check and readjust operation finish hardware in work just prior to final inspection. Leave work in complete and proper operating condition. Remove and replace defective work.
- B. Immediately after erection, sand smooth all rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

3.4 NOTIFICATION OF WORK COMPLETION:

A. After installation and prior to acceptance testing, provide a letter to the Architect and the project Acoustics Consultant, co-signed by the General Contractor's project representative, indicating that all Sound Control Doors assemblies have been installed and gaskets have been adjusted to form an airtight seal around the full perimeter of each door panel.

3.5 ACCEPTANCE TESTING

A. At the discretion of the Owner, Architect, or project Acoustical Consultant acoustic performance testing of the installation may be performed. The cost of such testing is not the responsibility of the door manufacturer.

B. The installation shall be deemed acceptable if the Sound Control Door assemblies meet or exceed a Noise Isolation Class (NIC) which is not more than six (6) points below the specified STC rating.

END OF SECTION

SECTION 08 90 00 - ACOUSTICAL LOUVERS

PART 1 GENERAL

1.01 SUMMARY

- A. Furnish and install louvers, bird screens, blank-off panels, structural supports and attachment brackets as shown on the drawings, as specified, and as needed for a complete and proper installation.
- B. The louvers to be furnished include the following:
 - 1. Standard fixed extruded louvers.
- C. Related sections include:
 - 1. Division 7 Section "Joint Sealants" for sealants installed in perimeter joints between louver frames and adjoining construction.

1.02 REFERENCES

- A. Air Movement and Control Association International, Inc.
 - 1. AMCA Standard 500-L Laboratory Methods of Testing Louvers for Rating
 - 2. AMCA Publication 501 Application Manual for Louvers
- B. The Aluminum Association Incorporated
 - 1. Aluminum Standards and Data
 - 2. Specifications and Guidelines for Aluminum Structures
- C. American Society of Civil Engineers
 - 1. Minimum Design Loads for Buildings and Other Structures
- D. American Society for Testing and Materials
 - 1. ASTM B209
 - 2. ASTM B211
 - 3. ASTM B221
 - 4. ASTM E90-90
- E. Architectural Aluminum Manufacturers Association
 - 1. AAMA 800 Voluntary Specifications and Test Methods for Sealants
 - 2. AAMA 605.2 Voluntary Specification for High Performance Organic Coatings on Aluminum Extrusions and Panels.
 - 3. AAMA TIR Metal Curtain Wall Fasteners
 - 4. AAMA 2605-98 Superior Performing Organic Coatings on Aluminum Extrusions and Panels

1.03 SUBMITTALS

- A. Product Data
 - 1. Air flow and water entrainment performance test results.
 - 2. Material types and thickness.
- B. Shop Drawings
 - 1. Include elevations, sections and specific details for each louver.

- 2. Show anchorage details and connections for all component parts.
- 3. Include signed and sealed structural calculations.
- C. Samples
- D. Submit color chips for approval.

1.04 QUALITY ASSURANCE

- A. Single subcontract responsibility: Subcontract the work to a single firm that has had not less than six years experience in the design and manufacturing of work similar to that shown and required.
- B. Performance Requirements: Provide AMCA and BSRIA test data as required to confirm that the louvers have the specified air and water performance characteristics.
- C. Acoustical Performance: Where applicable, submit test reports to confirm that the louvers meet the specified STC and Noise Reduction requirements.
- D. Structural Requirements: Design all materials to withstand wind and snow loads as required by the applicable building code. Maximum allowable deflection for the louver structural members to be 1/180 or 0.75 inches, whichever is less. Maximum allowable deflection for the louver blades to be 1/120 or 0.50 inch across the weak axis, whichever is less.
- E. Professional Engineer Requirements: Drawings and structural calculations to be signed and sealed by a professional engineer licensed to practice in the project state.
- F. Warranty: Provide written warranty to the owner that all products will be free of defective materials or workmanship for a period of one year from date of installation.

1.05 DELIVERY, STORAGE AND HANDLING

A. Delivery: At the time of delivery all materials shall be visually inspected for damage. Any damaged boxes, crates, louver sections, etc. shall be noted on the receiving ticket and immediately reported to the shipping company and the material manufacturer.

B. Storage:

- 1. Material may be stored flat, on end or on its side.
- 2. Material may be stored either indoors or outdoors.
- 3. If stored outdoors the material must be raised sufficiently off the ground to prevent it being flooded.
- 4. If stored outdoors the material must be covered with a weather proof flame resistant sheeting or tarpaulin.

C. Handling:

- 1. Material shall be handled in accordance with sound material handling practices and in such a way as to minimize racking.
- 2. Louver sections may be hoisted by attaching straps to the jambs and lifting the section while it is in a vertical position.
- 3. Louver sections should only be lifted and carried by the jambs. Heads, sills and blades are not to be used for lifting or hoisting louver sections.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The louvers and related materials herein specified and indicated on the drawings shall be as manufactured by:

Construction Specialties, Inc.

49 Meeker Avenue

Construction Specialties, LTD.

895 Lakefront Promenade

Cranford, New Jersey 07016 Mississauga, Ontario L5E 2C2 Telephone: 800-631-7379 Telephone: 888-895-8955

Construction Specialties, LLC CS Group Construction Specialties 1705 World Trade Centre Ltd.

PO Box 9260 Room 616-617

Dubai, U.A.E. No.899 Cross Region Plaza, Lingling

Telephone: +971-4-3312167 Road Xuhui District, Shanghai, China

200030

Telephone: +86-21-64329257

Construction Specialties (UK) LTD 1010 Westcott Venture Park, Westcott, Aylesbury,

Bucks HP18 0XB. United Kingdom. Telephone: +44 (0) 1296 652800

B. Products equal to the CS materials may be offered providing that the manufacturer and materials are pre-approved at least 10 working days before the bid date.

2.02 MATERIALS

- A. Aluminum Extrusions: ASTM B211, Alloy 6063-T5, 6063-T6 or 6061-T6.
- B. Aluminum Sheet: ASTM B3209, Alloy 1100, 3003 or 5005.

2.03 FABRICATION, GENERAL

- A. Provide CS louver models, bird screens, blank-off panels, structural supports and accessories as specified and/or shown on the drawings. Materials, sizes, depths, arrangements and material thickness to be as indicated or as required for optimal performance with respect to strength; durability; and uniform appearance.
- B. Louvers to be mechanically assembled using stainless steel or aluminum fasteners.
- C. Include supports, anchorage, and accessories required for complete assembly.

2.04 LOUVER MODELS

A. CS 8" (203.2mm) Deep Standard Fixed Acoustical Louver Model A-8370

1. **Material:** Fixed blades and frame to be formed from aluminum alloy sheet. Interior acoustical material to be fiberglass insulation protected by a woven fire retardant

(self–extinguishing) 100% polyester sheeting. Material minimum thickness to be as follows: Heads, sills, jambs, mullions and fixed blades: 0.081" (2.06mm).

2. **Performance tested in accordance with AMCA:** A 4' x 4' unit shall conform to the following:

Free Area 3.68 sq. ft. (0.34 sq. m.) Free area velocity at the point of beginning water penetration 942 FPM (318.8 m/min) Intake Pressure drop at the point of beginning water penetration Exhaust pressure drop at 1000 fpm free area velocity (305 m/min) $0.08 \text{ in. H}_2\text{O} (2.03 \text{ mm})$

3. **Acoustical Performance:** When tested in accordance with ASTM Standard E90-90 the louver shall have an STC of 15 and shall provide the following Noise Reduction:

Frequency (hz):	63	12	250	50	100	200	400	8000
		5		0	0	0	0	
Transmission Loss:	9	7	7	11	18	19	14	13
Noise Reduction:	15	13	13	17	24	25	20	19

2.05 FINISHES

- A. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory. Protect finishes on exposed surfaces prior to shipment. Remove scratches and blemishes from exposed surfaces that will be visible after completing finishing process. Provide color as indicated or, if not otherwise indicated, as selected by architect.
- B. 100% Fluoropolymer Resin Powder Coat System complying with AAMA-2605-5 standards for gloss and color retention. Finish thickness to be 1.5 to 3.0 mils.
 - 1. Finish to allow zero VOCs to be emitted into facility of application or at job site.
 - 2. Finish to adhere to a 4H Hardness rating.
 - 3. Furnish manufacturer's twenty (20) year warranty for finish for gloss and color retention

OR

- B. Three Coat Fluorocarbon Coating
 - 1. Louvers to be finished with a minimum 1.4 mil (0.035mm) thick full strength 70% resin, 3 coat Fluoropolymer system.
 - 2. All aluminum shall be thoroughly cleaned, etched and given a chromated conversion pre-treatment before application of the Kynar/Hylar coating. The coating shall consist of a primer, a high metallic color coat and a clear PVF2 topcoat. It shall receive a bake cycle of 17 minutes at 450°F. All finishing procedures shall be one continuous operation in the plant of the manufacturer.
 - 3. Manufacturer to furnish an extended 20 limited warranty for the Kynar/Hylar coating. This limited warranty shall begin on the date of material shipment.

OR

B. Two Coat Fluorocarbon Coating

- 1. Louvers to be finished with a minimum 1.0 mil (0.025mm) thick full strength 70% resin, 2 coat Fluoropolymer system.
- 2. All aluminum shall be thoroughly cleaned, etched and given a chromated conversion pre-treatment before application of the MICA II coating. The coating shall consist of a primer and a pearlescent pigmented PFV2 topcoat. It shall receive a bake cycle of 17 minutes at 450°F. All finishing procedures shall be one continuous operation in the plant of the manufacturer.
- 3. Manufacturer to furnish an extended 20 limited warranty for the Kynar/Hylar coating. This limited warranty shall begin on the date of material shipment.

OR

B. Clear Anodize

- 1. Louvers to be given a one hour 215R1 Architectural Class I anodic coating of 0.7 mil (0.018mm) thickness (Aluminum Association designation AA-C22A41).
- 2. The thickness of the coating shall be tested in accordance with ASTM B244-68.
- 3. The coating shall be sealed to pass the ASTM B136-77 Modified Dye Stain Test.

OR

B. Bronze Anodic

- 1. Louvers to be given a Bronze Anodic Architectural Class 1 coating of 0.7 mil (0.018mm) minimum thickness; and a minimum weight of 27 mg. per sq. in.
- 2. The thickness of the coating shall be tested in accordance with ASTM B244-68.
- 3. The coating shall be sealed to pass the ASTM B136-77 Modified Dye Stain Test.

2.06 BIRD SCREENS

- A. Unless otherwise indicated, all louvers to be furnished with mill finish bird or insect screens.
- B. Screens to be 5/8" (15.9mm) mesh, 0.050" (1.27mm) thick expanded and flattened aluminum bird screen secured within 0.055" (1.40mm) thick extruded aluminum frames. Frames to have mitered corners and corner locks.

OR

B. Screens to be 18 x 16 aluminum mesh 0.011" (0.279mm) diameter wire insect screens secured within 0.055" (1.40mm) thick extruded aluminum frames. Frames to have mitered corners and corner locks.

2.07 BLANK OFFS

- A. Furnish where indicated on the drawings blank-off panels fabricated by the louver manufacturer.
- B. Blank-off panels to be 0.050" (1.27mm) thick aluminum sheet. Panels to be finished with Kynar 500 minimum 1 mil (0.025mm) thick full strength 70% resin Fluoropolymer coating. Color to be selected by the architect.

OR

B. Blank-off panels to be 1" (25.4mm) thick and to be faced on both sides with 0.032" (0.81 mm) thick aluminum sheet. Panels to be fabricated with a mineral wool core (#6 density) having an R-value of 4 (0F*ft2*h/Btu) per inch. Insulation to comply with ASTM C 612 Mineral fiber block and board thermal insulation Type 1VB. Panel perimeter frame to be 0.050" (1.27mm) thick-formed aluminum channels. Panel frame to be mitered at the corners. Panels to be finished black.

Complies Fire Performance:

ASTM E 136 Behavior of Materials at 750 °C (1382 °F) CAN4 S114 Test for Non-Combustibility ASTM E 84 (UL 723) Surface Burning Characteristics	Non-Combustible Non-Combustible Flame Spread = 0
Smoke Developed = 0 CAN/ULC S102 Surface Burning Characteristics Smoke Developed = 0	Flame Spread = 0
Thermal Resistance: ASTM C 518 (C177) R-value/inch @ 75 °F RSI value/25.4 mm @24 °C	4.2 hr.ft ² .F/Btu*** 0.74 m ² K/W

OR

B. Blank-off panels to be 2" (50.8mm) thick and to be faced on both sides with 0.032" (0.81 mm) thick aluminum sheet. Panels to be fabricated with a mineral wool core (#6 density) having an R-value of 8 (0F*ft2*h/Btu). Panel perimeter frame to be 0.050" (1.27mm) thick-formed aluminum channels. Panel frame to be mitered at the corners. Panels to be finished black.

Complies Fire Performance:

Non-Combustible
Non-Combustible
Flame Spread = 0
Flame Spread = 0
4.2 hr.ft ² .F/Btu***
$0.74 \text{ m}^2\text{K/W}$

PART 3 EXECUTION

3.01 EXAMINATION:

A. Examine openings to receive the work. Do not proceed until any unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation of the work.
- B. Verify dimensions of supporting structure at the site by accurate field measurements so that the work will be accurately designed, fabricated and fitted to the structure.
- C. Anchor louvers to the building substructure as indicated on architectural drawings.
- D. Erection Tolerances:

- 1. Maximum variation from plane or location shown on the approved shop drawings: 1/8" per 12 feet of length, but not exceeding 1/2" in any total building length or portion thereof (non-cumulative).
- 2. Maximum offset from true alignment between two members abutting end to end, edge-to-edge in line or separated by less than 3": 1/16" (shop or field joints). This limiting condition shall prevail under both load and no load conditions.
- E. Cut and trim component parts during erection only with the approval of the manufacturer or fabricator, and in accordance with his recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly.
- F. Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process as directed.
- G. Set units level, plumb and true to line, with uniform joints.

3.03 PROTECTION

A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

3.04 ADJUSTING AND CLEANING

- A. Immediately clean exposed surfaces of the louvers to remove fingerprints and dirt accumulation during the installation process. Do not let soiling remain until the final cleaning.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to the material finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers and accessory components damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by the Architect, remove damaged materials and replace with new materials.
 - 1. Touch up minor abrasions in finishes with a compatible air-dried coating that matches the color and gloss of the factory applied coating.

END OF SECTION

SECTION 09 05 00 – COMMON WORK RESULTS FOR FINISHES

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. The General Conditions apply to all sections of this specification, which shall be completed as shown on the plans and as specified, and shall be properly coordinated with work in other Specifications.
- B. The DRAWINGS and these specifications are complementary to each other; what is called for by one shall be as binding as if called for by both. If there is any conflict between what is shown on the DRAWINGS and what is written in the specifications, the details described on the DRAWINGS shall take precedence and the CONTRACTOR shall communicate the conflicts to the Design ENGINEER in a timely manner.

C. Safety

1. The CONTRACTOR shall be familiar with, and shall at all times conform to, the regulations of the "OSHA General Industry Occupational Safety and Health Standards," "OSHA Safety and Health Regulations for Construction," and other applicable state and municipal standards and regulations.

1.02 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 01 33 00 SUBMITTAL PROCEDURES
 - 2. SECTION 05 00 00 METALS

1.03 CITED STANDARDS – NONE

1.04 NOTED RESTRICTIONS

A. No lead or chromate containing paints shall be used.

1.05 SUBMITTALS

- A. The CONTRACTOR shall submit, for the OWNER's approval, a proposed plan for accomplishing the required surface preparation and painting work. The plan shall include, as a minimum, the following:
 - 1. A schedule for accomplishing the surface preparation, priming and painting within each area of work.
 - 2. A plan for protecting areas just painted from damage during sandblasting.
 - 3. A plan for protecting surrounding areas, structures, and equipment from damage during sandblasting and/or painting.
 - 4. Submit in accordance with Section 01 33 00 Submittal Procedures.

PART 2 - PRODUCTS

2.01 PAINT

- A. All paint for concrete and metal surfaces shall be especially formulated for the intended use and shall be applied in conformance with the manufacturer's published specifications.
- B. All paint for final coats shall be fume resistant. If a paint manufacturer proposes use of paint which is not designated "fume resistant" in its literature, it shall furnish full information concerning the pigments used in this paint.
- C. Coatings used in conjunction with potable water supply systems shall have FDA, NSF, and California State DOHS approval for use with potable water and shall not impart a taste or odor to the water.
- D. Complete data on each type and kind of paint and primer shall be submitted to the OWNER for review. Submittals shall be reviewed and approved by the OWNER before the paint is purchased and delivered to the jobsite. This procedure shall be followed whether or not the paint that the CONTRACTOR proposes to use is named in the Specifications. Review data shall show where and for what uses each paint product is proposed to be used with cross reference made to paragraphs of the Specifications or Painting Schedule. Data submitted on each proposed type and kind of paint shall include data to show that the paint meets the requirements of these Specifications.
- E. Paints not listed in the Specifications and which are submitted for review shall be submitted with a certified ingredients analysis. Data shall include sufficient information for making a complete comparison between specified and proposed paint.
- F. Colors shall be as specified or as selected by the OWNER. Colors will not necessarily be standard colors with all suppliers, and colors shall be mixed by the manufacturer to secure desired color when not standard. The CONTRACTOR shall prepare and submit color chip samples for all items which require color selection by the OWNER. If requested for special architectural finishes, the CONTRACTOR shall also submit 6-inch by 6-inch samples similar to the intended coated surfaces and coated with the selected color. No color selection will be made until all samples of all paints have been submitted. After all samples of all paints have been submitted, the OWNER will prepare a color scheme using the submitted colors.
- G. All paint shall comply with all requirements of the Air Pollution Regulatory Acts concerning the application and formulation of paints and coatings for an area in which the paints are applied. Specifically, paints shall be reformulated as required to meet the local, State, and Federal requirements.

H. Specified Products List

1. The CONTRACTOR shall use paint from one of the following Manufacturer's, unless approved otherwise by the ENGINEER.

Brand Name	Manufacturer		
Amchem	Amchem Products Fremont, California		

Brand Name	Manufacturer			
Amercoat	Ameron Corporation			
Amercoat	Brea, California			
	Borden Chemical Company			
Borden	50 West Broad Street			
	Columbus, Ohio 43215			
Carboline	Carboline Company			
Carbonne	St. Louis, Missouri 63144			
	Koppers Company, Inc.			
Kop-Cote	Koppers Building			
	Pittsburgh, Pennsylvania 15219			
	The Sherwin-Williams Company			
Sherwin-Williams	101 Prospect Avenue, N.W.			
	Cleveland, Ohio 44115			
	Sinclair Paint Co.			
Sinclair Paint Co.	6100 South Garfield Avenue			
	Los Angeles, CA 90040			
	Tnemec Company, Inc.			
Tnemec	123 West 23rd Avenue			
THEMEC	North Kansas City, Missouri			
	64116			
	International			
International	Louisville, KY			
	(800) 284-2994			
	Akzo Nobel Coatings Inc.			
Glidden	Louisville, KY			
	(502) 254-0470			

I. Painting Systems

1. Waterproofing sealer for concrete shall be Sikagard 704W, Conspec No. 1, Thompson's No. 201, or ENGINEER approved equal.

2. Coatings of Dissimilar Metals

- a. Where aluminum surfaces come in contact with dissimilar metals, aluminum surfaces shall be kept from direct contact with said metal by use of neoprene gaskets or washers, polyethylene self-adhesive tape (two wraps of 20-mil tape), or washers. Galvanizing or paint will not be considered as adequate protection.
- b. Aluminum surfaces to be placed in contact with wood, concrete, or masonry construction shall be given a heavy coat of an alkali-resistant bituminous paint before installation. The bituminous paint shall be Koppers Bitumastic Black Solution, International: Intertuf 100, Tnemec 46-465 HB Tnemecol, or equal. The paint shall be applied as it is received from the manufacturer without the addition of any thinner, and the surface shall be cleaned according to the manufacturer's instructions. Not less than two coats shall be applied. All exposed surfaces shall be cleaned of any coating before installation. Coatings shall be continuous and holiday free.

c. All stainless steel bolt and screw surfaces in contact with aluminum shall be coated with Never-Seez by Never Seez Compound Corp., WLR No. 111 by Oil Research Inc., or equal.

3. Hot-Dip Galvanizing

a. Area of Application: includes but not limited to stair stringers, grating embeds, fasteners, support members, and interior structural members not epoxy coated.

b. Fabricator Preparation

- 1) The Fabricator shall consult with the hot dip galvanizer to insure that materials, fabrication, and prep work will prevent potential problems during the galvanizing process.
- 2) The Fabricator shall remove all welding slag, splatter, anti-splatter compounds and burrs prior to delivery for galvanizing. Avoid unsuitable marking paints. Consult with the galvanizer about removal of grease, oil paint and other deleterious material prior to fabrication. Remove by blast cleaning or other methods surface contaminants and coatings, which would not be removable by the normal chemical cleaning process in the galvanizing operation.

c. Hot-Dip Galvanizing

- 1) Pre-clean steelwork in accordance with accepted methods to produce an acceptable surface for quality hot dip galvanizing.
- Galvanize steel members, fabrications, and assemblies after fabrication by the hot dip process in accordance with ASTM A123. Galvanize bolts, nuts and washers and iron and steel hardware components in accordance with ASTM A153.
- 3) Safeguard products against steel embrittlement in conformance with ASTM A143.
- 4) Handle all articles to be galvanized in such a manner as to avoid any mechanical damage and to minimize distortion.
- 5) Coating Weight: conform with paragraph 5.1 of ASTM A123, Table 1 of A767, or Table 1 of ASTM A153, as appropriate.
- 6) Surface Finish: Continuous, adherent, as smooth and evenly distributed as possible and free from any defect detrimental to the stated end use of the coated article.
- 7) Adhesion: Withstand normal handling consistent with the nature and thickness of the coating and normal use of the article.

d. Testing

- Inspection and testing of hot dip galvanized coatings shall include visual examination and tests in accordance with ASTM A123, A767 or A153 as applicable to determine the thickness of the zinc coating on the metal surface.
- 2) Furnish Notarized Certificate of Compliance with ASTM Standards and Specifications herein listed. The Certificate must be signed by the galvanizer

and contain a detailed description of the material processed. The Certificate shall include information as to the ASTM standard used for the coating.

J. Painting Schedules

1. General

- a. Painting shall be as specified in this section of the Specifications and as indicated on the Plans and specified herein.
- b. In general, all steel, iron, gypsum board and wood surfaces shall be painted unless specifically indicated or specified otherwise. Concrete surfaces shall be painted only where indicated or specified. Aluminum surfaces shall not be painted unless specifically indicated or specified.
- c. The Painting Schedule sets forth a listing of the type of items and type of paint system which they shall receive. This Schedule shall compliment the lists of items to be painted listed hereinbefore. This listing is not necessarily complete, and items of a like nature to those shown on the Painting Schedule shall be painted the same as if they were included in the Painting Schedule. In case of question as to whether an item is to be painted, or as to type of paint system to use, the City shall be consulted to render a judgment.
- 2. Exterior paint colors shall closely match adjacent housing units. All paint colors shall be selected by the City.

PART 3 - EXECUTION

3.01 PREPARATION

A. Manufacturer's Instructions

- 1. The manufacturers' published instructions for use as a guide in specifying and applying the manufacturers' proposed paint shall be submitted to the OWNER. Paint shall not be delivered to the job before approval of the manufacturer's instructions is given by the OWNER.
- 2. A manufacturer's paint will not be considered for review unless that manufacturer's published instructions meet the following requirements:
 - a. The instructions must have been written and published by the manufacturer for the purpose and with the intent of giving complete instruction for the use and application of the proposed paint in the locality and for the conditions for which the paint is specified or shown to be applied under this Contract.
 - b. All limitations, precautions, and requirements that may adversely affect the paint; that may cause unsatisfactory results after the painting application; or that may cause the paint not to serve the purpose for which it was intended, that is, to protect the covered material from corrosion, shall be clearly and completely stated in the instructions. These limitations and requirements shall, if they exist, include, but not be limited to the following list:
 - 1) Methods of application.
 - 2) Number of coats.
 - 3) Thickness of each coat.

- 4) Total thickness.
- 5) Drying time of each coat, including primer.
- 6) Primer required to be used.
- 7) Primers not permitted.
- 8) Use of a primer.
- 9) Thinner and use of thinner.
- 10) Temperature limitations during application and after application.
- 11) Time allowed between coats.
- 12) Protection from sun.
- 13) Physical properties of paint including solids content and ingredient analysis.
- 14) Surface preparation.
- 3. Concrete surfaces specified by the paint manufacturer to be acid etched shall be etched in Accord with the manufacturer's instructions. The surface shall then be thoroughly scrubbed with clean water, rinsed, and allowed to dry. The surface shall be tested with a moisture meter to determine when dry before coating.

B. Preparation of Surfaces

- 1. Paint surface preparation shall be as specified in the following or as recommended by the paint manufacturer's published application instructions, whichever imposes the most stringent requirements.
- 2. All surfaces to be painted shall be clean and dry except that in some cases the paint manufacturer's directions may require wetting the surface before painting.
- 3. Except as otherwise provided, all preparation of metal surfaces shall be in Accord with Specifications SP-1 through SP-11 of the Steel Structures Painting Council (SSPC). Where Steel Structures Painting Council Specifications are referred to in this specification, the corresponding Pictorial Surface Preparation Standard shall be used to define the minimum final surface conditions to be supplied. Grease and oil shall be removed by wiping with mineral spirits or naphtha per Specification SP-1. Rust, scale, welding slag, and spatter shall be removed and the surface prepared by hand tool cleaning, power tool cleaning or blast cleaning in Accord with the appropriate Specifications SP-2 through SP-11.
- 4. Unless otherwise specified, all iron or steel surfaces which are to be painted as submerged or high temperature metal shall be sandblasted on the site in Accord with Specification SP-10, near white blast cleaning or better. All metal surfaces which are to be painted as unsubmerged metal shall be commercial blast cleaned per Specification SP-6 except as otherwise specified, in locations where sandblasting would damage previously coated surfaces and installed equipment, and in locations where dry blasting is prohibited. The above locations in which SP-6 commercial blasting is not possible shall be given a SP-3 power tool cleaning if interior mild environment and SP-11 if interior corrosive environment or exterior exposed. This blasting shall be done not more than 12 hours ahead of the painting, subject to humidity and weather conditions between the time of blasting and painting operations. If any rusting or discoloration of blasted surfaces occurs before painting, such rusting or discoloration shall be removed. Prepared surfaces shall not be left overnight before painting. No surface which is to be blasted shall be

- given a coat of primer or paint in the shop or in the field before sandblasting. Blasting shall provide a roughened surface profile of not less than 2.0 mils in depth.
- 5. Surfaces to be painted at erection welds, surfaces exposed by damage to the coating, as during erections, shall be cleaned as above before painting.
- 6. Threaded portions of valve stems, machined surfaces which are intended for sliding contact, surfaces which are to be assembled against gaskets, surfaces or shafting on which sprockets are to fit, or which are intended to fit into bearings, machined surfaces of bronze trim, and similar surfaces shall be masked off to protect them from the sandblasting. Cadmium plated items shall not be sandblasted except that cadmiumplated, zinc-plated, or sherardized fasteners used in assembly of equipment to be sandblasted shall be sandblasted in the same manner as the unprotected metal. Galvanized items shall not be sandblasted except when otherwise specified. All installed equipment, mechanical drives, and adjacent painted equipment shall be protected from sandblasting. Protection shall prevent any sand or dust from entering the mechanical drive units or equipment where damage could be caused.
- 7. There will be some surfaces which cannot be sandblasted, or which cannot be sandblasted and painted, after the items of which they are a part have been assembled in final position. These surfaces shall be sandblasted, or sandblasted and painted, before the items are put into final position. In some cases while the painting could be done after the items concerned were in place, the limitation on time between sandblasting and painting may make it necessary to paint the surfaces before installation of the items concerned.
- 8. Sand from sandblasting shall be thoroughly removed, using a vacuum cleaner if necessary. No surface which has been sandblasted shall be painted until inspected by the OWNER.
- 9. All concrete to be painted or coated shall be prepared as specified in **Section 03 00 00**.
- 10. Concrete and masonry surfaces shall be free of dust, mortar droppings and spatter, fins, loose concrete particles, form release materials, oil, grease, and other deleterious materials. If required by the coating manufacturer, such surfaces shall be etched as specified above or brush-off blast cleaned.
- 11. All painted surfaces shall be dusted between coats and high gloss finishes shall be lightly sanded and dusted between coats unless otherwise directed by the paint manufacturer.
- 12. Surfaces which are to be painted with other than bituminous paint and which have had a bituminous coating (such as coal-tar varnished pipe), shall be sealed with not less than two coats of Inertol Tar Stop, Sherwin-Williams Metalatex B-42 W100, Glidden Insulcap, or equal, in sufficient quantity to permanently prevent bleeding of the bituminous coating.
- 13. Galvanized surfaces which are to be painted shall first be treated with Koppers No. 40 Metal Conditioner; Amercoat No. 59, Galvaprep No. 5 as manufactured by Amchem Products; or equal. Pretreatment for galvanized metal shall be applied not more than 48 hours prior to coating.
- 14. All fiberglass to be painted shall be lightly sandblasted or sanded to roughen surfaces just prior to painting.
- 15. Plastic surfaces shall be solvent-washed to dull the surface, using a thinner approved by the finish coating manufacturer.

16. Aluminum, copper, and other metal surfaces shall be lightly sanded or receive surface preparation as specified in the following or as recommended by the paint manufacturer.

3.02 INSTALLATION

A. Application of Paint

- 1. The applicator of the paint shall have had at least two (2) years past experience in applying the type or types of coatings and under similar conditions that he will be required to meet in this Contract. The CONTRACTOR shall provide written verification, the paint applicator's qualifications, and past performance, which shall include a listing of projects completed with names and telephone numbers of OWNERs, before subcontracting the work to him.
- 2. No painting shall be done under dusty conditions, during or immediately after a rain, during rainy weather, when surface temperature is less than 50 degrees F, or when the temperature exceeds that recommended for application by the paint manufacturer. Relative humidity shall be between 30 and 85 percent and the dew point shall not be within 5 degrees of the surface temperature.
- 3. Paint may be applied by brush, roller, trowel, or spray, unless the manufacturer's recommendations or these Specifications call for some particular type of application. Where spray application is used, each coat of paint shall be applied to a thickness equivalent to a brush coat application at a coverage not greater than that specified by the manufacturer for a brush coat application. All spray painting shall be by the airless method except where specifically allowed by the OWNER for architectural painting. All air spray units shall have operable line filters for removal of all oil and moisture. The CONTRACTOR shall demonstrate the efficiency of the line filters before applying any paint.
- 4. Spray painting shall be conducted under controlled conditions and the CONTRACTOR shall be fully responsible for any damage to adjacent work or adjoining property occurring from spray painting.
- 5. All work shall be done leaving the finished surfaces free from drops, ridges, waves, holidays, laps, or brush marks. Drop cloths and other coverings shall be so placed at all times as to protect floors, other surfaces, and equipment from spatter and droppings. Hardware, plates, lighting fixtures, nameplates, and similar articles which are not to be painted shall be masked off or removed completely. After completion of painting, any spatter or droppings shall be removed.
- 6. Primer and intermediate coats of paint shall be unscarred and completely integral at the time of application of each succeeding coat. Each coat shall be subject to the inspection and approval of the OWNER the next succeeding coat is applied. Defective work of any kind shall be deemed sufficient cause for stripping, removal, and re-preparing if required by the OWNER followed by recoating the entire surface involved at no additional cost to the OWNER.
- 7. Except as otherwise provided in these Specifications, or approved in writing by the OWNER, prime coats, undercoats, and finish coats on any one item shall be of the same manufacturer. If the incorrect prime coat is applied for any reason, it shall be blasted off and replaced with the specified primer at no additional cost to the OWNER.
- 8. When multiple coats of the same material are specified, the prime coat and undercoats applied shall be tinted to distinguish each from the following coat and finish coat.

- 9. Sufficient time shall be allowed between coats to insure proper drying unless these Specifications or manufacturer's recommendations specifically state otherwise. Excessive time or exposure between coats shall not occur in cases where such excessive time or exposure will impair the bond between coats. To prevent impairment of bond between coats, space heaters shall be provided to dry the coat or keep the coating dry, if recommended by the paint manufacturer or required by the OWNER at no additional cost.
- 10. The number of coats specified is the minimum to be applied. Suction spots between coats shall be touched up, and additional coats shall be provided if required to produce a finished surface of solid, even color, free from defects. The total thickness of the coating shall be as specified. Additional coats of paint shall be added if necessary to bring the total thickness up to not less than that specified. No holidays shall be left. Particular care shall be used to assure that the specified coverage is secured on the edges and corners of all surfaces. Additional brush coats shall be applied if necessary to cover the edges and corners. The CONTRACTOR shall control and check the dry film thickness of all coatings. The CONTRACTOR shall control and check the dry film thickness on metal surfaces with a correctly calibrated thickness meter and shall check for holidays with a low voltage holiday detector. The OWNER may use the CONTRACTOR's detector for additional checking. However, the OWNER will use an Elcometer to inspect the dry film thickness of the coatings, and its findings utilizing this meter will be final as to the dry film thickness of the applied coatings.
- 11. Damaged paint or scratched painted surfaces shall be sanded smooth before repainting. Sanding and repainting shall be done to such a degree and in such a manner that all evidence of the scratches or damages are obscured.

B. Factory-Painted Equipment

- 1. Except as otherwise noted on the Painting Schedule or specified, the following items shall receive final finish coats at the factory and shall be protected against damage during transit, storage, and erection. Damaged areas must be refinished as the original. Factory-painted items shall be of a color specified, selected, or approved by the OWNER.
 - a. Air conditioning and heating units
 - b. Chlorinators
 - c. Electric distribution centers
 - d. Gauges and meters
 - e. Instrument and control panels
 - f. Instruments
 - g. Light fixture not specified to be field painted
 - h. Meter panels
 - i. Motor control centers
 - j. Transformers
 - k. Transmitters
 - 1. HVAC equipment

C. Items Not Painted

- 1. The following items shall not be painted, unless specifically called for:
 - a. Aluminum, galvanized steel, or fiberglass grating
 - b. Aluminum, brass, bronze, copper, plastic, rubber, stainless steel, chrome, everdur, or lead
 - c. Buried or encased piping or conduit Exterior concrete
 - d. Galvanized pipe trays and cable trays (supports or hangers for these shall
 - e. be painted)
 - f. Galvanized steel framing
 - g. Grease fittings
 - h. Galvanized or aluminum ducting Nameplates
 - i. Serial numbers
 - j. Steel encased in concrete or masonry
 - k. Warning or operating instruction labels.

D. Painting Concrete, Masonry

1. General

a. Except as otherwise noted on the Painting Schedules or specified herein, exterior concrete shall not be painted. Interior floors shall be sealed and painted as noted in **Section 03 00 00** and as shown on the plans. Form release agents shall be removed from poured or precast surfaces by sandblasting or as recommended by the paint manufacturer and approved by the OWNER. Review surface preparation for concrete and masonry under Preparation of Surfaces. Concrete masonry, plaster, shall he coated as specified in the following. Exterior masonry shall be sealed with a waterproofing sealer as specified.

2. Exterior above Grade

a. Exterior masonry surfaces shall be water roofed per the architectural plans, painting schedule, **Section 09 90 00**.

E. Painting Metal Surfaces

1. General

- a. Except as otherwise specified or indicated on the Painting Schedule, all metal shall be painted. Metal surfaces shall be primed and painted as specified in the following paragraphs.
- b. Steel and miscellaneous iron items which are to be built into masonry or concrete shall, unless otherwise noted, have no field painting. Steel and miscellaneous iron items which have had a shop primer and which will be concealed above the ceilings shall be field primed. This includes but is not limited to the unexposed underside of steel roof decks and structural steel items such as beams, channels, and angles above ceilings. Touching up of these items shall be done after erection but before installation of the ceiling system. No further painting of these items will be required.

2. Shop Priming of Metals

a. Certain items have been listed to receive complete finish at the factory. Surfaces specified to be field sandblasted and galvanized surfaces shall not be shop coated. All other ferrous surfaces, except stainless steel and surfaces specified or shown to receive epoxy or grease type coatings, shall receive a shop coat of primer as specified compatible with the finish coats specified.

3. Field Priming of Metals

- a. All abraded, scratched, or otherwise damaged areas in the shop prime coat shall be sanded smooth or receive power tool cleaning SP-3 and then spot primed. Where 20 percent or more of the shop priming is failing, weathered excessively, or where recommended by the paint manufacturer's representative, the entire shop prime coat shall be removed with SP-6 commercial sandblast surface preparation before re-priming at no additional cost to the OWNER.
- b. Paint manufacturer's representative shall recommend changes in metal primers where specified primers and finish coats are not compatible. Changes shall be submitted for review and approval by the OWNER. Where the shop primer is not compatible with field primer and/or finish coats, the shop primer shall be removed by sandblasting to not less than SP-6 commercial sandblast. All shop primer shall be removed from all metal to be installed as submerged metal by sandblasting to near white SP-10 at no additional cost to the OWNER.
- c. Primer shall be finish coated within the time recommended in writing by the paint manufacturer. Primed surfaces exposed longer than this recommended period shall be SP-7 sandblasted and re-primed prior to finish painting at no additional cost to the OWNER.
- d. Galvanized, sherardized, aluminum, copper, or bronze surfaces to be painted shall be solvent cleaned and receive a surface preparation as specified hereinbefore, then either wash coated and primed or primed with a special primer in Accord with the directions of the manufacturer of the finish coats.

F. Painting Architectural and Process Metals

1. Doors, frames, ventilators, louvers, grilles, roof framing exposed sheet metal, exposed flashing, and other architectural metals, structural or nonstructural, that on integral parts of the structure or building shall be painted as specified or as indicated on the Architectural Painting Schedule. Piping, valve, pumps, motors and other process equipment and metals shall be painted or coated as specified or indicated in the Painting Schedule. All metal shall be primed as specified.

G. Field Quality Control

1. Verify coating thickness and penetration value immediately before installation and as required by OWNER.

H. Extra Paint

1. At the end of the project, the CONTRACTOR shall turn over to the OWNER a gallon can of each type and color of paint, primer, thinner, and other coating used in the field painting. If the manufacturer packages the material concerned in gallon cans, then it shall be delivered in unopened labeled cans as it comes from the factory. If the manufacturer does not package the material in gallon cans, and in the case of special colors, the

materials shall be delivered in new gallon containers, properly closed with typed labels indicating brand, type, color, etc. The manufacturer's literature describing the materials and giving directions for their use shall be furnished in three bound copies. A typewritten inventory list shall be furnished at the time of delivery. The CONTRACTOR shall also submit a list by name, code number and composition of all colors used in the Work.

3.03 TESTING

A. Testing

- 1. Holiday Testing. Test all coated ferrous surfaces which will be submerged in water or other liquids for pinholes in the coating using an approved holiday detector. Additionally, test any other ferrous surfaces required elsewhere in these specifications to be tested for holidays, in accordance with the provisions of this Section. Repair or recoat areas found to contain pinholes in accordance with the coating manufacturer's instructions and retest.
 - a. COATINGS WITH THICKNESS EXCEEDING 20 MILS. For surfaces having a total dry film coating thickness exceeding 20 mils; pulse-type holiday detector, Tinker & Rasor Model AP-W, D.E. Stearns Co., Model 14.20 or equal, adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.
 - b. COATINGS WITH THICKNESS OF 20 MILS OR LESS. For surfaces having a total dry film coating thickness of 20 mils or less: Tinker & Rasor Model Ml non-destructive type holiday detector, K-D Bird Dog, or equal, operating at less than 75 volts. For thickness between 10 and 20 mils, a non-sudsing type wetting agent, Kodak Photo-Flo, or equal, shall be added to the water prior to wetting the detector sponge.
- 2. Testing dry film thickness. On ferrous metals, coating thickness shall be measured with a magnetic type dry film thickness gauge such as Mikrotest Model FM, Elcometer Model 11 l/IEZ, or equal. Each coat shall be checked for the correct thickness. No measurement will be made until at least 8 hours after application of the coating.
- 3. CONTRACTOR shall supply the testing equipment along with proper calibration devices.

B. Cleanup

1. Upon completion of all painting, the CONTRACTOR shall remove all surplus materials, protective coverings and accumulated rubbish and thoroughly clean all surfaces and repair any overspray or other paint-related damage.

END OF SECTION

SECTION 09 06 90 – SCHEDULES FOR PAINTING AND COATING

(WELL TREAT<EMT PLANT)

Application		Type	Product*	Color	VOC #/gal
Ferrous Piping and structural steel, pipe supports, anchor bolts and threaded surfaces subject to rusting.	Per Mfgr.	Primer Paint	Carboguard 890 VOC Carbothane 133 MC	Blue (Fed. Std. 15052)	0.8
Installed Equipment – Touch-up after installation	Per Mfgr.	Paint and/or Primer	Touch-up paint to be supplied by equipment manufacturer	Per Mfgr.	N/A

END OF SECTION

SECTION 09 51 00 - ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.01 REQUIREMENT

A. The Contractor shall furnish and install all acoustical ceiling systems, including supporting systems and appurtenant work, complete and in accordance with the requirements of the Contract Documents.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. All work specified herein shall conform to or exceed the requirements of the Building Code and the applicable requirements of the following trade standards to the extent that the provisions of such documents are not in conflict with the requirements of this Section.
 - 1. "Specification for Acoustical tile and lay-in panel Ceiling Suspension Systems" by the Acoustical Material Association (AMA).
 - 2. Manufacturer's printed recommendations and Specifications.

1.03 SUBMITTALS

A. Manufacturer's literature, installation instructions and samples shall be submitted in accordance with Section 01 33 00 Submittal Procedures.

PART 2 - PRODUCTS

2.01 GRID SYSTEM MATERIALS

- A. <u>Cross Tees</u>: Cross tees shall be properly sized, cold-rolled, electro-galvanized steel with white baked enamel finish.
- B. <u>Wall Molding</u>: Wall molding shall be 1-inch x 3/4-inch matching the beams and tees in material and finish.
- C. <u>Hanger Wires</u>: Hanger wires shall be not lighter than 12-gage, pre-straightened, galvanized, annealed steel wire.
- D. <u>Spacers</u>: Spacers shall be tempered spring steel and shall be fitted into wall molding to provide tension on the ceiling system.

2.02 EXPOSED GRID SYSTEMS

- A. The exposed grid system shall be National Rolling Mills Series; Donn Corp., Series "DXL"; or equal.
- B. Main beams shall be not less than 1-1/2-inch high by 1-inch wide by 0.020-inch thick, cold-rolled, electro-galvanized steel with white baked enamel finish.

2.03 ACOUSTICAL TILE MATERIALS

- A. <u>Acceptable Manufacturer</u>: Acoustical tile shall be as manufactured by Armstrong; Acousti-Celotex; U. S. Gypsum; or equal.
- B. <u>Flame Spread Rating</u>: Tiles shall be mineral fiber tile or panel, shall have a Class 1, ASTM flame spread and a flame spread rating of under 25 per Federal Specifications SS-S-118B.
- C. Finish: Finish shall be factory-applied white latex paint.

2.04 ACOUSTICAL TILE PATTERNS AND SIZES

A. Exposed grid system ceiling tile shall be 24-inch by 48-inch by 5/8-inch square edge, unless otherwise shown on the Drawings, laid in panels of non-directional fissured or embossed design. Provide Armstrong Second Look II unless otherwise indicated.

2.05 MOLDINGS

A. "U" Molding: Slip-on "U" molding shall be a semi-rigid, white cover molding sized to fit the tile, as manufactured by A. Z. Bogert Co.; Lok-Products; or equal.

2.06 CEMENT/ADHESIVE

A. Tile cement or adhesive shall conform to the printed recommendations of the tile manufacturer for bonding to concrete or other indicated surface material.

PART 3 - EXECUTION

3.01 GENERAL

- A. The acoustical ceiling system shall consist of continuous main beams and intersecting cross tees, joined together to form the patterns shown or specified herein. The system shall be complete with all necessary components, anchors and supports. The system shall be designed so that the ceiling panels may be removed and replaced without damage and such that main beams and cross tees can be removed or replaced without deforming the members or disturbing the balance of the grid system.
- B. Suspension systems and tile work shall be coordinated with lighting fixtures, air diffusers and other features such that all installations work together without interference and in accordance with the ceiling layout design.

3.02 INSTALLATION

- A. Installation shall be strict accordance with these specifications and the manufacturer's published directions, installation instructions and Specifications.
- B. The ceiling system shall be engineered to carry the applied dead and live loads with a deflection of less than 1/360 of the span and shall be level to within 1/8-inch in 12-feet.

- C. The Contractor and its tradesman shall be responsible for inspecting all acoustical treatment receiving areas so as to ensure a proper installation. The Contractor shall not proceed with its work before all conditions are ready to receive the acoustical tile work.
- D. Unless shown otherwise the layout scheme shall be such that all ceiling tile is symmetrical about the center of the rooms to provide the least number of cut tiles. The tile shall be laid in a pattern with all edges in alignment and will all faces in a plane.

3.03 BEAM SPLICES AND TEE INTERSECTIONS

- A. All main beams shall be joined together by a splice clip which draws the members tightly together with bottom flanges flush. Cross tee intersections shall be joined together by interlock methods, by positioning the ends of the cross tees snugly against the main beam and in holding the cross tees in vertical alignment with bottom flanges flush. All main beam splices and cross tee intersections shall be capable of withstanding at least 100 lbs. tension or compression.
- B. The main beams and cross tees which terminate at the walls shall be attached to a perimeter wall angle which shall be continuous along at least two (2) intersecting walls with spring steel clips. Wall angles shall be securely attached to the walls at approximately 16-inch intervals using screws into framing members.

3.04 HANGER WIRES

A. Hanger wires shall be spaced at 48-inch o.c. along the main beams and at the corners of lay-in-fixtures. They shall be secured to the supporting structure with approved fastenings. Hangers and fastenings shall be capable of carrying at least four (4) times the design load, but not less than 100 lbs.

3.05 HORIZONTAL RESTRAINT

A. Ceiling systems shall be provided with diagonal bracing wires as required by the Building Code for the room size. Horizontal restraints shall be effected by four (4) No. 12-gage wires secured to the main beams within 2-inches of the cross tee intersection and splayed 90 degrees from each other at an angle not exceeding 45 degrees from the plane of the ceiling. These horizontal restraint points shall be placed 12-feet on center in both directions with the first point within 4-feet from each wall. The restraint wire attachment to the supporting structure shall be adequate for the loads imposed.

3.06 FIRE-RATING

A. Where a fire-rating is specified the complete ceiling system shall meet the requirements for the specified rating.

3.07 FINISHED CONDITION

A. After installation the ceiling system shall be free from any discoloration smudges, scratches, chips, blemishes or any misalignment.

END OF SECTION

SECTION 09 77 00 - FIBERGLASS REINFORCED WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Prefinished polyester glass reinforced plastic sheets and adhered to unfinished [gypsum] [cementitous] [untreated plywood] wallboard.
 - 1. [Aluminum] [PVC] trim.
 - 2. [PVC Wall base.]
- B. Products Not Furnished or Installed under This Section:
 - 1. Gypsum [Cementitious] substrate board.
 - 2. Resilient Base.

1.2 REFERENCES

- A. American Society for Testing and Materials: Standard Specifications (ASTM)
 - 1. ASTM D 256 Izod Impact Strengths (ft #/in)
 - 2. ASTM D 570 Water Absorption (%)
 - 3. ASTM D 638 Tensile Strengths (psi) & Tensile Modulus (psi)
 - 4. ASTM D 790 Flexural Strengths (psi) & Flexural Modulus (psi)
 - 5. ASTM D 2583- Barcol Hardness
 - 6. ASTM D 5319 Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.
 - 7. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.

1.3 SUBMITTALS

- A. Product Data: Submit sufficient manufacturer's data to indicate compliance with these specifications, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- B. Shop Drawings: Submit elevations of each wall showing location of paneling and trim members with respect to all discontinuities in the wall elevation.
- C. Selection Samples: Submit manufacturer's standard color pattern selection samples representing manufacturer's full range of available colors and patterns.
- D. Samples for Verification: Submit appropriate section of panel for each finish selected indicating the color, texture, and pattern required.
 - 1. Submit complete with specified applied finish.
 - 2. For selected patterns show complete pattern repeat.
 - 3. Exposed Molding and Trim: Provide samples of each type, finish, and color.

E. Manufacturers Material Safety Data Sheets (MSDS) for adhesives, sealants and other pertinent materials prior to their delivery to the site (available as downloads for most Marlite's products at http://www.marlite.com/tech-details.aspx or by contacting Marlite at info@marlite.com).

1.4 QUALITY ASSURANCE

- A. Sanitary Standards: System components and finishes to comply with:
 - 1. United States Department of Agriculture (USDA) / Food Safety & Inspection Services (FSIS) requirements for food preparation facilities, incidental contact.
 - 2. Food and Drug Administration (FDA) 2013 Food Code 6-101.11.
 - 3. Canadian Food Inspection Agency (CFIA) requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials factory packaged on strong pallets.
- B. Store panels and trim lying flat, under cover and protected from the elements. Allow panels to acclimate to room temperature (range of 60 to 75°F) for 48 hours prior to installation.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Building are to be fully enclosed prior to installation with sufficient heat (70°) and ventilation consistent with good working conditions for finish work
- B. During installation and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.
 - 1. Provide ventilation to disperse fumes during application of adhesive as recommended by the adhesive manufacturer.

1.7 WARRANTY

A. Furnish one-year guarantee against defects in material and workmanship.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Marlite; 1 Marlite Drive, Dover, OH 44622. 800-377-1221 FAX (330) 343-4668 Email: info@marlite.com www.marlite.com.
- B. Product:
 - 1. Standard FRP
 - 2. Laminated FRP

2.2 PANELS

- A. Fiberglass reinforced thermosetting polyester resin panel sheets complying with ASTM D 5319.
 - 1. Dimensions:
 - a. Thickness -0.090 " (2.29mm) nominal
 - b. Width 4'-0" (1.22m) nominal
 - c. Length -[10'-0" (3.0m)][8'-0" (2.4m)][As indicated on the drawings] nominal
 - 2. Tolerance:
 - a. Length and Width: $\pm -1/8$ " (3.175mm)
 - b. Square Not to exceed 1/8 " for 8 foot (2.4m) panels or 5/32 " (3.96mm) for 10 foot (2.4m) panels
- B. Properties: Resistant to rot, corrosion, staining, denting, peeling, and splintering.
 - 1. Flexural Strength 1.7 x 10⁴ psi per ASTM D 790.
 - 2. Flexural Modulus -6.0×10^5 psi per ASTM D 790.
 - 3. Tensile Strength -8.0×10^3 psi per ASTM D 638.
 - 4. Tensile Modulus -9.43×10^5 psi per ASTM D 638.
 - 5. Water Absorption 0.17% per ASTM D 570.
 - 6. Barcol Hardness (scratch resistance) of 30 as per ASTM D 2583.
 - 7. Izod Impact Strength of 7.0 ft. lbs./in ASTM D 256
- C. Back Surface: Smooth. Imperfections which do not affect functional properties are not cause for rejection.
- D. Front Finish: Submit sample options for TVMWD selection.

2.3 BASE

- A. Marlite Base Molding for 0.090" (2.29mm) thick FRP Panels
 - 1. Color: [Black] [Quarry Red].
 - 2. Profiles:
 - a. M 612 FRP Base Molding, 10' length
 - b. M 651 Inside Corner
 - c. M 660 Outside Corner
 - d. M 620 LH End Cap
 - e. M 625 RH End Cap

2.4 MOLDINGS

- A Aluminum Anodized Trim: Heavy weight extruded aluminum 6063-T5 alloy prefinished at the factory.
 - 1. Profiles:
 - a. F 550 Inside Corner, 8' length
 - b. F 561 Outside Corner, 8' length
 - c. F 565 Division, 8' length
 - d. F 570 Edge, 8' length
 - e. Color: [Brite Satin Anodized] [Black Satin Anodized]
 - B. PVC Trim: Thin-wall semi-rigid extruded PVC.

- 1. M 350 Inside Corner, [8' length][10' length]
- 2. M 360 Outside Corner, [8' length][10' length]
- 3. M 365 Division, [8' length][10' length]
- 4. M 370 Edge, [8' length][10' length]
- 5. V 177 135° Inside Corner [8' length] [White only]
- 6. V 179 135° Outside Corner [8' length] [White only]
- 7. Color: [White][Beige][Natural Almond][Ivory][Silver][Light Grey][Black]

C. Outside Corner Guard:

- 1. F 560SS Stainless Corner Guard, [8' length][10' length]
- 2. Finish: #4 brushed satin
- 3. M 961 PVC Outside Corner Guard
 - a. Color: [White, [8' length]][10' length]][Natural Almond, [8' length][10' length]][Ivory, 10' length][Silver, 10' length][Light Grey, 10' length]

2.5 ACCESSORIES

- A. Fasteners: Non-staining nylon drive rivets.
 - 1. Match panel colors.
 - 2. Length to suit project conditions.
- B. Adhesive: Either of the following construction adhesives complying with ASTM C 557.
 - 1. Marlite C-551 FRP Adhesive Water- resistant, non-flammable adhesive.
 - 2. Marlite C-915 Construction Adhesive Flexible, water-resistant, solvent based adhesive, formulated for fast, easy application.
 - 3. Titebond Advanced Polymer Panel Adhesive VOC compliant, non-flammable, environmentally safe adhesive.

C. Sealant:

- 1. Marlite Brand MS-250 Clear Silicone Sealant.
- 2. Marlite Brand MS-251 White Silicone Sealant.
- 3. Marlite Brand Color Match Sealant.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine backup surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.
 - 1. Verify that stud spacing does not exceed 24" (61cm) on-center.
- B. Repair defects prior to installation.
 - 1. Level wall surfaces to panel manufacturer's requirements. Remove protrusions and fill indentations.

3.2 INSTALLATION

- A. Comply with manufacturer's recommended procedures and installation sequence.
- B. Cut sheets to meet supports allowing 1/8" (3 mm) clearance for every 8 foot (2.4m) of panel.
 - 1. Cut and drill with carbide tipped saw blades or drill bits, or cut with shears.
 - 2. Pre-drill fastener holes 1/8" (3mm) oversize with high speed drill bit.
 - a. Space at 8" (200mm) maximum on center at perimeter, approximately 1" from panel edge.
 - b. Space at in field in rows 16' (40.64cm) on center, with fasteners spaced at 12" (30.48 cm) maximum on center.
- C. Apply panels to board substrate, above base, vertically oriented with seams plumb and pattern aligned with adjoining panels.
 - 1. Install panels with manufacturer's recommended gap for panel field and corner joints.
 - a. Adhesive trowel and application method to conform to adhesive manufacturer's recommendations.
 - b. Drive fasteners for snug fit. Do not over-tighten.
- D. Apply panel moldings to all panel edges using silicone sealant providing for required clearances.
 - 1. All moldings must provide for a minimum 1/8 "(3mm) of panel expansion at joints and edges, to insure proper installation.
 - 2. Apply sealant to all moldings, channels and joints between the system and different materials to assure watertight installation.

3.3 CLEANING

- A. Remove excess sealant from panels and moldings. Wipe panel down using a damp cloth and mild soap solution or cleaner.
- B. Refer to manufacturer's specific cleaning recommendations Do not use abrasive cleaners.

END OF SECTION 09 7700

SECTION 09 84 00 - V-FACED METAL ACOUSTICAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sound Absorptive Wall Panels
- B. Sound Absorptive Ceiling Panels [Clouds]
- C. Sound Absorptive Ceiling Tile
- D. Miscellaneous Accessories

1.02 REFERENCES

A. ASTM International:

- 1. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- 2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- 3. ASTM E795 Standard Practices for Mounting Test Specimens During Sound Absorption Tests.

1.03 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Surface Burning Characteristics ASTM E84 Class I

1.04 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Product Data: Submit product data sheet, for specified products.
- C. Shop Drawings: Submit shop drawings showing layout, edge profiles and panel components, including anchorage, accessories, finish colors and textures.
- D. Samples: Submit selection and verification samples of finishes, colors and textures.
- E. Test Reports: Certified test reports showing compliance with specified performance requirements.

1.05 DELIVERY, STORAGE & HANDLING

- A. General: Comply with Division 1 Product Requirements Section.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1.06 PROJECT CONDITIONS

A. Environmental Requirements: Do not install panels until building has been enclosed and environmental conditions approximate interior conditions that will exit during occupancy.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Sound Seal, Inc., located at 50 HP Almgren Drive, Agawam, MA 01001. Contact Sound Seal Architectural Division at 413-78-1770, Email: soundquality@soundseal.com; Web: www.soundseal.com
- B. Substitutions: No substitutions permitted.

2.02 V-GROOVE FACED ACOUSTICAL WALL PANELS

- A. Acoustic Panels: Sound Seal TRANQUILITY Metal Absorptive Wall Panels
 - 1. Panel Thickness: 2.625 inches (66.7 mm)
 - 2. Panel Width: 30 inches (762 mm)

B. Panel Performance:

1. Sound Absorption: Provide panels that are certified to meet the following minimum sound absorption coefficients when tested in accordance with ASTM C423 and E 795:

Flush Mount:

125 Hz:	0.30
250 Hz:	0.71
500 Hz:	1.21
1000 Hz:	1.31
2000 Hz:	1.22

4000 Hz: 1.14

NRC: 1.10, minimum

Stand-Off Mount:

125 Hz: 0.56 250 Hz: 1.11 500 Hz: 1.33 1000 Hz: 1.31 2000 Hz: 1.31 4000 Hz: 1.23

NRC: 1.25, minimum

2. Fire: Provide panels when tested in accordance with ASTM E84 demonstrate: Flame Spread = 10, Smoke Developed=10.

C. Panel Construction:

- 1. All materials to be A-60 galvanealed steel.
- 2. Panel body shall be fully formed one piece perforated metal shell. Material shall be minimum 22 gauge (.76 mm) steel sheet perforated with 3/32 inch (2 mm) diameter holes on 5/32 inch (4 mm) staggered centers for a 33% open area. V-Groove ridges shall be formed on 6 inch (152 mm) centers x 0.625 inches (16 mm) deep.
- 3. Internal framing and reinforcement s when required shall be a minimum of 20 gauge (0.9mm) steel channels spotwelded and / or riveted to the panel body shell.
- D. Acoustical Insulation: Fill shall be 2 inch (50 mm) thick fiberglass or mineral wool having a density of not less than 1.5 pounds per cubic foot (24 kg/cubic m). When required, panel fill shall be totally encased in a 2 mil thick heat sealed black poly wrap
- E. Finish: Manufacturer's standard acrylic baked polyester powder coat.
- F. Panel Mounting: Manufacturer's standard minimum 14 gauge (1.90 mm) [concealed z-clip flush or stand-off mounting brackets], [exposed edge mount brackets], [exposed top Z and bottom J mounting channels].

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces to receive acoustical panels. Do not begin installation until any unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install panels on walls in locations and in patterns as indicated on the drawings.
- B. Install each panel in accordance with manufacturer's instructions using approved anchors and fasteners.

3.03 CLEANING

- A. Follow manufacturer's instructions for cleaning panels soiled during installation. Replace panels that cannot be cleaned to as new condition.
- B. Keep site free from accumulation of waste and debris.

END OF SECTION

SECTION 09 90 00 - PAINTING AND COATING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes materials and application of painting and coating systems for multiple surfaces such as exposed metal, buried metal, metal in contact with concrete, masonry surfaces, wood surfaces, drywall surfaces, and concrete surfaces.

1.02 REFERENCED SECTIONS

- A. Related Sections are listed below:
 - 1. SECTION 01 33 00 SUBMITTAL PROCEDURES

1.03 CITED STANDARDS

- A. All surface preparation, coating, and painting shall conform to the following standard specifications, of the latest revisions, as applicable:
 - 1. Requirements of the Steel Structures Painting Council
 - 2. Requirements of the National Association of Corrosion ENGINEERs
 - 3. The paint manufacturer's printed application instructions

1.04 RELATED WORK

- A. Standard Drawings
- B. Standard Specifications

1.05 NOTED RESTRICTIONS

A. All exposed wood surfaces should be covered with aluminum sheeting.

1.06 QUALITY CONTROL

- A. Notify the City 48 hours in advance of field operations involving surface preparation and coating application.
- B. The City will inspect shop-and field-prepared surfaces. The Contractor shall not proceed with paint application until the surface preparation has been approved by the City Engineer.
- C. The City will inspect application of all prime, intermediate, finish, and touch-up coatings to verify the integrity of the coating and compliance with the specifications. Each coating application will be checked and deficiencies marked. Items exhibiting an improper finish or color, or insufficient surface preparation or dry film thickness shall be prepared as necessary and corrected, utilizing the specified paint materials to obtain compliance.

1.07 SUBMITTALS

- A. The CONTRACTOR shall submit shop DRAWINGS in accordance with Section 01 33 00 Submittal Procedures.
- B. Submit manufacturer's data sheets showing the following information:
 - 1. Percent solids by volume.
 - 2. Minimum and maximum recommended dry-film thickness per coat for prime, intermediate, and finish coats.
 - 3. Recommended surface preparation.
 - 4. Recommended thinners.
 - 5. Statement verifying that the specified prime coat is recommended by the manufacturer for use with the specified intermediate and finish coats.
 - 6. Application instructions including recommended equipment and temperature limitations.
 - 7. Curing requirements and instructions.
 - 8. Verification from the manufacturer that the product meets current California VOC requirements.
- C. Submit color swatches.
- D. Submit certificate identifying the type and gradation of abrasives used for surface preparation.

1.08 DELIVERABLES

A. All materials specified by name, brand, or manufacturer, or selected for use under these specifications shall be delivered unopened at the jobsite in their original containers bearing the manufacturer's label.

1.09 SURFACES NOT TO BE FIELD PAINTED

- A. Generally, the following items or materials are not to be field painted unless specifically required elsewhere in the specifications:
 - 1. Buried mortar-coated pipe and fittings.
 - 2. Stainless steel.
 - 3. Interior surfaces of valves, fittings and pipe.
 - 4. Nameplates.
 - 5. Grease fittings.
 - 6. Brass, copper, bronze, or galvanized items except as required for recycled water system identification.
 - 7. Buried pipe and appurtenances except as required in the piping specifications.

1.10 COLOR AND PAINT SYSTEM SCHEDULE

A. The following tables designate the color and paint system that shall be used on the City's various potable water and recycled water facilities.

B. Potable Water:

ITEM	COLOR	PAINT SYSTEM
Fire Hydrant	Safety Yellow	Acrylic or Epoxy/Urethane
Blow Off Box Lids	Safety Yellow	Acrylic Traffic Paint
Gate Well Lids	Blue	Acrylic Traffic Paint
Valve Can Lids - Fire	Safety Yellow	Acrylic Traffic Paint
Hydrant Valves		
Valve Can Lids- Normally	Safety Red	Acrylic Traffic Paint
Closed Valves		
Air/Vac Assemblies	Safety Yellow	Acrylic or Epoxy/Urethane
Water Test Station Enclosures	Green	Fusion Bonded Polyester
Protector Posts	Safety Yellow	Acrylic or Epoxy/Urethane
Vault Piping	Per City	Acrylic or Epoxy
Above Ground Piping	Per City	Acrylic or Epoxy/Urethane

PART 2 - PRODUCTS

2.01 PAINTING AND COATING SYSTEMS

- A. Coating products and colors shall be selected from the tables above or shall be Sinclair gloss enamel paint.
- B. All materials of a specified paint system(s), including prime, intermediate, finish, and touch-up coats shall be provided by the same manufacturer.
- C. Thinners, cleaners, driers and other additives shall be as recommended by the coating manufacturer for the specified paint system(s) and shall be approved by the City Engineer.
- D. All coating products shall be delivered to the job site in original and unopened containers.
- E. The following index lists the various painting and coating systems by service and generic type:
 - 1. Exposed Metal Coating Systems

No.	Title	Generic Coating				
7.	Submerged Metal	Ероху				
10.	Exposed Metal, Below Grade	Zinc prime coat, high-build in vaults epoxy intermediate and finish coat				
15.	Exposed Metal, Atmospheric Weathering Environment	Zinc prime coat, high-build epoxy intermediate and finish coat				

2. Buried Metal Coating Systems

No.	Title	Generic Coating			
21.	Buried Metal	Coal-tar epoxy			

- 3. Coating Systems for Nonferrous Metals
- 4. 51. Aluminum and Concrete (See Below)
- 5. Coating Systems for Wood and masonry surfaces
- 6. 61. Interior and Exterior (See Below)
- F. These systems are specified in detail in the following paragraphs. For each coating, the required surface preparation, prime coat, intermediate coat (if required), topcoat, and coating thicknesses are described. Mil thicknesses shown are minimum dry-film thicknesses.
- G. Exposed Metal Coating Systems
 - 1. System No. 7 submerged Metal (Epoxy)
 - a. Type: Epoxy.
 - b. Service Conditions: For use with structures, piping, or equipment immersed in water.
 - c. Surface Preparation: SSPC SP-10.
 - d. Coating System: Apply three or more coats of Tnemec Series 20, Engard 460 HS, or equal; 15 mils total. Color of topcoat: White.
 - 2. System No. 10–Exposed Metal, Corrosive Environment:
 - a. Type: High-build epoxy intermediate and finish coat having a minimum volume solids of 60 percent, with an inorganic zinc prime coat.
 - b. Service Conditions: For use with metal structures or pipes located in vaults, manholes or structures, subjected to water condensation; chemical fumes, such as hydrogen sulfide; salt spray; and chemical contact.
 - c. Surface Preparation: SSPC SP-6.
 - d. Prime Coat: Self-curing, two-component inorganic zinc-rich coating recommended by the manufacturer for overcoating with a high-build epoxy finish coat. Minimum zinc content shall be 14 pounds per gallon. Apply to a thickness of 3 mils. Products: Tnemec 90-97 or equal.
 - e. Intermediate and Finish Coat: Tnemec Series 69 Epoxoline II, 5-mils each coat, or equal.
 - 3. System No. 15 Exposed Metal, Atmospheric Weathering Environment:
 - a. Service Conditions: For use on the exterior of metal and piping.
 - b. Surface Preparation: SSPC SP-3.
 - c. Prime Coat: Self-curing, two-component inorganic zinc-rich coating recommended by the manufacturer for overcoating with a high-build epoxy finish

- coat. Minimum zinc content shall be 14 pounds per gallon. Apply to a thickness of 3 mils. Products: Tnemec 90-97 or equal.
- d. Intermediate and Finish Coat: Tnemec Series 69 Epoxoline II, 5-mils each coat, or equal.

H. Buried Metal Coating Systems

- 1. System No. 21--Buried Metal:
 - a. Type: Coal-tar epoxy having a minimum volume solids of 68 percent (ASTM D 2697).
 - b. Service Conditions: Buried metal, such as valves, flanges, bolts, nuts, structural steel, and fittings.
 - c. Surface Preparation: SSPC SP-10.
 - d. Prime Coat: Ameron 78 HB, 16 mils; Tnemec 46H-413, 16 mils; Porter 7080, 16 mils; or equal.
 - e. Topcoat: Ameron 78 HB, 16 mils; Tnemec 46H-413, 16 mils; Porter 7080, 16 mils; or equal.

I. Coating Systems for Nonferrous Metals

- 1. System No. 51 -- Aluminum and Concrete Insulation:
 - a. Type: Bituminous paint having a minimum volume solids of 68 percent coal-tar pitch based.
 - b. Surface Preparation: Dust blast.
 - c. Prime Coat: Apply synthetic resin primer to metal surface before finish coats. Products: Koppers 40, Tnemec 32-1210, Porter VC 1799, or equal.
 - d. Finish Coat: Two coats of Koppers Bitumastic Super Service Black, 12 mils each; two coats of Tnemec 46-450 Heavy Tnemecol, 12 mils each; two coats of Porter Tarmastic 100, 12 mils each; or equal.

J. Wood and Masonry Surfaces

- 1. System No. 61 Interior and Exterior:
 - a. All exterior wood surfaces should be covered with aluminum sheeting. All interior wood surfaces coated with a prime coat and two finish coats selected by the City. The prime and two finish coats shall be oil-based enamel, earth-tone colors which shall be submitted to the City for approval. Paint shall be Sherwin Williams, Dunn-Edwards, Sinclair or ENGINEER approved equal suitable for interior applications. Surface preparation shall be as per the paint manufacturer's written recommendations.
 - b. All masonry surfaces as indicated on the DRAWINGS shall be waterproofed per Division 04.

K. Abrasives for Surface Preparation

- 1. Abrasives used for preparation of iron and steel surfaces shall be one of the following:
 - a. 16 to 30 or 16 to 40 mesh silica sand or mineral grit.

- b. 20 to 40 mesh garnet.
- c. SAE Grade G-40 or G-50 iron or steel grit.

L. Organic Zinc Primer for Field Touch-Up and Shop Coating

- 1. Organic zinc coating system shall have a minimum zinc content of 14 pounds per gallon. Coating shall be of the two- or three-component converted epoxy, epoxy phenolic, or urethane type. Products: Tnemec 90-97, or equal; applied to a minimum dry-film thickness of 3 mils. Organic zinc primer shall be manufactured by the prime coat manufacturer.
- 2. Where shop-applied inorganic zinc primers cannot be used because of volatile organic compound (VOC) regulations, the above organic zinc primers may be substituted for the specified inorganic zinc primers.

M. Masonry Surfaces:

- 1. Concrete Sealer: Conspec #1
- 2. Interior Walls and Exterior Walls above grade: Sikagard 704W, Chemstop Barricade, or approved equal.
- N. The painting CONTRACTOR shall be capable of performing the various items of work as specified. He will be required to furnish a statement covering experience on similar work, a list of machinery, plant and other equipment available for the proposed work, and a financial statement, including a complete statement of the CONTRACTOR's financial ability and experience in performing similar painting and coating work. The CONTRACTOR shall have a minimum of five (5) years practical experience and a successful history in the application of the specified products to metal surfaces. Upon request, the CONTRACTOR shall substantiate this requirement by furnishing a list of references. Those references shall include jobs of a similar nature.

2.02 EPOXY PAINT SYSTEM

A. Prime, Intermediate, Finish and Touch-Up Coats: VOC-compliant, two-component, chemically cured epoxy.

2.03 EPOXY/URETHANE PAINT SYSTEM

A. Prime and Intermediate Coats: Field-applied, VOC-compliant, surface tolerant, two-component, chemically cured epoxy. Finish and Touch-Up Coats: Field-applied, VOC-compliant, two-component, chemically cured aliphatic urethane semi-gloss enamel.

2.04 ACRYLIC PAINT SYSTEM

- A. Acrylic Paint System may be either solvent borne or waterborne as described below:
 - 1. Solvent borne Acrylic Paint System:
 - a. Prime, Intermediate, Finish and Touch-Up Coats: Field-applied, VOC-compliant, solvent borne acrylic paint.
 - 2. Waterborne Acrylic Paint System:

a. Prime, Intermediate, Finish and Touch-Up Coats: Field-applied, VOC compliant, waterborne acrylic paint.

2.05 ACRYLIC TRAFFIC PAINT SYSTEM

A. Prime and Finish Coats: Field-applied, VOC-compliant, rapid-drying, weather and abrasion resistant waterborne acrylic paint containing 100% solids by volume.

2.06 FUSION BONDED POLYESTER

A. Primer: Powder Epoxy Primer: Primer shall be a one-part, fusion-bonded, heat-cured, thermosetting 100% solids, zinc-rich, dry powder epoxy resin.

B. Finished Coat:

- 1. Polyester Powder: Powder finish coat shall be a high gloss thermosetting fusion-bonded, 100% solid, dry powder TGIC-Polyester resin.
- 2. Thinners, cleaners, dryers, and other additives shall be as recommended by the coatings manufacturer for the specified system. Any deviation from the manufacturer's recommendations shall be approved in writing by the Engineer prior to starting work.
- 3. All coatings, thinners, pigments, and other materials to be used on potable water service shall have FDA approval for use with potable water

2.07 PAINT COLORS

- A. Safety Yellow, Safety Purple and Safety Red paint colors shall be as specified in Federal OSHA regulations.
- B. White paint color shall be as specified by the California Department of Transportation for striping.
- C. Green paint color shall be as specified in Article 2.06 herein.
- D. Successive coats of each paint color shall be of a slightly different shade, as directed by the City Engineer, to facilitate the inspection of surface coverage of each coat. The true colors specified above shall be used for all Finish and Touch-up coats.

PART 3 - EXECUTION

3.01 PREPARATION

A. Weather Conditions

- 1. Do not paint in the rain, wind, snow, mist, and fog or when steel or metal surface temperatures are less than 5 degrees F above the dew point.
- 2. Do not apply paint when the relative humidity is above 80 percent or the temperature is above 90 degrees F.
- 3. Do not paint when temperature of metal to be painted is above 120 degrees F.
- 4. Do not apply paint on an exterior or interior surface if air or surface temperature is below 60 degrees F or expected to drop below 60 degrees F in 24 hours.

B. Protection of Surfaces Not to be Painted

1. Remove, mask, or otherwise protect hardware, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, nameplates and other surfaces not intended to be painted. Protect working parts of mechanical and electrical equipment from damage during surface preparation and the painting process. Provide drop cloths or masking to prevent paint materials from dripping or accumulating on adjacent surfaces.

C. Surface Preparation

- 1. Do not prepare more surface area than can be coated in the same workday.
- 2. Do not sandblast or prepare more surface area in one day than can be coated in one day; prepare surfaces and apply coatings the same day. Remove all sharp edges, burrs, and weld spatter. Do not sandblast PVC, CPVC, or FRP piping or equipment. Do not sandblast epoxy- or enamel-coated pipe that has already been factory coated, except to repair scratched or damaged coatings.
- 3. Surface preparation shall conform with the SSPC specifications as follows:

a.	Solvent Cleaning	SP-1
b.	Hand Tool Cleaning	SP-2
c.	Power Tool Cleaning	SP-3
d.	White Metal Blast Cleaning	SP-5
e.	Commercial Blast Cleaning	SP-6
f.	Brush-Off Blast Cleaning	SP-7
g.	Pickling	SP-8
h.	Near-White Blast Cleaning	SP-10

- 4. Wherever the words "solvent cleaning," "hand tool cleaning," "wire brushing," or " blast cleaning" or similar words are used in these specifications or in paint manufacturer's specifications, they shall be understood to refer to the applicable SSPC (Steel Structure Painting Council, Surface Preparation Specifications, ANSI A159.1) specifications listed above.
- 5. Surface preparation shall be as specified herein, or as directed by the City Engineer.
- 6. Unless otherwise directed by the City, do not blast-clean items that have previously been factory primed or painted.
- 7. Dust blasting is defined as cleaning the surface through the use of very fine abrasives, such as siliceous or mineral abrasives, 80 to 100 mesh. Apply a fine etch to the metal surface to clean the surface of any a contamination or oxide.
- 8. Remove oil and grease from metal surfaces in accordance with SSPC SP-1. Use clean cloths and cleaning solvents and wipe dry with clean cloths. Do not leave a film or greasy residue on the cleaned surfaces before sandblasting.
- 9. Remove weld spatter and weld slag from metal surfaces and grind smoothly rough welds, beads, peaked corners, and sharp edges including erection lugs in accordance with SSPC SP-2 and SSPC SP-3.

10. Neutralize welds with a chemical solvent that is compatible with the specified coating materials. Use clean cloths and chemical solvent. Wipe dry with clean cloths. Do not leave a residue on the cleaned surfaces.

11. Masonry Surfaces:

- a. All concrete surfaces shall be prepared in accordance with the recommendations of the coating manufacturer.
- b. All concrete and masonry surfaces shall have cured for not less than 14 days, prior to application of coatings.
- c. Surfaces shall be clean and dry.
- 12. Wood Surfaces: All surfaces shall be clean and dry.

D. Procedures for Application

- 1. Conform to the requirements of SSPC-PA 1, Shop, Field, and Maintenance Painting. Follow the recommendations of the coating manufacturer, if more restrictive, including the selection of spray equipment, brushes, rollers, mixing, drying time, temperature and humidity limitations during application, and safety precautions. The Engineer will review procedures for the application of coatings. The Engineer's decision will be final as to interpretation and/or conflict between these Specifications and the recommendations of the coating manufacturer.
- 2. Stir, strain, and keep coating materials at a uniform consistency during application. When the Engineer permits thinning, do not reduce the coating material more than is necessary to obtain the proper application characteristics and to obtain the specified dry film thickness. Do not exceed the maximum thinning rate allowed by the manufacturer. Stir coating materials at all times when adding thinner.
- 3. Apply each layer of coating evenly, free from brush marks, sags, runs, bridges, shiners, laps or other imperfections or other evidence of poor workmanship. Visible areas of chipped, peeled, or abraded paint shall be hand or power-sanded, feathering the edges. The areas shall then be primed and finish coated in accordance with the specifications. Finished surfaces shall be free from defects and blemishes prior to final acceptance.

E. Procedures for Items Having Shop-Applied Prime Coats

- 1. After application of primer to surfaces, allow coating to cure for a minimum of two hours before handling to minimize damage.
- 2. When loading for shipment to the project site, use spacers and other protective devices to separate items to prevent damaging the shop-primed surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the shop-primed surfaces after separation. Use padded chains or ribbon binders to secure the loaded items and minimize damage to the shop-primed surfaces.
- 3. Cover shop-primed items 100 percent with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.
- 4. Handle shop-primed items with care during unloading, installation, and erection operations to minimize damage. Do not place or store shop-primed items on the ground or on top of other work unless ground or work is covered with a protective covering or tarpaulin. Place shop-primed items above the ground upon platforms, skids, or other supports.

F. Field touch-Up of Shop-Applied Prime Coats

- 1. Prior to field touch-up, prepare the surface in accordance with the manufacturer's recommendations and as directed by the City Engineer.
- 2. Remove oil and grease surface contaminants on metal surfaces in accordance with SSPC SP-1. Use clean rags wetted with a degreasing solution, rinse with clean water, and wipe dry.
- 3. Remove dust, dirt, salts, moisture, chalking primers, or other surface contaminants that will affect the adhesion or durability of the coating system. Use a high-pressure water blaster or scrub surfaces with a broom or brush wetted with a solution of trisodium phosphate, detergent, and water. Before applying intermediate or finish coats to inorganic zinc primers, remove any soluble zinc salts that have formed by means of scrubbing with a stiff bristle brush. Rinse scrubbed surfaces with clean water.
- 4. Remove loose or peeling primer and other surface contaminants not easily removed by the previous cleaning methods in accordance with SSPC SP-3. Take care that remaining primers are not damaged by the blast cleaning operation. Remaining primers shall be firmly bonded to the steel surfaces with blast cleaned edges feathered.
- 5. Remove rust, scaling, or primer damaged by welding or during shipment, storage, and erection in accordance with SSPC SP-3. Take care that remaining primers are not damaged by the blast cleaning operation. Remaining primers shall be firmly bonded to the steel surfaces with blast cleaned edges feathered.
- 6. Surfaces that are shop primed with inorganic zinc primers shall receive a field touch-up of organic zinc primer to cover all scratches or abraded areas.
- 7. Other surfaces that are shop primed shall receive a field touch-up of the same primer used in the original prime coat.
- 8. Reapply primer as required to cover all scratched, abraded, or deficient areas.

G. Painting Systems

- 1. All materials of a specified painting system, including primer, intermediate, and finish coats, shall be produced by the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the painter manufacturer for the particular coating system.
- 2. Deliver paints to the jobsite in the original, unopened containers.

H. Paint Mixing

1. Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small quantity kits for touch-up painting and for painting other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

I. Limitations to The Application of Coatings

1. Apply coatings in accordance with the manufacturer's recommendations. Do not apply coatings under adverse weather conditions. If any of the following minimum conditions

are present, the application of coatings shall be delayed or postponed until conditions are favorable.

- a. During rain, fog, or mist, or when the relative humidity exceeds 80 percent.
- b. When the surface to be coated is wet, moist, or contaminated with any foreign matter.
- c. When the surrounding air temperature or the temperature of the surface to be coated is below 13° C (55° F).
- d. When the temperature of the surface to be coated is more than 2.8° C (5° F) below the air temperature or when the surface temperature is 49 C (120° F) or above.
- e. When the surface temperature is less than 2.8° C (5° F) above the dew point or is expected to be so within twelve hours after application of coating.
- 2. If a change in weather conditions results in damage to a newly applied coating, restore the affected coatings to their specified condition as directed by the City Engineer.

J. Epoxy Paint System Application

- 1. Surface preparation for the Epoxy Paint System shall be in accordance with SSPC-SP-6, Commercial Blast Cleaning. If Commercial Blast Cleaning is not feasible, prepare surfaces in accordance with SSPC-SP-11, Power Tool Cleaning to Bare Metal.
- 2. The Epoxy Paint System shall consist of an epoxy prime coat, an epoxy intermediate coat, and epoxy finish coat(s) to provide a total dry film thickness of 9 mils to 15 mils. Apply the coatings in accordance with the manufacturer's recommended film thickness, adding finish coats as necessary to meet the minimum total dry film thickness specified above.
- 3. Observe minimum and maximum re-coat times and specified by the manufacturer. If these times are exceeded, the surface shall be re-prepared as recommended by the manufacturer and as directed by the City Engineer prior to receiving additional coats.

K. Epoxy/Urethane Paint System Application

- 1. Surface preparation for the Epoxy/Urethane Paint System shall be in accordance with SSPC-SP-6, Commercial Blast Cleaning. If Commercial Blast Cleaning is not feasible, prepare surfaces in accordance with SSPC-SP-11, Power Tool Cleaning to Bare Metal.
- 2. The Epoxy/Urethane Paint System shall consist of an epoxy prime coat, an epoxy intermediate coat, and compatible urethane finish coat(s) to provide a total dry film thickness of 9 mils to 15 mils. Apply the coatings in accordance with the manufacturer's recommended film thickness, adding finish coats as necessary to meet the minimum total dry film thickness specified above.
- 3. Observe minimum and maximum re-coat times and specified by the manufacturer. If these times are exceeded, the surface shall be re-prepared as recommended by the manufacturer and as directed by the City Engineer prior to receiving additional coats.

L. Acrylic Paint System

1. Surface preparation for the Acrylic Paint System shall be in accordance with SSPC-SP-6, Commercial Blast Cleaning. If Commercial Blast Cleaning is not feasible, prepare surfaces in accordance with SSPC-SP-11, Power Tool Cleaning to Bare Metal.

- 2. The Acrylic Paint System shall consist of an acrylic prime coat, an acrylic intermediate coat, and acrylic finish coat(s) to provide a total dry film thickness of 9 mils to 15 mils. Apply the coatings in accordance with the manufacturer's recommended film thickness, adding finish coats as necessary to meet the minimum total dry film thickness specified above.
- 3. Observe minimum and maximum re-coat times and specified by the manufacturer. If these times are exceeded, the surface shall be re-prepared as recommended by the manufacturer and as directed by the City Engineer prior to receiving additional coats.

M. Acrylic Traffic Paint System

- 1. Surface preparation for the Acrylic Traffic Paint System shall be in accordance with SSPC-SP-6. Commercial Blast Cleaning. If Commercial Blast Cleaning is not feasible, prepare surfaces in accordance with SSPC-SP-11, Power Tool Cleaning to Bare Metal.
- 2. The Acrylic Traffic Paint System shall consist of a rapid-drying acrylic prime coat and a rapid-drying acrylic finish coat to provide a total dry film thickness of 6 mils to 10 mils.
- 3. Observe minimum and maximum re-coat times and specified by the manufacturer. If these times are exceeded, the surface shall be re-prepared as recommended by the manufacturer and as directed by the City Engineer prior to receiving additional coats.

N. Fusion-Bonded Polyester

- 1. Surface preparation for the Fusion-Bonded Polyester Paint System shall be in accordance with SSPC-SP-6. Commercial Blast Cleaning. If Commercial Blast Cleaning is not feasible, prepare surfaces in accordance with SSPC-SP-11, Power Tool Cleaning to Bare Metal.
- 2. The Fusion-Bonded Polyester Paint System shall consist of a rapid-drying fusion-bonded polyester prime coat and a rapid-drying fusion-bonded polyester finish coat to provide a total dry film thickness of 6 mils to 10 mils.
- 3. Observe minimum and maximum re-coat times and specified by the manufacturer. If these times are exceeded, the surface shall be re-prepared as recommended by the manufacturer and as directed by the City Engineer prior to receiving additional coats.

3.02 INSTALLATION

A. Procedures for the Application of Coatings

- 1. Conform to the requirements of SSPC PA-1. Follow the recommendations of the coating manufacturer including the selection of spray equipment, brushes, rollers, cleaners, thinners, mixing, drying time, temperature and humidity of application, and safety precautions.
- 2. Stir, strain, and keep coating materials at a uniform consistency during application. Apply each coating evenly, free of brush marks, sags, runs, and other evidence of poor workmanship. Use a different shade or tint on succeeding coating applications to indicate coverage where possible. Finished surfaces shall be free from defects or blemishes.
- 3. Do not use thinners unless recommended by the coating manufacturer. If thinning is allowed, do not exceed the maximum allowable amount of thinner per gallon of coating material. Stir coating materials at all times when adding thinner. Do not flood the coating material surface with thinner prior to mixing. Do not reduce coating materials

- more than is absolutely necessary to obtain the proper application characteristics and to obtain the specified dry-film thicknesses.
- 4. Remove dust, blast particles, and other debris from blast cleaned surfaces by dusting, sweeping, and vacuuming. Allow ventilator fans to clean airborne dust to provide good visibility of working area prior to coating applications. Remove dust from coated surfaces by dusting, sweeping, and vacuuming prior to applying succeeding coats.
- 5. Apply coating systems to the specified minimum dry-film thicknesses as measured from above the peaks of the surface profile.
- 6. Apply primer immediately after blast cleaning and before any surface rusting occurs, or any dust, dirt, or any foreign mater has accumulated. Re-clean surfaces by blast cleaning that have surface colored or become moist prior to coating application.
- 7. Apply a brush coat of primer on welds, sharp edges, nuts, bolts, and irregular surfaces prior to the application of the primer and finish coat. The brush coat shall be done prior to and in conjunction with the spray coat application. Apply the spray coat over the brush coat.

B. Surfaces Not to be Coated

- 1. Do not paint the following surfaces unless otherwise noted on the DRAWINGS or in other specification sections. Protect during the painting of adjacent areas:
 - Concrete sidewalks.
 - b. Mortar-coated pipe and fittings.
 - c. Stainless steel.
 - d. Metal letters.
 - e. Glass.
 - f. Roofing.
 - g. Chain link fencing.
 - h. Copper tubing, red brass piping, and PVC piping except where such piping occurs in rooms where the walls are painted, or required for color coding.
 - i. Electrical fixtures except for factory coatings.
 - i. Nameplates.
 - k. Grease fittings.
 - 1. Brass and copper, submerged.
 - m. Buried pipe, unless specifically required in the piping specifications.
 - n. Fiberglass items, unless specifically required.
 - o. Aluminum handrail, stairs, and grating.

C. Protection of Surfaces Not to be Painted

1. Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and

electrical equipment from damage during surface preparation and painting process. Mask openings in motors to prevent paint and other materials from entering the motors.

D. Surfaces to be Coated

- 1. Coat Surfaces as described below:
 - a. Coat mechanical equipment as described in the various mechanical equipment specifications. Color shall be selected by OWNER.
 - b. Coat aboveground and exposed piping or piping in vaults and structures as described in the various piping specifications. Color shall be as selected by the OWNER.
 - c. Coat valves as described in the various valve specifications. Aboveground valves, or valves in vaults and structures, shall match the color of the connecting piping.
 - d. Coat aluminum surfaces in contact with concrete per system No. 51.
 - e. Coat buried flanges, nuts and bolts, valves, flexible pipe couplings, exposed rebar in thrust blocks, and valve boxes per System No. 24.
 - f. Coat aboveground structural steel or structural steel located in vaults and structures as System 15.

E. Concrete Surfaces

1. For concrete floor and landings.

F. Epoxy Floor Coating

- 1. Apply epoxy coatings to floor surfaces including the chlorine and ammonia storage room floor, and up the concrete walls as follows:
 - a. Provide a 2-part epoxy coating system in two coats. Minimum dry film thickness of the finished system shall be 15-mils. Apply epoxy coating in strict accordance with the coating manufacturer's written instructions.
 - b. Bead blast all areas to be coated in conformance with the coating system manufacturer's written instructions and **Section 09 90 00** of these specifications.
 - c. All exterior portions of the walls (both concrete and masonry) below grade and adjacent to pipe trenches shall be coated with a minimum of two (2) coats of cold applied, coal tar type coating. (The coating shall be carried a minimum of 6" above the surrounding finished grade.) The coating shall be applied per manufacturer's instruction and shall be Bitumastic Plastic No. 505 as manufactured by Kopper's Company, Inc., or approved equivalent.

G. Wood Surfaces

- 1. All exposed surfaces, including the underside of the roof and rafters.
- 2. The color shall be as selected by the OWNER. The CONTRACTOR shall submit to the OWNER, for approval, color chips of all finish paints to be used prior to application.

H. Dry-Film Thickness Testing

1. Measure coating thickness specified for metal and concrete surfaces with a calibrated magnetic-type dry-film thickness gage. Test the finish coat (except zinc primer and

- galvanizing) for holidays and discontinuities with an electrical holidays detector, low-voltage, wet-sponge type. Provide measuring equipment. Provide detector as manufactured by Tinker and Rasor or K-D Bird Dog. Provide dry-film thickness gage as manufactured by Mikrotest or Elcometer. Check each coat for the correct dry-film thickness. Do not measure within eight hours after application of the coating.
- 2. Make five separate spot measurements (average of three readings) spaced evenly over each 100 square feet of area (or fraction thereof) to be measured. Make three gage readings for each spot measurement of either the substrate or the paint. Move the probe a distance of 1 to 3 inches for each new gage reading. Discard any unusually high or low gage reading that cannot be repeated consistently. Take the average (mean) of the three gage readings as the spot measurement. The average of five spot measurements for each such 100 square foot area shall not be less than the specified thickness. No single spot measurement in any 100 square foot area shall be less than 80 percent, nor more than 120 percent, of the specified thickness. One of three readings which are averaged to produce each spot measurement may underrun by a greater amount.

I. Repair of Improperly Coated Surfaces

1. If the item has an improper finish color or insufficient film thickness, clean and topcoat the surface with the specified paint material to obtain the specified color and coverage. Sandblast or power-sand visible areas of chipped, peeled, or abraded paint, feathering the edges. Then prime and finish coat in accordance with the specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

3.03 TESTING – NONE

PART 4 - MEASUREMENT AND PAYMENT

Measurement and payment for work in this section will be considered as subsiding obligation of the Contractor and the cost thereof shall be in the applicable items listed in the Bid Schedule.

END OF SECTION

SECTION 13 48 13 – MANUFACTURED SOUND AND VIBRATION CONTROL COMPONENTS

PART 1 - GENERAL

1.01 Work Included

A. Furnish all labor, sound absorptive curtains, materials, tools, and equipment for the installation of the composite sound curtain as shown on the contract drawings.

1.02 Product Description

- A. All quilted face sound absorbers are to be a fire safe, high performance, acoustical attenuating fiberglass blankets that are used to reduce reverberant (reflected) airborne noise.
- B. The quilted fiberglass absorber shall consist of standard vinyl impregnated, aluminized facing that is quilted directly to fiberglass batting using high strength thread and locking stitches. The batting is a low binder, fine fiber, acoustically absorptive, fiberglass batting. The quilting forms a matrix of 4" (102 mm) diamond stitch patterns which encapsulate the glass fibers. When the facing material on these stable encasements is subjected to airborne sound waves, the individual membrane faces respond diaphragmatically, like a drum head, and transmit sound energy through the nonporous facing into the fiberglass batting core material, where it is dissipated as thermal energy.
- C. Available as single or double layer, nominal thickness 1" (25 mm) or 2" (51 mm)

1.03 Quality Assurance

- A. The absorbing sound curtains shall be produced by a manufacturer having a minimum of ten (10) years' experience in furnishing similar noise control curtain material.
- B. Product shall meet the following minimum sound absorptive criteria when tested in accordance with ASTM C423 or ASTM E-90 & E-13. Products not meeting these minimum performance will not be accepted.

Nominal Thickness	Octave Band Frequency (Hz)						
Nominal Thickness	125	250	500	1000	2000	4000	NRC
1 in (25 mm)	0.12	0.47	0.85	0.84	0.64	0.62	0.70
1 in (25 mm)	0.04	0.46	0.86	0.81	0.59	0.31	0.70
2 in (51 mm)	0.08	0.33	0.79	1.02	1.04	1.02	0.80

PART 2 - PRODUCTS

2.01 Materials

- A. Standard Width: 48 inches (1219 mm).
- B. Length: As indicated, up to 25 feet (7.62 m) long.
- C. Facing Material: Vinyl coated fiberglass cloth facing on both sides
- D. Quilted absorber panels shall be:
 - 1. Model KFA as manufactured by Kinetics Noise Control
 - 2. Model QFA-1 as manufactuered by Sound Seal
 - 3. ACOUSTI-CURTAIN Sound Absorbing Drapery as manufactured by Acoustical Surfaces, Inc.
 - 4. Approved Equal

E. Facing

- 1. Breaking strength (warp and fill): 100 lbs./in.
- 2. Continuous service temperature limits: -20°F to 250°F (-29°C to 121°C)
- 3. Color: Gray

F. Fiberglass Batting

- 1. Form: Fiber diameter 4-6 microns.
- 2. Resin Binder: Thermosetting phenolic, 3-5% content by Wt.,
- 3. Density: 2 lbs./ ft.^3 (9.8 kg/m²) (nominal)
- 4. Thermal conductivity: K = 0.25 (BTU in./°F x sq. ft. x hr.) @ 75°F mean (44.3 cal/in. x °C x sq. cm x hr. @ 24°C mean).

G. Edge Binding:

- 1. All curtain panel edges shall be factory edge bound, no raw edges allowed.
- H. Sound Absorbers/Noise barrier Composites shall be nominally 1 inches (51 mm) thick-1.6 lb per cubic foot density.
- I. Construction: The quilted fiberglass absorber shall be supplied in lengths indicated. Manufacturer's standard panel construction shall have all edges bound with #4 spur grommets across the top and mating hook and loop fastener on vertical edges. A polyester thread suitable for exterior applications shall be used in the quilting process and in the matching edge binding.
- J. Mounting: Grommets shall be installed to facilitate mounting on either the short or long edge of the panel, as indicated on the drawing.
- K. Fire Test Report: Provide quilted fiberglass curtains with the following surface-burning characteristics as per ASTM E-84. Flame Spread Index: less than 23. Smoke Density Index: less than 31. Flammability Rating: Material shall have a Class A flammability rating per ASTM E-84:
- L. Acoustical Test Report: Provide acoustical test report from a qualified testing agency indicating quilted fiberglass absorber meets a NRC value of at least 0.85 per ASTM C423.
- M. Acoustical Test Report: Provide acoustical test report from a qualified testing agency indicating the Sound Absorber/Noise Barrier Composite meets a STC value of at least 29 per ASTM E-90 & E-413.

N. Acoustical Test Report: Provide acoustical test report from a qualified testing agency indicating the Sound Absorber/Noise Barrier Composite meets a STC value of at least 29 per ASTM E-90 & E-413.

2.02 Manufacturers

- A. Acceptable Manufacturer:
 - 1. Kinetics Noise Control Inc., 6300 Irelan Place, Dublin, OH. 43017
 - 2. Acoustical Surfaces, Inc., 123 Columbia Ct. N. Suite 201 Chaska, MN 55318
 - 3. Sound Seal, 50 H.P. Almgren Dr. Agawam, MA 01001
- B. Substitutions: Not permitted
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 Product Requirements.

PART 3 - EXECUTION

3.01 Examination

- A. Site Verification of Conditions:
 - 1. Examine surfaces scheduled to receive furred out or directly attached acoustical units for unevenness, irregularities and dampness that would affect quality and execution of work.
 - 2. Do not proceed with installation of acoustical panels until unacceptable conditions are corrected.

3.02 Installation

- A. The correct installation of the composite curtain material is critical in order to achieve the desired noise reduction. Refer to manufacture's guidelines.
- B. General: Do not begin installation until materials sufficient to complete an entire room are received and are ready for installation.
 - 1. Field cut acoustical panels as required, in accordance with manufacturers recommended procedures and equipment.
 - 2. Install acoustical wall panels in accordance with quantity and lay-outs as shown on the architectural drawings.
 - 3. Acoustical wall panels shall be adhesively or mechanically mounted in accordance with manufacturer's recommendations and/or as detailed on the drawings.
- C. Manufacturer's Instructions:
 - 1. Comply with the instructions and recommendations of the acoustical panel manufacturer.
 - 2. Install materials in accordance with governing regulations, fire resistance rating requirements and industry standards applicable to work.

3.03 Fabric Mounting

- A. Adhesive Mounting: Fabric panels are to be installed per recommended adhesive instructions.
- B. Magnetic Fasteners: The magnetic fastener is applied to the panel before shipment. Permanent spanport is required.
- C. Hook and Loop Fasteners: The loop side of the fastener is applied to the panel at time of shipment. The hook side is attached to its mate, and when installing, the tape backing is removed and the panel is positioned on the wall. Permanent support is required.
- D. Concealed Splines: Panels with concealed spline attachment are provided with kerfs along the edges of the panels. The spline then inserts into one panel and is mounted onto the wall. Adjoining panels are inserted into the remaining half of the spline.
- E. Mechanical Clips: The panel clips are mounted onto the panels at the time of shipment. The wall clips are installed on the wall at the location established by the position of the panel clips or wall bars.
- F. Impaling Clip: The impaling clips are screwed directly to the wall with the prongs extending outward. The glass fiber acoustical panel is positioned and pressed firmly onto the clip. Locking Adhesive is recommended with this clip mounting.

3.04 Cleaning

- A. Clean exposed surfaces of acoustical fabric to comply with manufacturer's instructions for cleaning.
- B. Fasteners: The magnetic fastener is applied to the panel before shipment. Permanent spanport is required.

3.05 Protection

A. Clean exposed surfaces of acoustical fabric to comply with manufacturer's instructions for cleaning. Protect installed work from damage due to subsequent construction activity, including temperature and humidity limitations and dust control, so that the work will be without damage and deterioration at the time of acceptance by the Owner.

END OF SECTION

SECTION 23 00 00 - COMMON WORK RESULTS FOR PIPING SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section describes the requirements and procedures for piping systems (pressure pipe and gravity sewer pipe) and appurtenances that apply to a number of other complimentary Specification Sections. The items are listed in this section to avoid repetition in sections elsewhere. This section includes, but is not limited to, temporary pipelines, wet taps, flexible pipe couplings, grooved and shouldered end couplings, joint restraint systems, field touch up, bolts, nuts, polyethylene wrap, warning/identification tape, tracer wire, gate well and extension stems, meter boxes, abandonment and removal of existing facilities, salvage, and disposal.
- B. Contractor shall provide the piping systems indicated, complete and operable, in accordance with the Contract Documents.
- C. The Drawings define the general layout, configuration, routing, pipe size and pipe type. The Contract Drawings are not pipe construction or fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct the piping system, to accommodate the equipment provided, and to provide and install spools, spacers, adapters and connectors for a complete and functional system. Flanges and joints in addition to those shown may be necessary to facilitate fabrication and installation. All project materials provided by the manufacturers and Contractor shall be pressure rated for the design pressures listed in Section 1.08 of this Specification.
- D. This section includes, but is not limited to: water mains, temporary bypass piping, tapping tee, joint restraint systems, reducing couplings, insulation unions & couplings, blow-off assembly, fire hydrants, service clamps, corporation ball valves, ball valves, copper tubing and fittings, meter boxes, polyethylene encasement, warning/identification tape, valve cans, water meters, meter boxes, flanged coupling adapters, straight and transition couplings, reducing couplings, blow off assemblies, fire hydrants, fire hydrant elbows, fire hydrant extensions, fire hydrant bolts, field touch up, flange gaskets, bolts, nuts, service clamps, corporation stops, ball valves, copper tubing and fittings, meter boxes, air release valves, polyethylene wrap, warning/identification tape, tracer wire, valve boxes and extension stems, abandonment and removal of existing facilities, and salvage.

1.02 REFERENCE STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, the work specified herein shall conform to or exceed the requirements of the Building Code, Standard Specifications for Public Works Construction (SSPWC), applicable requirements of the Contract Documents (Special Provisions), and of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this section; provided, that for Building Codes and SSPWC, the latest editions, as adopted as of the date of award by the Owner having jurisdiction, shall apply to the Work.
- B. The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for.

- C. American National Standards Institute (ANSI)
 - 1. B16.1 Cast iron Pipe Flanges and Flanged Fittings
 - 2. B16.42 Ductile Iron Pipe Flanges and Flanged Fittings, Classes 15 and 300
 - 3. B1.1 Unified Inch Screwed Threads
 - 4. B1.2 Gages and Gauging for Unified Inch Screw Threads
- D. American Society for Testing and Materials (ASTM)
 - 1. A 47/A 47M Ferritic Malleable Iron Castings
 - 2. A 36/A 36M Carbon Structural Steel
 - 3. A 53 Pipe, Steel, Black and Hot Dipped, Zinc-Coated Welded and Seamless
 - 4. A 108 Steel Bars, Carbon, Cold Finished, Standard Quality
 - 5. A183 Carbon Steel Track Bolts and Nuts
 - 6. A 283A 283 M Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
 - 7. A 307 Carbon Steel Bolts and Studs
 - 8. A 325/A 325M High Strength Bolts for Structural Steel Joints
 - 9. A 510/A 510 General Requirements for Wire Rods and Course Round Wire, Carbon Steel
 - 10. A 512 Cold Drawn Buttwelded Carbon Steel Mechanical Tubing
 - 11. A 536 Specification for Ductile Iron Castings
 - 12. A 568/A568M Steel Sheet and Strip, Carbon, Hot Rolled, Structural Quality and Cold Rolled.
 - 13. D16 Terminology Relating to Paint, Varnish, Lacquer and Related Products
 - 14. D 2000 System for Rubber Products in Automotive Applications
 - 15. F 593 Stainless Steel Bolts, Hex Cap Screws, and Studs
 - 16. F 594 Stainless Steel Nuts
- E. American Water Works Association
 - 1. M11 Steel Pipe and Fittings
 - 2. M41 Ductile Iron Pipe and Fittings
 - 3. M23 PVC Design and Installation
 - 4. C104 Cement Mortar Lining for Ductile Iron Pipe and fitting for Water
 - 5. C105 Polyethylene Encasement for Ductile Iron Pipe Systems
 - 6. C110 Ductile Iron and Gray Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids
 - 7. C111 Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
 - 8. C115 Flanged Ductile Iron Pipe with Threaded Flanges

- 9. C150 Thickness Design of Ductile Iron Pipe
- 10. C151 Ductile Iron Pipe, Centrifugally Cast for Water and Other Liquids
- 11. C153 Ductile Iron Compact Fittings, 3-inch through 24-inch, and 54-inch through 64-inch
- 12. C200 Steel Water Pipe 6-inch and Larger
- 13. C203 Coal Tar Protective Coatings and Linings for Steel Water Pipelines-Enamel and Tape-Hot Applied
- 14. C 205 Cement Mortar Protective Lining and Coating for Steel Water Pipe 4-inch and Larger
- 15. C 206 Field Welding of Steel Water Pipe
- 16. C207 Steel Pipe Flanges for Waterworks Services 4-inch through 144-inch
- 17. C 208 Dimension for Fabricated Steel Water Pipe Fittings
- 18. C210 Liquid Epoxy Coating Systems for Interior and Exterior of Steel Water Pipelines.
- 19. C 213 Fusion Bonded Epoxy Coatings for the Interior and Exterior of Steel Water Pipelines
- 20. C 217 Petrolatum and Petrolatum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines
- 21. C 219 Bolted, Sleeve-Type Couplings for Plain End Pipe
- 22. C 227 Bolted, Split-Sleeved Restrained and Nonrestrained Couplings for Plain- End Pipe.
- 23. C600 Installation of Ductile Iron Mains and Their Appurtenances
- 24. C 602 Cement Mortar Lining of Water Pipelines in Place 4-inch and Larger
- 25. C 604 Installation of Steel Water Pipe 4-inch and Larger
- 26. C 605 Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
- 27. C 606 Grooved and Shouldered Joints
- 28. AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4" through 12" for Water Transmission and Distribution
- 29. C 654 Disinfection
- F. Greenbook Standard Specifications for Public Works Construction (latest edition)
- G. Standard Plans for Public Works Construction
- H. California Department of Public Health Title 22
- I. NSF 61

1.03 RELATED SECTIONS

A. Standard Specifications 01 00 00, 01 04 50, 01 32 16, 01 33 00, 02 41 13.13, 03 30 00, 03 15 16, 09 90 00, 09 96 71, 21 50 10, 23 00 00, 23 26 13, 23 31 19.13, 23 91 10, 23 91 19, 23 92 13, 23 92 17, 23 93 10, 23 93 17, 23 94 05, 23 95 13, 31 23 00, 31 23 19, 32 16 13, 33 02 22

1.04 SUBMITTALS

- A. Furnish submittals in accordance with General Conditions and Section 01 33 00 Submittal Procedures.
- B. Submit manufacturer-prepared catalog data showing dimensions, construction by ASTM reference and grade and coatings.
- C. Shop Drawings: Shop Drawings shall contain the following information:
 - Drawings: Layout drawings including necessary dimensions, details, pipe joints, fittings, specials, bolts and nuts, gaskets, valves, appurtenances, anchors, guides, thrust blocks, restrained lengths and material lists. Fabrication drawings shall indicate spacers, adapters, connectors, fittings, and pipe supports to accommodate the equipment and valves in a complete and functional system.
 - 2. All project materials in contact with potable water shall be submitted with a proof of certification letter stating compliance with the standards listed in Section 1.05 CONTAMINATION PREVENTION.
 - 3. Samples: Performing and paying for sampling and testing as necessary for certifications are the Contractor's responsibility.
 - 4. Certifications:
 - a. Certificates, test reports, and affidavits of compliance shall be obtained and provided by the Contractor and the Manufacturer.
 - b. A certification from the pipe fabricator that each pipe will be manufactured subject to the fabricator's or a recognized Quality Control Program. An outline of the program shall be submitted to the Engineer for review prior to the manufacture of any pipe.
- D. Construction Phasing and Detailed Procedure Plan:
 - 1. Plans shall include project location, date, valves requiring closures, length of time required for each valve closure and tie in connections, proposed hot tapping locations, construction by-pass piping plans, pressure testing procedure and schedule, abandonment, and line activation.

1.05 CONTAMINATION PREVENTION

- A. Volatile organic compounds present in the linings of items in contact with potable water or recycled water shall not exceed concentrations allowed by the latest requirements of the State Office of Drinking Water and Department of Health Services. All products in contact with potable water require proof of NSF certification on the lining materials to be used.
- B. All materials shall comply with NSF 61 for materials for water-service piping and specialties for domestic water, including Annex G.

- C. All materials shall comply with NSF 14 for plastic potable-water-service piping. Include marking "NSF-PW" on piping.
- D. All materials shall comply with California Assembly Bill (AB) 1953 (Lead Free)

1.06 TEMPORARY PIPELINES

A. Temporary pipelines shall be provided when water mains are removed and replaced in the same location or where shown on the Approved Plans or required by the City Engineer, provide temporary service shall be provided to existing customers at all times during construction.

1.07 PIPE TAPPING (WET TAP)

A. All pipe tap (wet tap) connections to existing pipelines, whether for mainline extension or service laterals, shall be approved by the City prior to contract. The Contractor shall provide materials and labor to excavate, pour thrust block, backfill, compact, and repair pavement as indicated in the project specifications. With specific prior approval of the City Engineer or when directed by the City Engineer, the Contractor may perform wet taps.

1.08 DESIGN CRITERIA

- A. AWWA C900 and C905 Polyvinyl Chloride (PVC) pressure pipe shall conform to Specification Section 23 91 10.
- B. Ductile Iron Pipe Flange including blind flanges unless otherwise noted shall conform to Specification Section 23 92 17.
- C. All pipe flanges shall meet the latest revision of AWWA C111, AWWA C207, and ANSI/ASME B16.5 standards.
- D. All flange materials and gaskets shall be certified compliant with NSF/ANSI 61, Drinking Water System Components-Health effects, in addition to the requirements of the Safe Drinking Water Act.
- E. Steel flanges shall conform to applicable requirements of AWWA C207.
- F. Steel flange selection shall be based on the test pressure. AWWA flanges shall not be exposed to test pressures greater than 125 percent of rated capacity. For higher test pressures, the next higher rated AWWA flange or an ANSI-rated flange shall be selected.
 - 1. For test pressures 150 psi or less, flanges shall conform to ASME B16.5 Pipe Flanges and Flanged Fittings, 150 lb class.
 - 2. For test pressures 150 psi to 275 psi, flanges shall conform to either ASME B16.5 150 lb class or AWWA C207 Class E or Class F.
 - 3. For test pressures 275 psi to 700 psi, flanges shall conform to ASME B16.5, 300 lb class.

Average Normal Working Pressure – 65 psi Estimated Surge Transient Pressure – 100 psi Test/Design Pressure – 200 psi

- G. Steel flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise indicated. Attachment of the flanges to the pipe shall conform to the applicable requirements of AWWA C207. Flange faces shall be perpendicular to the axis of the adjoining pipe. Flanges for miscellaneous small diameter pipes shall be in accordance with the standards indicated for these pipes.
- H. Steel Blind Flanges: Blind flanges shall be in accordance with AWWA C207, or as indicated for miscellaneous small pipes. Blind flanges for pipe sizes 12-inches and greater shall be provided with lifting eyes in the form of welded or screwed eye bolts.
- I. Flange Coating: Machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.
- J. Provide Affidavit of Compliance per requirements in Specification Section 01 33 00.

1.09 MEASUREMENT AND PAYMENT

Measurement and payment for work in this section will be considered as subsiding obligation of the Contractor and the cost thereof shall be in the applicable items listed in the Bid Schedule.

PART 2 - PRODUCTS

2.01 GENERAL

A. All products in contact with potable water shall comply with shall be certified compliant with NSF/ANSI 61, Drinking Water System Components-Health effects including Annex G, in addition to the requirements of the Safe Drinking Water Act.

2.02 FLANGE GASKETS

- A. All pipe gaskets shall conform where applicable to the latest revision of AWWA C111, AWWA C115, and AWWA C207 standards.
- B. All gasket materials shall be suitable for municipal potable water systems and shall be certified compliant with NSF/ANSI 61, Drinking Water System Components-Health effects, in addition to the requirements of the Safe Drinking Water Act.
- C. All gaskets shall be full-faced gasket type and with 1/8-inch minimum thickness.
- D. All gaskets shall be of non-asbestos materials and suitable to be connected to the adjacent flange materials. The minimum gasket thicknesses shall conform to AWWA C207 Table 1 and the size details per AWWA C111 Table C.1
- E. The operating temperature range shall be 0-250°F.
- F. The flange gaskets shall be a minimum pressure rating equal to the adjacent flanges including the system the test pressure. Refer to **Section 23 00 00**, Article 1.08 Design.
- G. Provide Affidavit of Compliance per requirements in Specification Section 01 33 00.

2.03 BOLTS AND NUTS

- A. All pipe bolts and nuts shall conform where applicable to the latest revision of AWWA C111, AWWA C115, and AWWA C207 standards.
- B. All bolts and nuts for ductile iron flanges shall be hot dipped galvanized or fluoropolymer coated carbon steel bolts conforming to ATSM A307 grade A with ASTM A563 heavy hex nuts.
- C. All bolts and nuts for steel flanges shall be hot dipped galvanized or fluoropolymer coated carbon steel bolts conforming to ATSM A193 grade B7 with ASTM A194 grade 2H heavy hex nuts.
- D. All bolts and nuts shall be provided with a washer under each nut and under each bolt head made of the same material as the nuts. Washers shall be sized such that no part of the washer shall project beyond the flange outside diameter. Washers shall be flush with the flange surface and shall not impinge on any welded surface between the flange and the pipe, valve, or fitting to which the flange is attached.
- E. Bolts shall be of such length that not less than 1/4 inch nor more than 1/2 inch shall project above nut in tightened position. All bolt heads and nuts shall be hexagonal, except where special shapes are required.
- F. All bolted connections shall be wrapped and protected with Petrolatum Wax Tape Coating. Refer to **Section 09 96 71**.
- G. Provide Affidavit of Compliance per requirements in Specification Section 01 33 00.
- H. Fire hydrants shall be provided with break off type bolts conforming to ASTM A307 Grade A. Hex nuts shall conform to ASTM A563 with washers. All fire hydrant bolts, nuts and washers shall hot dipped galvanized.

2.04 POLYETHYLENE ENCASEMENT

- A. Polyethylene encasement shall be used for all ferrous metal materials, coated or uncoated.
- B. Polyethylene wrap or sleeves shall be used for the protection of buried ductile-iron pipe, fittings, appurtenances, and valves.
- C. Polyethylene sleeves shall be used for the protection of buried ductile iron pipe and fittings. Where the use of a sleeve is not practical, the fittings may be wrapped. Additionally, all bolted connections shall be coated with wax tape.
- D. Polyethylene wrap or sleeves may also be installed around buried PVC pipe for recycled water identification.
- E. Polyethylene encasement shall be as indicated below. Polyethylene materials shall be kept out of direct sunlight exposure.
 - 1. Polyethylene wrap and sleeves shall be a minimum 0.008" thick linear low density polyethylene film in accordance with AWWA C105.

- 2. Polyethylene wrap and sleeves shall be clear for use with potable water and purple for use with recycled water.
- 3. Polyethylene or vinyl adhesive tape a minimum of 2" wide or plastic tie straps shall be used to secure polyethylene encasement.
- 4. Polyethylene wrap and sleeves shall be clear for use with potable water and purple for use with recycled water.
- 5. Installation Methods and shall comply with AWWA C105. Method A is preferred.
- 6. Polyethylene encasement shall be secured with 2" wide polyethylene or vinyl adhesive tape or with plastic tie straps.
- F. Provide Affidavit of Compliance per requirements in Specification Section 01 33 00.

2.05 WARNING/IDENTIFICATION TAPE

- A. Warning/identification tape shall be used to identify location of underground utilities and to act as a warning against accidental excavations of buried utilities. Warning/identification tape shall be used on all underground water and recycled water mains, potable and recycled water irrigation systems, sewer mains, and all related appurtenances. Warning/identification tape shall also be used on cathodic protection wiring systems and tracer wire brought into and out of access ports.
- B. Warning/identification tape shall be as indicated below.
 - 1. Tape shall be an inert, metallic plastic film formulated for prolonged underground use that will not degrade when exposed to alkalis, acids and other destructive substances commonly found in soil.
 - 2. Tape shall be puncture-resistant and shall have an elongation of two times its original length before parting.
 - 3. Tape shall be colored to identify the type of utility intended for identification. Printed message and tape color shall be as follows:

Printed Message	<u>Tape Color</u>
Caution: Potable Waterline Buried Below	Blue
Caution: Urban-Treated Run-Off Pipe Buried Below	Yellow w/Black Stripes
Caution: Sewerline Buried Line	Green
Caution: Cathodic Protection Cable Buried Below	Red
Caution: Electric Line Buried Below	Red

- 4. Ink used to print messages shall be permanently fixed to tape and shall be black in color with message printed continuously throughout.
- 5. Tape shall be minimum 0.004" or 4 mil thick x 6" wide with a printed message on one side. Tape used with the installation of onsite potable and recycled water irrigation systems shall be a minimum of 3" wide.
- 6. Provide Affidavit of Compliance per requirements in Specification Section 01 33 00.

2.06 TRACER WIRE MATERIAL

- A. Tracer wire to be twelve (12) gauge minimum solid copper with thermoplastic insulation recommended for direct burial. Wire connectors to be 3M DBR, or approved equal, and shall be watertight to provide electrical continuity.
- B. Tracer wire color shall be blue for all water construction and green for all wastewater construction
- C. Tracer Wire Access Boxes for locations where valve boxes are not present, the tracer wire access point shall be composed of one SnakePit Tracer Wire Access Box, or approved equal, installed at each proposed access point.
- D. Contractor shall perform a continuity test on all tracer wire in the presence of the Engineer or the Engineers' representative. If the tracer wire is found to be not continuous after testing, Contractor shall repair or replace the failed segment of the wire at their own expense.

2.07 VALVE CANS

- A. Valve cans shall be used for buried valves 2" and larger, unless otherwise indicated by the City. Gate well lids shall be used on all valve cans.
- B. Valve cans for valves 2" and smaller shall be 4" diameter SDR-35 PVC sewer pipe.
- C. Valve cans for valves larger than 2" shall be 8" diameter Class 305 C900 PVC pipe.
- D. Valve cans for use in potable water system applications shall be blue. Valve cans for use in urban-treated runoff system applications shall be yellow with black stripe.
- E. Gate well lids shall be circular ductile-iron, **rated for H-20 Traffic Loading** and shall include a skirt for a close fit inside the upper portion of the gate well. Lids shall be cast with the City's name and the word "WATER" for use on potable water systems.
 - 1. Gate well lids for valves 2" and smaller shall be 4" diameter with 1/2" long skirt.
 - 2. Unless otherwise indicated on the Approved Plans or directed by the City Engineer, gate well lids for valves larger than 2" shall be Type Christy-G05T Traffic Valve Box 10-3/8" I.P.x 12" with an 8: PVC PIP.

2.08 VALVE STEM EXTENSION

- A. Valves 4" and larger require valve stem extensions to be installed when the valve operating nut is more than 5' below grade or as required by the City Engineer. All valves 2" and smaller requiring the installation of a gate well shall include a valve stem extension.
- B. Stem extensions shall be complete with operating nut, location ring, and lower socket to fit valve operating nuts. The configuration of the extension stem socket shall match that of the valve it operates.
 - 1. Valve stem extensions for valves 2" or smaller shall be in accordance with Water Agencies' Standards WV5.

2. Valve stem extensions for valves 4" or larger extensions may be round or square hotdipped galvanized steel tubing of solid design (no pinned couplings permitted) with guides in accordance with Water Agencies' Standards WV4.

2.09 PIPE JOINT LUBRICANT

- A. All pipe lubricant shall be suitable for municipal potable water systems and certified compliant with NSF/ANSI 61 and Annex G, NSF14 and Drinking Water System Components-Health effects, in addition to the requirements of the Safe Drinking Water Act.
- B. The pipe lubricant shall be formulated to prevent turbidity, taste, and odor problems and shall not promote bacterial growth in new main installations.
- C. The lubricant shall be safe for the use with metal or plastic rubber gasketed pipe.
- D. The consistency shall be smooth and must remain a paste at temperatures above 150°F. The temperature range for use shall be 7°F to 150°F.
- E. The lubricant shall be non-corrosive and nonflammable and shall not swell rubber gaskets.
- F. Provide Affidavit of Compliance per requirements in Specification Section 01 33 00.

2.10 SLEEVED TYPE COUPLINGS

- A. Sleeve type couplings include straight couplings, transition couplings, reducing couplings and flange coupling adapters and will be used to connect all combinations of ductile iron, cast iron, steel and ACP pipe.
- B. All sleeve couplings shall meet the latest revision of AWWA C219 standards.
- C. Center ring shall be:
 - 1. Ductile Iron per ASTM A536, 65-45-12
 - 2. Steel per ASTM A283 Grade C or equivalent with a minimum yield of 30,000 psi.
- D. End rings shall be:
 - 1. Ductile Iron per ASTM A536, 65-45-12.
 - 2. Steel per ASTM A576-Grade 1020 or equivalent have a minimum yield of 54,000 psi.
- E. Coupling flanges shall have the same bolt pattern and equal or exceed pressure rating of the connecting flange. Refer to Section 2.10 for flange coupling adapter flange requirements.
- F. The location and number of each type of sleeve coupling shall be determined from the construction drawings.
- G. The product shall be certified compliant with NSF/ANSI 61, Drinking Water System Components-Health effects, in addition to the requirements of the Safe Drinking Water Act.
- H. The pipe material and nominal pipe sizes are shown on the plans and it shall be field verified prior to ordering any type of couplings.

- I. All couplings shall be pressure rated for a minimum of 250 psi or the rating of the pipe (whichever is greater) and shall with operate with manufacturer guarantee at the water system design pressures.
- J. The water system operating temperature range is between 32 150°F.
- K. The minimum wall thickness of the sleeve coupling shall be ¼ inch and the minimum center sleeves length shall comply with Table 2 of AWWA C219. Manufacturer shall confirm the minimum length is sufficient for each application. Minimum lengths for reducing couplings shall be 12-inches.
- L. Allowable angular pipe deflections shall not exceed 80 % of the manufacturer's recommendation and conform to Section 4.5 and Table 3 of AWWA C219.
- M. Coatings thickness shall be a minimum of 16 mils of either shop applied liquid or fusion bonded epoxy in accordance with AWWA C210 or AWWA C213.
- N. Gasket materials shall Buna N Grade 60 and/or exceed or meet the requirements AWWA C219 Section 4.23 and ASTM D2000.
- O. Flange bolts and nuts shall conform to the requirements of Section 2.03. End ring bolts and nuts shall conform to AWWA C219 Section 4.2.4 and AWWA C111.
- P. All couplings shall clearly be marked with a pressure rating per AWWA C219 Section 6.1.4.
- Q. Affidavits of Compliance (Certifications) shall be provided by the manufacturer and the contractor final material approval.

2.11 JOINT RESTRAINT SYSTEMS

- A. Joint restraint systems shall be used for rubber ring joint pipe. Joint restraint systems shall be used in conjunction with, concrete thrust blocks unless otherwise directed. Restrained joint systems shall be wax tape coated and polyethylene encased. Contractor shall submit manufacturer produced shop drawings, calculations, and catalog data for each joint restraint systems. All products shall be installed per manufacturer's recommendations including all referenced AWWA standards.
- B. Mechanical Joint Restraint Ductile Iron Pipe and PVC
 - 1. Restraint devices for joining plain end pipe to mechanical joint fittings and appurtenances shall conform to either ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53. Restraint devices shall be Listed by Underwriters Laboratories (3- inch through 24-inch size) and approved by Factory Mutual (3- inch through 12- inch size).
 - 2. Restraint devices for nominal pipe sizes 3-inch through 48-inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10.
 - 3. The devices shall have a working pressure rating of 350 psi for 3-inch through 16- inch and 250 psi for 18-inch through 48-inch. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes.

- 4. Gland body, wedges, and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
- 5. Ductile iron gripping wedges shall be heat treated within a range of 370 to 470 BHN.
- 6. All wedge assemblies and related parts shall be processed through a phosphate wash, rinse and drying operation prior to coating application. The coating shall consist of a minimum of 12 mils of coats of liquid or fusion bonded thermoset epoxy coating per AWWA 210 or AWWA 213.
- 7. All casting bodies shall be surface pretreated with a phosphate wash, rinse and sealer before drying. The coating shall be electrostatically applied and heat cured. The coating shall be a polyester based powder to provide corrosion, impact and UV resistance.
- 8. All components shall be manufactured and assembled in the United States. The purchaser shall, with reasonable notice, have the right to plant visitation at his/her expense.
- 9. Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly as well as allowing joint deflection after assembly. Manufacturer installation recommendations shall be followed.
- 10. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.

C. Straight and Transition Couplings

- 1. Joint restraint to prevent axial separation shall be incorporated into the design of the sleeve or coupling used to connect two plain pipe ends. The working water pressure shall be rated for 250 psi minimum and all higher design pressures per **Section 23 00 00**, 1.08. For ductile iron pipe, the flange adapter shall have a safety factor of 2:1 minimum.
- 2. The restraint mechanism shall consist of a plurality of individually actuated gripping surfaces to maximize restraint capability.
- 3. Torque limiting twist off nuts shall be used to insure proper actuating of the restraint devices.
- 4. The restraint devices shall be coated with 12 mils of Fusion-Bonded Epoxy Coating (AWWA C213-07).
- 5. Ductile iron components shall be of a minimum of 65-45-12 ductile iron meeting the requirements of ASTM A536 of the latest revision and shall be tested in accordance with the stated standard.
- 6. The restrained joining system shall meet the applicable requirements of AWWA C219, ANSI/AWWA C111/A21.11, and ASTM D2000.

D. Restrained Flanged Coupling Adapters

- 1. Restrained flange adapters shall be used in lieu of threaded, or welded, flanged spool pieces. Flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C110/A21.10.
- 2. Restraint for the flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.

- 3. The flange adapter shall be capable of deflection during assembly, or permit lengths of pipe to be field cut, to allow a minimum of 0.6" gap between the end of the pipe and the mating flange without affecting the integrity of the seal.
- 4. For PVC pipe, the flange adapter will have a pressure rating equal to the pipe.
- 5. The restraint shall be manufactured of ductile iron conforming to ASTM A536 and rated for a minimum of 250 psi and all higher design pressures per **Section 23 00 00**, 1.06. For ductile iron pipe, the flange adapter shall have a safety factor of 2:1 minimum.
- 6. The restraint devices shall be coated with liquid or fusion bonded epoxy per AWWA C210 or AWWA C213.
- E. Coupling Restrainer for Asbestos Pipe: Restrainer for use over A/C coupling, MJ Couplings, and mechanical couplings use JCM Industries model JCM 631ACP/DIP RESTRAINED COUPLING.
- F. Provide Affidavit of Compliance for all restraining devices per requirements in Specification Section 01 33 00.
- 2.12 GROOVED END (VICTAULIC) OR SHOULDERED COUPLINGS FOR DUCTILE IRON OR STEEL PIPE
 - A. Groove end or shouldered couplings are described below:
 - B. Use square-cut shouldered or grooved ends per AWWA C606. Grooved-end couplings shall be malleable iron per ASTM A 47, or ductile iron per ASTM A 536. Gaskets shall be per ASTM D 2000.
 - C. Bolts in exposed service shall conform to ASTM A 183, 69 MPa (10,000 psi) tensile strength.
 - D. The minimum design working pressure shall be 250 psig.
 - E. The finish shall be fusion bonded epoxy per AWWA C213.
- 2.13 DUCTILE-IRON PIPE
 - A. Refer to Specification Section 23 92 17.
- 2.14 COPPER TUBE AND FITTINGS
 - A. Refer to Specification Section 23 92 13.
- 2.15 BLOWOFF ASSEMBLIES
 - A. Refer to Specification Section 23 94 05.
- 2.16 RESILIENT WEDGE GATE VALVES
 - A. Refer to Specification Section 23 93 17.

2.17 AIR RELEASE VALVE

A. Refer to Specification Section 23 93 10.

2.18 BACKFLOW PREVENTERS

A. Refer to Specification Section 23 95 13

2.19 FIRE HYDRANTS

A. Refer to Specification Section 21 50 10.

PART 3 - EXECUTION

3.01 GENERAL

A. All materials shall be installed per manufacturers' recommendations including the applicable AWWA standards C600, C602, C604, 605 including the Standards referenced in Part 2 Materials of Specification Section 23 00 00.

3.02 TEMPORARY PIPELINES

- A. All temporary piping, fittings, and service connections shall be furnished, installed, and maintained by the Contractor, and the Contractor shall make connections to a water source designated by the City.
- B. All pipe, valves, fittings, hose and connections furnished by the Contractor shall be of good quality, clean, and suitable for conveying potable water in the opinion of the City Engineer.
- C. The temporary pipe shall be installed in such a manner that it will not present a hazard to traffic and will not interfere with access to homes and driveways along its route.
- D. Valves shall be installed at locations shown on Plans or as directed by the City Engineer. The use of pressure reducing valves (PRV) may be required as directed by the City Engineer.
- E. The Contractor shall be responsible for disinfecting all pipe, connections, flushing, and assisting the City in taking water samples for bacteriological testing in accordance with **Section 15041**, Disinfection of Piping.
- F. Following disinfection and acceptance of the temporary pipe as a potable water system, the Contractor shall maintain continuous service through the temporary piping to all consumers normally served both directly and indirectly by the pipeline.
- G. Upon completion of the work, the Contractor shall remove the temporary piping and appurtenances and shall restore all surfaces to the satisfaction of the City Engineer.
- H. If repairs to temporary piping are necessary, Contractor shall make such repairs in a timely manner as directed by the City Engineer. If progress in making repairs is inadequate, or in the event of emergency, the City Engineer may take immediate corrective measures, which may include the performance of repair work by City forces or another contractor. All costs for corrective measures shall be borne by the Contractor.

3.03 CONCRETE THRUST BLOCKS

A. All tees, elbows, crosses, offsets, valves, fire hydrants and plugged pipe ends shall have concrete thrust blocks or collars with a minimum of bearing area against undisturbed earth or as indicated on the plans. All concrete used in thrust block shall attain a 3,250 psi minimum strength per **Section 03 30 00**, Article 2.01.B.

3.04 BOLTS AND NUTS

- A. All pipe bolts and nuts shall be installed per the latest revision of AWWA C111, AWWA C115 and AWWA C207 standards.
- B. All bolts and nuts shall be new and unused. Bolts shall not be reused once tightened. Used bolts and nuts shall be discarded and removed from the job site.
- C. Bolts and nuts shall be cleaned, if needed, by wire brushing and shall be lubricated prior to assembly.
- D. Tighten nuts uniformly and progressively in a "star" pattern.
- E. All bolted connections shall be wrapped and protected with Petrolatum Wax Tape Coating. Refer to Section **09 96 71**.
- F. Buried bolts and nuts shall receive a heavy coat of protective grease prior to being wrapped with polyethylene.
- G. All stainless steel bolts shall be coated with an anti-seize compound.

3.05 POLYETHYLENE ENCASEMENT

- A. Polyethylene encasement shall completely encase and cover all metal surfaces.
- B. Pipe and pipe-shaped appurtenances: All ductile-iron pipe and pipe-shaped appurtenances such as bends, reducers and offsets shall be encased with polyethylene sleeves in accordance with Method A described in AWWA C105, or with polyethylene wrap in accordance with Method C described in AWWA C105.
 - 1. Odd-Shaped Appurtenances: Odd-Shaped Appurtenances such as tees and crosses shall be encased with polyethylene wrap in accordance with AWWA C105. Valves:
 - 2. Valves shall be encased with polyethylene wrap in accordance with AWWA C105 such that only the stem and operating nut are exposed and the wrap shall be attached so that valve operation will not disturb the wrapping or break the seal.
- C. Polyethylene sleeves shall be secured with polyethylene or vinyl adhesive tape or plastic tie straps at the ends and quarter points along the sleeve in a manner that will hold the sleeve securely in place during backfill. Polyethylene wrap shall be secured with polyethylene or vinyl adhesive tape or plastic tie straps in a manner that will hold the wrap securely in place during backfill.

3.06 WARNING/IDENTIFICATION TAPE

A. Warning/Identification Tape shall be installed as described below.

- B. Tape shall be placed at the top of the pipe zone 12" above and centered over the utility intended for identification. Tape used with onsite potable and recycled water irrigation systems shall be installed at 6" above the pipe.
- C. Tape shall be installed with the printed side up and run continuously along the entire length of the utility intended for identification. Tape shall be installed on the main piping and all appurtenant laterals, including blowoffs, air valve assemblies, fire hydrants, and services. Tape splices shall overlap a minimum of 24" for continuous coverage.
- D. Tape shall be installed prior to placement of the Trench Zone Backfill.

3.07 TRACER WIRE

- A. Tracer wire shall be installed as described below.
- B. Tracer wire shall be installed with all potable water and urban treated run-off water mains.
- C. Wire shall be placed on the top centerline of the pipeline and shall run continuously along the entire length of pipe prior to placement of trench backfill. Wire shall be mechanically and electrically continuous throughout the pipeline, including within pipe casings.
- D. Tracer wire shall be secured to the pipe at 6' intervals with plastic adhesive tape, duct tape or plastic tie straps. The wire may alternately be secured to the pipe by looping the tracer wire around itself such that tracer wire remains continuous atop the pipe during backfill operations.
- E. Tracer wire access ports shall be installed in accordance with the Water Agencies' Standard Drawings WP 01 within the concrete splash pad of all fire hydrants installed as a part of the work. In addition, tracer wire may terminate within meter boxes, blow off boxes, CP test boxes or air valve enclosures as shown on the Approved Drawings or as directed by the City Engineer at intervals of not more than 1,000'. Locations of all tracer wire access ports installed shall be noted on the field record drawings.
- F. Wire shall extend into the access port and shall terminate with a coiled 24" length of wire. All tracer wires not attached to piping shall be installed, without splices, within a conduit at a minimum depth of 24" in accordance with the Water Agencies' Standard Drawings WP 01.
- G. Splices shall be installed only when necessary and shall be made using wire connectors.
- H. The Contractor shall test tracer wire for electrical continuity in the presence of the City Engineer prior to the installation of any paving over atop pipelines or appurtenances. Testing shall be accomplished using a device capable of detecting improper connections or ground fault interruptions.
- I. Tracer wire shall be installed per Water Agencies' Standards WP01.

3.08 VALVE CANS

A. Valve cans shall be installed as shown on the Construction Plan Details and as described below.

- B. Valve cans shall be installed with lids flush with the final surface. No more than two 1" adjustment rings shall be used. Valve cans and adjustment rings shall be accurately cut perpendicular to the length of the piping used.
- C. Valve cans shall be color-coded to identify the type and use of the valve installed.
 - 1. The inside portion of the gate well lid and interior portion of PVC gate well shall be identified with a minimum 2" diameter painted identification marking. Paint color shall be as follows:

ColorGate Well Lid and PVC Gate Well for:RedNormally Closed System Valves (NCV)BlueResilient Wedge Gate Valves (RWGV)

Blue Butterfly Valves (BFV)
Yellow Fire Hydrant (RWGV)

- 2. The top exterior portion of the gate well lid and ring shall be coated in accordance with Section 09 96 71.
- D. Valve can and covers shall be installed per the manufacturer's recommended Installation procedures. Manufacturer's procedures shall be part of the submittal package.
- E. Valve boxes shall be centered on the valve operating stem and shall be of sufficient and continuous length to prevent adjoining backfill material from interfering with valve operation.
- F. Valve boxes shall be carefully installed to prevent entry of solid material. The interior of valve boxes shall be cleaned of all material to the level 2 inches below the bottom of exposed portion of the valve stem. Valve boxes shall be kept covered at all times, except when operating valves, and care shall be taken to prevent entry of solid materials when uncovered.
 - 1. Each valve box shall be fitted with a valve box cap. Valve box caps shall be epoxy painted cast iron loosely fitted inside the top of the valve box and marked "City of Norwalk Water" on top.
 - 2. The tops of valve boxes in paved areas or areas soon to be paved shall be adjusted to snugly retain the cap, the top of which shall be flush with finish grade.
 - 3. The tops of valve boxes and caps in untraveled areas shall be adjusted to ground surface. If the traveled surface is ungraded or graded earth, the valve box cap shall be set 6-inches below ground surface and covered with a plug of asphaltic concrete until such time that grade is restored.

3.09 VALVE STEM EXTENSIONS

- A. All valves 2" and smaller requiring the installation of a Valve Can shall include a valve stem extension fabricated and installed in accordance with the City requirements. Stem extensions shall be of sufficient length to bring the operating nut to a point approximately 6" below the gate well lid.
- B. Valves 4" and larger require valve stem extensions to be fabricated and installed in accordance with the City requirements when the valve-operating nut is more than 5' below grade. Valve stem extensions shall be of sufficient length to bring the operating nut to a point between 12" and 18" below the gate well lid.

3.10 FLEXIBLE PIPE COUPLINGS

- A. Flexible pipe couplings shall be installed in accordance with the manufacturers' recommendations and as described below:
 - 1. Use plain-end pipe with flexible couplings per AWWA C200. Provide joint harnesses per AWWA M11 for aboveground applications or where indicated on the Approved Plans.
 - 2. Flexible couplings may be used only where indicated on the drawings
 - 3. Clean oil, scale, rust, and dirt from the pipe ends and touch up the mortar or epoxy lining and coating and allow time for curing before installing the coupling. Clean the gaskets before installing.
 - 4. Follow the manufacturer's recommendations for installation and bolt torque using a properly calibrated torque wrench.
 - 5. Lubricate the bolt threads with graphite prior to installation.

3.11 GROOVED-END OR SHOULDERED COUPLINGS FOR DUCTILE-IRON OR STEEL PIPE

- A. Grooved-end or shouldered couplings shall be installed in accordance with the manufacturer's recommendations and as described below:
 - 1. Grooved-end or shouldered joint couplings shall be installed per AWWA C606 and the manufacturer's recommendations.
 - 2. Clean loose scale, rust, oil, grease, and dirt from the pipe or fitting groove and touch up the epoxy coating as necessary, allowing time for curing before installing the coupling.
 - 3. Clean the gasket before installation. Apply a lubricant selected to the gasket exterior including lips, pipe ends, and housing interiors.
 - 4. Fasten the coupling alternately and evenly until the coupling halves are seated. Follow the manufacturer's recommendations for bolt torque using a properly calibrated torque wrench.

3.12 JOINT RESTRAINT SYSTEMS-DUCTILE IRON AND PVC PIPE

- A. Joint Restraint Systems shall be installed as shown on the Construction Documents, in accordance with the manufacturers' recommendations and as described below:
 - 1. Split ring restraint shall be installed on the spigot end of pipe, connected to a back-up ring which seats behind the bell of the adjoining pipe or fitting or directly to the fitting. All joint restraint devices shall be installed in accordance with the manufacturers' instructions

END OF SECTION

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. The General Conditions apply to all sections of this specification, which shall be completed as shown on the plans and as specified, and shall be properly coordinated with work in other Specifications.
- B. The DRAWINGS and these specifications are complementary to each other; what is called for by one shall be as binding as if called for by both. If there is any conflict between what is shown on the DRAWINGS and what is written in the specifications, the details described on the DRAWINGS shall take precedence and the CONTRACTOR shall communicate the conflicts to the ENGINEER in a timely manner.

C. Safety

1. The CONTRACTOR shall be familiar with, and shall at all times conform to, the regulations of the "OSHA General Industry Occupational Safety and Health Standards," "OSHA Safety and Health Regulations for Construction," and other applicable state and municipal standards and regulations.

1.02 REFERENCED SECTIONS – NONE

1.03 CITED STANDARDS

- A. Refrigeration systems shall be constructed in accordance with ASHRAE Standard ASHRAE 15 "Safety Code for Mechanical Refrigeration".
- B. Refrigeration systems shall meet or exceed the minimum COP/Efficiency levels as prescribed in ASHRAE 90A "Energy Conservation in New Building Design".
- C. Refrigeration units shall be listed by UL and have UL label affixed.

1.04 NOTED RESTRICTIONS – NONE

1.05 QUALITY CONTROL

- A. The following HVAC equipment will be provided and installed by the CONTRACTOR per this section and as shown in the DRAWINGS.
 - 1. Provide aluminum dampers with actuators, as shown on the DRAWINGS.
 - 2. Provide electric unit heater as noted in DRAWINGS, as shown on the DRAWINGS.
 - 3. Provide air conditioner/heat pump split unit as noted in DRAWINGS.
 - 4. Provide gas furnace and air conditioning units along with ductwork and all other accessories capable of heating and cooling, as noted on the DRAWINGS.

B. Manufacturer's Qualifications

1. Firms regularly engaged in manufacture of HVAC equipment of the types of materials, and sizes required, whose products have been in satisfactory use in similar services.

C. Installer's Qualifications

1. A firm with at least 3 years of successful installation experience on projects with HVAC equipment work similar to that required for this project.

1.06 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model, clearly indicated weights, dimensions, required clearances, and methods of assembly of components, furnished specialties and accessories; and installation and start-up instructions.
- B. Wiring Diagrams: Submit ladder-type wiring diagrams for power and control wiring required for final installation equipment and control. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- C. Shop DRAWINGS: Submit manufacturer's assembly-type shop drawing for each type of HVAC equipment, indicating materials and methods of assembly of components.
- D. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes and spare parts lists. Include this data, product data, and shop DRAWINGS in maintenance manuals; in accordance with requirements of **Section 01 78 23**.

1.07 DELIVERABLES

- A. Handle HVAC equipment and components carefully to prevent damage, breaking, denting, and scoring. Do not install damaged packaged equipment or components; replace with new.
- B. Store packaged HVAC equipment and components in clean dry place off the ground. Protect from weather, dirt, fumes, water construction debris, and physical damage.
- C. Comply with Manufacturer's rigging and installation instructions for unloading packaged HVAC equipment and moving them to final location for installation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All HVAC equipment is located in the HVAC SCHEDULE in the DRAWINGS. The schedule contains the location, service, capacity/size, and models. Where no model is indicated, the CONTRACTOR shall appropriately size the equipment and submit it to the ENGINEER for approval.

PART 3 - EXECUTION

3.01 PREPARATION – NONE

3.02 INSTALLATION

- A. General: Install HVAC equipment in accordance with manufacturer's installation instructions. Install units plumb and level, unless otherwise recommended by manufacturer, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- B. Support: Install AC unit on concrete pad as indicated in DRAWINGS. Coordinate installation of anchoring devices.

3.03 TESTING

A. Start-Up:

- 1. Provide the services of a factory-authorized service representative to start-up air conditioning equipment in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
- B. Operating and Maintenance Training:
 - Provide services of manufacturer's service representative to instruct OWNER's personnel
 in operation and maintenance of HVAC equipment. Training shall include start-up and
 shutdown, servicing and preventative maintenance schedule and procedures, and
 troubleshooting procedures plus procedures for obtaining repair parts and technical
 assistance.

END OF SECTION

SECTION 23 05 44

SOUND ATTENUATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Sound attenuator.
- B. Fill material.

1.02 RELATED SECTIONS

A. Identification of sound attenuators shall be as specified in Section 20 40 13 - Identification for Facility Services.

1.03 MEASUREMENT AND PAYMENT

A. General: Separate measurement or payment will not be made for the work required under this Section. All costs in connection with the Work specified herein will be considered to be included or incidental to the Work of this Contract.

1.04 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM E84 Test Method for Surface Burning Characteristics of Building Materials
 - 2. ASTM E90 Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
 - 3. ASTM E477 Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers
- B. National Fire Protection Association (NFPA):
 - 1. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems
- C. Sheet Metal and Air Conditioning Contractors National Association Inc. (SMACNA):
 - 2. SMACNA HVAC Duct Construction Standards Metal and Flexible

1.04 SUBMITTALS

- A. General: Refer to Section 01 33 00 Submittal Procedures, and Section 01 33 23 Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.
- B. Shop Drawings: Submit manufacturer's assembly-type Shop Drawings, indicating dimensions, weight loadings, required clearances, and methods of assembly of component parts.

- C. Product Data: Submit manufacturer's product data, including construction sizes, pressure drop and acoustical performance data, for specified sound attenuators. Submit certificates of compliance for products proposed for use.
- D. Maintenance Data: Submit maintenance data and parts list for each type of sound attenuator, including "trouble-shooting" maintenance guide. Include this data, product data, and Shop Drawings in maintenance manual in accordance with requirements of Section 01 78 23 Operations and Maintenance Data.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sound attenuators with identification on outside of casings indicating type of sound attenuator and location to be installed. Avoid crushing or bending, and prevent dirt and debris from entering and settling in sound attenuators.
- B. Store sound attenuators so as to protect them from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.01 SOUND ATTENUATOR

- A. Sound attenuators shall be of the factory-fabricated type for low velocity service.
- B. Sound attenuators shall be constructed of galvanized steel sheets. Outer casing gage and seam construction shall be equal to or greater than required by SMACNA HVAC Duct Construction Standards Metal and Flexible for ductwork of the same size and pressure class, but not less than 22 gage. Inner casing shall be perforated plate, 26 gage minimum. Seams shall be lockformed and mastic-filled.
- C. Sound attenuators shall not fail structurally when subjected to an air pressure differential of 10 inches water gage from inside to outside of casing. For attenuators with multiple modules, airtight construction shall be provided by use of duct sealing compound between modules.
- D. For a sound attenuator unit rated at 2000 fpm face velocity, the self-noise power levels shall not exceed, and the dynamic insertion loss (DIL) ratings shall not be less than, the values shown in Table 1, as follows:

Table 1 - Sound Attenuator Rating

$(dB \text{ re } 10^{12} \text{ W})$								
Octave Band	1	2	3	4	5	6	7	8
Mid-Frequency (cycles per second)	63	125	250	500	1000	2000	4000	8000
Self-Noise Power Level	58	52	46	43	42	45	45	39
DIL - 5 feet length	3	8	15	28	30	21	14	10
DIL - 7 feet length	4	12	20	36	38	28	18	12

Values shall be obtained on a test unit not less than 24 inches by 24 inches in size made by a nationally recognized independent certified acoustical laboratory.

- E. Airflow capacities shall be as indicated or required. Air pressure drop through the attenuator shall not exceed the value indicated, or shall not be in excess of 15 percent of the total external static pressure of the air handling system, whichever is less.
- F. Sound attenuators shall be acoustically rated with metal duct inlet and outlet sections while under the rated airflow conditions measured by independent laboratory in accordance with requirements of ASTM E90 and ASTM E477. Noise reduction data shall include the effects of flanking paths and vibration transmission.
- G. Certified test ratings for attenuation, regeneration, and pressure drop shall be furnished. Provide manufacturer's certification that insertion loss ratings, regenerated noise ratings, and pressure drop tests were all made on same identical equipment by an independent acoustical laboratory.

2.02 FILL MATERIAL

- A. Provide inorganic, mineral, or glass fiber fill material, of sufficient density to obtain the specified acoustical performance, pre-packed under not less than five percent compression, to eliminate voids due to vibration and pressure variables.
- B. Fill material shall be inert, vermin- and moisture-proof, and shall comply with applicable requirements of NFPA 90A.
- C. Provide fill material with flame spread index of 25 or less, and smoke developed index of 50 or less, when tested in accordance with ASTM E84 testmethod.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install sound-attenuation devices and appurtenances as indicated. Conform to SMACNA HVAC Duct Construction Standards - Metal and Flexible and the manufacturer's installation instructions, as applicable.

SOUND ATTENUATION FOR HVAC PIPING AND EQUIPMENT

- B. Provide sealed joints to prevent air leakage through cell joints. Streamline leading edges of adjacent cells with continuous nonferrous metal nosing.
- C. Provide bracing of internal components of casing to prevent distortion or flutter.
- D. Reduction of noise shall be not less than the indicated values.
- E. Hangers and devices in exterior locations exposed to the weather shall be painted with corrosion-resistant paint as specified in Section 09 91 00 Painting.
- F. Connect ductwork to sound attenuators in accordance with applicable requirements of Section 23 31 00 -HVAC Ducts and Casings.

END OF SECTION 23 05 44

RELEASE - R2.1 SECTION 23 05 44 BART FACILITIES STANDARDS ISSUED: 10/01/2009 PAGE 4 OF 4 STANDARD SPECIFICATIONS

SECTION 23 34 00 – HVAC FANS (EXHAUST AND VENT FANS)

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section includes the extent of power and gravity ventilator work required by this section is indicated on DRAWINGS and schedules, and by requirements of this section.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 QUALITY CONTROL
- 1.05 CAPACITY AND HEADLOSS
 - A. Per plans schedule
- 1.06 SOUND ATTENUATION
 - A. Min: 7.5 Sones @ 5 ft

PART 2 - PRODUCTS

2.01 CEILING EXHAUST FANS

- A. Material of construction shall be aluminum or other material resistant to chlorine vapor corrosion.
- B. Integral backdraft damper shall be totally chatter-proof with no metal to metal contact. Fans shall have true centrifugal wheels. Entire fan, motor and wheel assembly shall be easily removable without disturbing the housing. All motors shall be suitably grounded and mounted on rubber in shear vibration isolators.
- C. Furnish each fan with a solid state speed controller.
- D. Ceiling exhaust fans shall be provided by of one of the following, or an ENGINEER approved equal.
 - 1. Two speed, thermostatically controlled
 - 2. Dayton Fan Series 48X48

2.02 VENTILATING FANS

- A. Material of construction shall be aluminum or other material resistant to chlorine vapor corrosion.
- B. Panel mounted, propeller type, balanced steel blades, steel panel frame, venturi orifice, v-belt drive with variable pitch sheave, adjustable motor mounted, zerk type grease fittings, ball bearing shaft, steel angle frame. Provide discharge or inlet wire guard as required for

protection. Finish housing with baked enamel finish, and finish blades and hub with epoxy. Maximum allowable fan tip speed - 6,000 fpm. Note required direction of air flow on DRAWINGS. Air flow shall accomplish 60 air volume exchanges.

PART 3 - EXECUTION

3.01 PREPARATION

A. Examine areas and conditions under which exhaust and vent fans are to be installed.

3.02 INSTALLATION

- A. Except as otherwise indicated or specified, install fans in accordance with manufacturer's installation instructions and recognized industry practices to insure that products serve the intended function.
- B. Coordinate work with work of roofing, walls and ceilings, as necessary for proper interfacing.
- C. Ductwork: Refer to Division 23. Connect ducts to fan.
- D. Roof Curbs: Install roof curbs. Flash and seal into roof.
- E. Control Dampers: Install control dampers and mount damper motors.

3.03 TESTING

- A. Cleaning: Clean factory-finished surfaces.
- B. Adjust and tighten belts and sheaves.
- C. Check and adjust clearances between fan and fan housing.
- D. Provide lubrication.

END OF SECTION

SECTION 23 93 10 – COMBINATION AIR VALVES FOR WATER

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This section includes the materials and installation instructions to cover the design, manufacture, and testing of 1- and 2-inch combination Air Valves for working pressures up to 250 psig designed specifically for use in water transmission applications.
- B. Combination Air Valves shall be float operated valves designed to release accumulated air or gas from a piping system while the system is in operation and under pressure. In addition, the valves shall discharge large quantities of air during pipe filling operations and intake large quantities of air during pipe draining and water column separation conditions.

1.02 REFERENCE STANDARDS

- A. The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for.
- B. The valve manufacturer shall have ISO 9001 and ISO 14001 certifications.
- C. The valve shall have NSF 61 certification for potable water applications.

1.03 RELATED WORK

A. Standard Specifications 01 00 00, 01 04 50, 01 32 16, 01 33 00, 02 41 13.13, 03 30 00, 03 15 16, 09 90 00, 09 96 71, 21 50 10, 23 00 00, 23 26 13, 23 31 19.13, 23 91 10, 23 91 19, 23 92 13, 23 92 17, 23 93 10, 23 93 17, 23 94 05, 23 95 13, 31 23 00, 31 23 19, 32 16 13, 33 02 22

1.04 DESIGN

- A. The valve shall have a single float design and shall be designed to ensure a drip tight sealing at system operation pressure as low as 3 psig.
- B. The float shall operate in concert with a rolling seal design that creates the closure of the valve preventing water from escaping the valve at system operation under pressure of 3 psig and higher, while being able to automatically adjust its position to allow for controlled intermittent air release. Valves that do not incorporate the rolling seal solution shall not be considered equal or acceptable. Valve designs that do not intentionally allow for intermittent release of air during operation shall not be considered equal or acceptable.
- C. Air flow alone will not prematurely shut the valve at pressure lower than 9 psig.
- D. The valve shall have a (1/2) (3/4) (1) (2) inch male NPT connection inlet as indicated on the drawings. In addition, the valve shall have a 1-1/2 inch NPT connection for attaching a vent pipe. (Alternate inlet and venting sizes are available. Please consult with your local authorized representative for appropriate size combinations).

- E. The sealing pressure shall be 3 psi and the working pressure shall be 250 psi, while the maximum working temperature shall be 140 degrees F, with maximum intermittent temperatures of up to 194 degrees F. Air valves which are not rated for minimum sealing pressure of 3 psi and maximum working pressure of 250 psi shall not be considered equal or acceptable.
- F. The reinforced nylon valve weight shall be 10 lb. or less. Valves in excess of 10 lb. shall not be considered equal or acceptable.

1.05 TESTING

A. All valves supplied under this section shall be hydraulically tested to a minimum pressure of 360 psi. Valves which are not tested to a minimum pressure of 360 psi shall not be considered equal or acceptable.

1.06 MANUFACTURER

- A. All valve manufacturers shall have a minimum of Ten (10) years' experience in manufacturing air valves for water and wastewater applications.
- B. All air valves shall be accompanied by a written Five (5) year warranty.
- C. All combination air valves shall be model ARI D-040 as manufactured by ARI or approved equal.
- D. All valves shall be installed in accordance with the manufacturers' recommendations and the installation shall include an isolation valve for control and valve maintenance.

1.07 MEASUREMENT AND PAYMENT

A. Payment for work in this section shall be for the furnishing and installation of 2-inch combination ARV assembly as designated on the construction plans. The payment will be at the unit price per each bid therefore in the bid schedule, complete and in place in accordance with the plans and these specifications, the Contract Documents, and as directed by the Engineer. The unit price shall include full compensation for furnishing all labor, tools, mobilization costs, bonds, insurance, equipment, materials, piping, fittings, valve enclosure, concrete, traffic control, backfill, excavation, plating, permanent resurfacing, restoration of landscape and hard scape and incidentals for doing all work involved in installing the pipeline except as provided otherwise by other items of work within the bid schedule, and no additional compensation shall be allowed therefore.

PART 2 - PRODUCTS

2.01 COMBINATION AIR VALVES

A. The valve body shall be constructed of NSF certified reinforced nylon. Valves constructed of cast iron or ductile iron shall not be considered equal or acceptable. Valves that do not carry and maintain the applicable NSF certification(s) shall not be considered equal or acceptable.

(Alternate materials of construction are available. Please consult with your local authorized representative for appropriate material combinations).

- B. The float shall be constructed of polypropylene.
- C. The rolling seal shall be constructed of EPDM rubber and provide smooth positive opening, closing, and leak free sealing over the range of pressures 3 psi and higher, that the system may experience, including static system pressure. For lower minimum sealing pressures, other rubber materials are available.
- D. All metal hardware shall be 316 stainless steel. All O-rings shall be of BUNA-N with pressure ratings equivalent to the overall working pressure of the valve.

2.02 AIR RELEASE VALVES AND AIR AND VACUUM VALVES

- A. Air release valves and air and vacuum valves shall be provided only as shown on the Approved Plans or at all high points along the alignments as dictated by field conditions. Air release valves, air and vacuum valves and appurtenant components and materials suitable for the system pressure.
- B. Air release valves and air and vacuum valves shall comply with AWWA C512 except as modified herein.
- C. Release valves and air and vacuum valves shall be the single-body type incorporating stainless steel internal components and suction screen. National Pipe Threaded (NPT) inlet and outlet configurations.
- D. Epoxy linings and coatings for valves shall be provided in accordance with AWWA C550.
 - 1. Liquid epoxy lining and coating materials shall be listed in the NSF Listing for Drinking Water Additives, Standard 61, certified for use in contact with potable water.
 - 2. The minimum dry film thickness for epoxy linings shall be 0.008" or 8 mils. Liquid epoxy lining shall be applied in two (2) coats in accordance with AWWA C210.

2.03 MANUAL AIR VALVES

A. Manual air valves shall be provided only as specifically shown on the Approved Plans.

2.04 ENCLOSURES

A. Air Valve Enclosures shall be a maximum of 18" in diameter.

2.05 CONCRETE

A. Concrete used for anchor or thrust blocks and equipment pads shall be in accordance with Section 03 30 00.

2.06 BREAK-AWAY BOLTS

A. Combination air valves, air release valves and air and vacuum valves sized 4" and larger shall be installed with break-away bolts.

2.07 TRACER WIRE

A. Tracer wire materials shall be in accordance with **Section 23 00 00**.

2.08 WARNING/IDENTIFICATION TAPE

A. Warning/Identification Tape shall be in accordance with **Section 23 00 00**.

2.09 FIELD PAINTING AND COATING

A. Field painting and coating materials shall be in accordance with Section 09 90 00

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Air valve assemblies shall be provided as shown on the Approved Plans. Additional air valve assemblies may be required in areas of potential air entrapment, at the discretion of the City Engineer.
- B. Air valve assemblies shall be installed relative to street improvements.
- C. Connections for the air valve assemblies shall be made within a section of the main line no closer than 24" to a bell, coupling, joint or fitting.

3.02 CONCRETE

A. Concrete thrust or anchor blocks and equipment pads shall be installed in accordance with Section 03 30 00. Refer to Section 03 30 00 for the minimum concrete curing time required.

3.03 TRACER WIRE

A. Tracer Wire shall be installed in accordance with **Section 23 00 00**.

3.04 WARNING/IDENTIFICATION TAPE

A. Warning/Identification tape shall be installed in accordance with Section 23 00 00.

3.05 DISINFECTION

A. Air valve assemblies shall be disinfected in accordance with **Section 23 26 13** in conjunction with disinfecting the main to which it is connected. The assembly valves shall be operated and the assembly flushed to completely disinfect all internal parts.

3.06 HYDROSTATIC TESTING

A. Air valve assemblies shall be hydrostatically tested in accordance with **Section 23 91 19** in conjunction with the pipeline to which they are connected.

3.07 FIELD PAINTING AND COATINGS

- A. Air valve assemblies shall be color coded, if required, in accordance with **Section 09 90 00**.
- B. Field repairs to the enclosure shall not be permitted. Enclosures requiring repairs to the coating shall be returned to the supplier or coating vendor for repairs or recoating in accordance with **Section 09 90 00**.

END OF SECTION

SECTION 23 93 17 – RESILIENT WEDGE GATE VALVES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes materials, testing, and installation of manually-operated Resilient Wedge Gate Valves (RWGV's).

1.02 REFERENCE STANDARDS

- A. The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for.
 - 1. AWWA C210 Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
 - 2. AWWA C213 Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
 - 3. AWWA C509 Resilient-Seated Gate Valves for Water Supply Service
 - 4. AWWA C515 Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
 - 5. AWWA C550 Protective Interior Coatings for Valves and Hydrants SSPC Steel Structures Painting Council

1.03 RELATED WORK

A. Standard Specifications 01 00 00, 01 04 50, 01 32 16, 01 33 00, 02 41 13.13, 03 30 00, 03 15 16, 09 90 00, 09 96 71, 21 50 10, 23 00 00, 23 26 13, 23 31 19.13, 23 91 10, 23 91 19, 23 92 13, 23 92 17, 23 93 10, 23 93 17, 23 94 05, 23 95 13, 31 23 00, 31 23 19, 32 16 13, 33 02 22

1.04 SERVICE APPLICATION

- A. RWGV's shall be installed on potable water mains and appurtenances in accordance with the Approved Plans.
- B. RWGV's shall be used to isolate and depressurize pipeline segments for repairs, modifications, inspections or maintenance.
- C. In general, RWGV's shall be used when valves are required on pipelines and appurtenances sized 4" through 12".

1.05 SUBMITTALS

- A. RWGV's 12" and smaller shall conform to these Specifications and Approved Plans.
- B. RWGV's 14" and larger require City approval. Submittals shall include catalog data showing conformance to AWWA C509, size(s) proposed for use, valve dimensions, pressure rating, and materials of construction, and such valves shall also conform to all other requirements specified herein. All gate valves larger than 12 inches shall conform to AWWA C515.

1.06 SIZING OF VALVES

A. Valves shall be the same size as the line in which they are installed unless otherwise noted on the Approved Plans.

1.07 VALVE ENDS

- A. Valve ends shall be compatible with the piping system in which they are being installed in accordance with the Approved Plans or directed by the City Engineer.
- B. Ductile-iron flanges shall be in accordance with **Section T33 11 11**.

1.08 VALVE TESTING

A. RWGV's shall be hydrostatically tested and valve coatings shall be holiday detected prior to shipment to the field in accordance with the testing procedures per AWWA C509. Valves delivered to the site prior to successful hydrostatic testing and holiday detection shall be rejected.

1.09 DELIVERY, STORAGE AND HANDLING

A. Valves shall be delivered and stored in accordance with AWWA C550. The port openings shall be covered with plastic, cardboard or wood while in transit and during storage in the field. These covers shall remain in place until valves are ready to be installed. Valves shall not be stored in contact with bare ground. Valves shall not be stacked.

1.10 POLYETHYLENE ENCASEMENT

A. Polyethylene wrap shall be used for the buried installation of resilient wedge gate valves in accordance with **Section 23 00 00**.

1.11 MEASUREMENT AND PAYMENT

A. Payment for work in this section shall be for the furnishing and installation of gate valve assemblies for the diameter and class of pipeline designated on the construction plans. The payment will be at the unit price per each bid therefore in the bid schedule, complete and in place in accordance with the plans and these specifications, the Contract Documents, and as directed by the Engineer. The unit price shall include full compensation for furnishing all labor, tools, mobilization costs, bonds, insurance, equipment, materials, mechanical thrust restraint, concrete thrust blocks, backfill, excavation, plating, permanent resurfacing, restoration of landscape and hard scape and incidentals for doing all work involved in installing the pipeline except as provided otherwise by other items of work within the bid schedule, and no additional compensation shall be allowed therefore.

PART 2 - PRODUCTS

2.01 RESILIENT WEDGE GATE VALVES (RWGV'S)

- A. RWGV's shall be ductile-iron in accordance with AWWA C509 and C515 except as modified herein.
- B. RWGV's shall have smooth unobstructed waterways free from any sediment pockets.

- C. RWGV's shall be leak-tight at their rated pressure.
- D. 4-12" Resilient Wedge Gate Valve Ductile Iron Full Wall:
 - 1. The resilient seat gate valves shall fully comply with the latest revision of AWWA C509, and shall also be UL listed and FM approved. The valves shall be tested and certified to ANSI/NSF 61.
 - 2. The valve shall have a 250 psig working pressure. Each valve shall be factory seat tested to 250psig and shell tested to 500psig.
 - 3. The valve type shall be NRS (non-rising stem).
 - 4. The valve shall have an arrow cast on the operating nut or hand-wheel showing opening direction. The direction of opening shall be as specified.
 - 5. The NRS valves shall be provided with a 2" square operating nut. The bolt that attaches the operating nut to the stem shall be recessed into the operating nut so as not to interfere with valve wrench operation.
 - 6. The valves shall have bolts and nuts for the stuffing box and bonnet with one of the following compositions:
 - a. Type 316 stainless steel.
 - 7. The valve stem shall be made of ASTM B98-C66100/H02 (Everdur) bar stock material (no cast stem material). The stem shall have at least one "anti-friction" thrust washer above and below the stem collar to reduce operating torque. The design of the NRS valve stem shall be such that if excessive input torque is applied, stem failure shall occur above the stuffing box at such a point as to enable the operation of the valve with a pipe wrench or other readily available tool. The stem material shall provide a minimum 70,000 psi tensile strength with 20% elongation and yield strength of 38,000 psi. Valves with two-piece stem collars are unacceptable.
 - 8. The NRS valves shall have a stuffing box (with dirt seal) that is o-ring sealed. Two o-rings shall be placed above and one o-ring below the stem thrust collar. The thrust collar shall be factory lubricated. The thrust collar and its lubrication shall be isolated by the o-rings from the waterway and from outside contamination providing permanent lubrication for long term ease of operation. Valves without a stuffing box are unacceptable. Valves without at least three stem o-rings are also unacceptable.
 - 9. The valve body and bonnet shall be composed of ASTM A536 ductile iron. The body and bonnet size shall also adhere to the minimum wall thickness table as set forth in AWWA C509. Wall thickness less than those are not acceptable.
- E. 3-12" Resilient Wedge Gate Valve Ductile Iron Full Wall:
 - 1. The valve disc and guide lugs must be fully (100%) encapsulated in EPDM. The peel strength shall not be less than 75 pounds per inch (ASTM D429). Guide caps of an Acetal-bearing material shall be placed over solid guide lugs to prevent abrasion and to reduce the operating torque. Guide lugs place over bare metal are not acceptable.
 - 2. The valves shall have all internal and external ferrous surfaces coated with a fusion bonded thermosetting powder epoxy coating of 10 mils nominal thickness. The coating shall conform to AWWA C550.

3. The valves shall be warranted by the manufacturer against defects in materials or workmanship for a period of ten (10) years from the date of manufacture. The manufacturing facility for the valves must have current ISO certification.

2.02 VALVE CANS AND EXTENSION STEMS

A. Valve cans and extension stems for buried valves shall be in accordance with Section 23 00 00.

2.03 POLYETHYLENE ENCASEMENT

A. Polyethylene wrap shall be in accordance with **Section 23 00 00**.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install valves with the bolt holes straddling the vertical centerline of pipe and the operating nut in the Vertical position unless otherwise noted on the Approved Plans.
- B. Valves shall be installed in accordance with the manufacturer's recommendations and the applicable section of these specifications for the piping material and joint type being used.

3.02 POLYETHYLENE ENCASEMENT

A. Install polyethylene wrap for all buried valves in accordance with Section 23 00 00.

3.03 CONCRETE

A. Concrete thrust, anchor, and support blocks shall be installed in accordance with Section 03 30 00. The concrete shall be placed so that valves and valve operators will be accessible for repairs or replacement. Prior to filling the pipeline with water, refer to Section 03 30 00 for the minimum concrete curing time required.

3.04 VALVE CANS AND EXTENSION STEMS

A. Valve cans and extension stems for buried valves shall be installed in accordance with **Section 23 00 00**.

3.05 DISINFECTION OF VALVES

A. Disinfection and flushing of valves shall be in accordance with **Section 23 26 13**, as part of the process of disinfecting the main pipeline. Valves shall be operated during the disinfection period to completely disinfect all internal parts.

3.06 HYDROSTATIC TESTING

A. Valves shall be hydrostatically tested in conjunction with the pipeline in which they are installed in accordance with **40.05.13.10**.

3.07 FIELD PAINTING AND COATING

A. The exterior of valves installed above ground or exposed in vaults or enclosures shall be field painted in accordance with **Section 09 90 00**.

END OF SECTION

SECTION 26 00 00 - GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. It is the intent of this part of the Contract Documents to cover the work and materials necessary for erecting a complete electrical system, tested and ready for continuous use. The system shall be constructed in accordance with the Contract Documents, and Federal, State, and Local codes and regulations.

1.02 RELATED SECTIONS

- A. The Contractor shall coordinate the work with other trades and furnish and install the equipment in accordance with the manufacturers' requirements.
- B. The Related Work can be found in other Divisions of these specifications, such as, but not limited to:
 - 1. Division 0 Procurement and Contracting Requirements
 - 2. Division 1 General Requirements
 - 3. Division 2 Existing Conditions
 - 4. Division 3 Concrete
 - 5. Division 9 Finishes
 - 6. Division 11 Equipment
 - 7. Division 23 Heating, Ventilating, and Air Conditioning (HVAC)
 - 8. Division 40 Process Integration

1.03 GENERAL PROVISIONS

- A. Minimum sizes of equipment, and electrical devices, are indicated but it is not intended to show every offset and fitting, nor every structural or mechanical difficulty that will be encountered during the installation of the work.
- B. Work indicated on the Plans is approximately to scale, but actual dimensions and detailed Plans should be followed as closely as field conditions permit. Field verification of scale dimensions on Plans is governed by field conditions. Installation of systems and equipment is subject to clarification as indicated in reviewed shop drawings and field coordination.
- C. Discrepancies indicated on different Plans, between Plans and actual field conditions, or between Plans and Contract Documents shall be promptly brought to the attention of the Engineer for clarification, prior to purchasing and installing equipment.
- D. The alignment of equipment and conduit shall be adjusted to accommodate architectural changes, or to avoid work of other trades, without extra expense to the Owner.

- E. The Contractor shall furnish and install the parts and pieces necessary to the installation of equipment, in accordance with the best practice of the trade, and in conformance with the requirements of these Contract Documents.
- F. Items not specifically mentioned in these Contract Documents, or noted on the Plans, or indicated on reviewed shop drawings, but which are obviously necessary to make a complete working installation, shall be deemed to be included herein.
- G. The Contractor shall layout and install electrical work prior to placing floors and walls. Furnish and install sleeves and openings through floors and walls, required for installation of conduits. Sleeves shall be rigidly supported and suitably packed, or sealed, to prevent ingress of wet concrete. Spacers shall be installed in order to prevent conduit movement. Dimensions indicated for electrical equipment and their installation are restrictive dimensions.
- H. The Contractor shall furnish and install inserts and hangers required to support conduits and other electrical equipment. If the inserts, hangers, sleeves, or other mounting hardware are improperly placed, or installed, the Contractor shall do necessary work, at their own expense, to rectify the errors.
- I. Electrical equipment shall be capable of operating successfully at full-rated load, without failure, at an ambient air temperature of 40 degrees C, and specifically rated for the altitude indicated on the Plans. Electrical equipment not rated for operation at that temperature shall be provided with air conditioning to meet the manufacturers' operating temperature.
- J. If any contradictions, contrasts, non-homogeneity, or inconsistency appears, the strictest criteria noted and the collective requirements in any and all of the project documents shall apply.
- K. The Contractor shall perform necessary saw cutting, core drilling, excavating, removal, shoring, backfilling, and other work required for the proper installation of conduits, whether inside, or outside of the buildings and structures. The Contractor shall repair and patch where demolition has taken place in a manner to match existing original structure.

1.04 REGULATIONS, CODES, AND STANDARDS

- A. Electrical work, including connection to electrical equipment integral with mechanical equipment, shall be performed in accordance with the latest published regulations, codes, and standards, of the following:
 - 1. National Electrical Code (NEC)
 - 2. State and local codes
 - 3. Institute of Electrical and Electronic Engineers (IEEE)
 - 4. American National Standards Institute (ANSI)
 - 5. American Society for Testing and Materials (ASTM)
 - 6. Insulated Cable Engineers Association (ICEA)
 - 7. National Electrical Manufacturers Association (NEMA) Standards
 - 8. Federal Occupational Safety and Health Act (OSHA)
 - 9. National Fire Protection Association (NFPA)

B. When applicable, the material used in the performance of the electrical work shall be listed by the Underwriters' Laboratories, Inc. (UL) for the class of service for which they are intended.

1.05 SUBMITTALS

- A. It is the obligation of the Contractor to organize their work, so that a complete electrical, instrumentation, and control system for the facility will be provided, and will be supported by accurate shop and record drawings, and O&M manuals.
- B. The Contractor shall submit detailed shop drawings and data prepared and organized by the suppliers. The quantity of submittal sets required shall be as specified in the Contract Documents.
- C. The submittals shall be neatly grouped and organized by specification section number, and subsection. Related information shall be highlighted, and the specific product shall be marked. All submittals shall be complete and presented in one package. Incomplete submittals will be returned without review. If a portion of the project requires a fast track schedule, that portion only may be submitted earlier under a separate cover letter. The following shall be submitted to the Engineer and returned, reviewed to the Contractor before fabrication is started.
 - 1. A complete list of the equipment and materials, including the manufacturer's name, product specification, descriptive data, technical literature, performance charts, catalog cuts, installation instructions, and spare part recommendations for each different item of the equipment specified. The above shall clearly show all the specified requirements as described in the Specifications including but not limited to specific U.L. and NEMA rating, technical capabilities, test result verifications, Seismic Zone rating, and acceptance letters.
 - 2. Drawings containing complete wiring and schematic diagrams, control diagrams, and any other details required to demonstrate that the system has been coordinated and will operate as intended. Drawings shall also show proposed layout, anchoring, support, and appurtenances of equipment, and equipment relationship to other parts of the work including clearances for maintenance and operations.
 - 3. Any exceptions to these specifications, with the reasons for requesting such exceptions, with calculations and drawings for redesign of related components, including detail drawings showing internal and assembly details, with installation instructions. Proposed layout showing any modifications or exceptions to related work made necessary by this work, with calculations and drawings showing such modifications or exceptions.
 - 4. Prior to project acceptance, The Contractor shall submit "Record Drawings" of the electrical, control, and instrumentation, along with step-by-step procedure manuals for the installation, operation start-up, and maintenance of the equipment. Each set shall include installation, operating, troubleshooting, and maintenance and overhaul instructions in complete detail. It shall also include possible breakdowns and repairs, and troubleshooting guides, as well as simplified wiring and control diagrams of the system installed. This shall provide the Owner with comprehensive information on all systems and components to enable operation, service, maintenance and repair. Exploded or other detailed views of all equipment, devices, assemblies, and accessory components shall be included, together with complete parts lists and ordering instructions.

5. Record Drawings:

- a. The Contractor shall maintain a marked up set of Contract Document Plans showing actual installed circuit numbers, conduit sizes, cable tray routing, number of conductors, conductor sizes (larger than #12 AWG), and all other deviations from the design Plans.
- b. Underground conduit and concealed items shall be dimensioned on the Plans from permanent, visible, building features.
- c. The Contractor shall provide actual motor size, starter size, and overload heater size, along with all other protective equipment for all 480 V and motor circuits as part of the one-line record drawings.
- d. The Contractor shall revise all conductor identification and panel schedules to indicate as-built conditions.

PART 2 - PRODUCTS

2.01 MATERIALS AND METHODS

- A. Materials, equipment, and parts comprising any unit, or part thereof, specified or indicated on the Plans, shall be new and unused, of current manufacture, and of highest grade consistent with the state of the art. Damaged or dirty materials, equipment and parts, are not considered to be new and unused, and will not be accepted.
- B. Field verification of scale dimensions on Plans is directed, since actual locations, distances, and levels will be governed by actual field conditions. The Contractor shall also review architectural, structural, yard, mechanical, and other Plans, and the accepted electrical and mechanical shop drawings, and shall adjust their work to conform to the conditions indicated therein.
- C. The fabricator of major components, such as distribution panelboards, switchgear, and motor control centers, shall also be the manufacturer of the major devices therein. Were possible, the major components shall be manufactured and supplied by the same fabricator.
- D. Refer to various Division sections for individual equipment manufacturers. Indicated manufacturers are subject to strict compliance with the specifications and complete project documents. The reference to a particular manufacturer does not relieve the Contractor from conforming to the specified requirements.

2.02 NAMEPLATES

A. Where indicated elsewhere in these specifications, or on the Plans, the Contractor shall furnish and install nameplates, which shall be white laminate with black letters. The nameplates shall be fastened to the various devices with round head stainless steel screws. Each disconnecting means for service, feeder, branch, or equipment conductors shall have nameplates indicating its purpose.

2.03 EQUIPMENT ASSEMBLIES

A. Equipment assemblies, such as Service Entrance Sections, Switchgear, Switchboards, Control and Distribution Panels, and other custom fabricated electrical enclosures shall bear a UL label

as a complete assembly. The UL label on the individual components making up the assembly will not be considered sufficient to meet the present requirement. Whenever a generic UL label does not apply for the assembly, a serialized UL label shall be affixed to the assembly, and the serial number shall be submitted with the assembly record shop drawings.

B. Custom fabricated electrical control panels, and enclosures, shall bear a serialized UL or ETL label affixed by a local inspector, and the serial number shall be submitted with the assembly record shop drawings.

2.04 SEISMIC RESTRAINT

- A. The construction area is classified by the Uniform Building Code (UBC) as Seismic Zone III. The Code requires that not only the structures, but also major electrical components be designed and installed in a manner which will preclude damage during a seismic event. All electrical equipment shall be securely anchored and seismic braced in accordance with regulations contained in the most recent adopted edition of the UBC, and the Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) "Guidelines for Seismic Restraints of Electrical Systems".
- B. Units mounted and secured directly to structure shall be provided with connectors of sufficient strength to meet the restraining criteria.
- C. All electrical equipment which is securely anchored (hard mounted) to the building or structure shall have supports designed to withstand lateral and vertical "G" loadings equal to or greater than UBC requirements and SMACNA guidelines.
- D. Shop drawings are required for all equipment anchors, supports and seismic restraints. Submittals shall include weights, dimensions, load/deflection data, center of gravity, standard connections, manufacturer's recommendations, and behavior problems (vibration, thermal, expansion, etc.) associated with equipment.

PART 3 - EXECUTION

3.01 UTILITY SERVICE AND EQUIPMENT

- A. The Contractor shall be responsible for contacting and coordinating the electrical utility work with the electrical utility company. The Contractor shall be responsible for furnishing and installing equipment and material required to bring electrical power service to the service location in conformance with the electrical utility requirements. The Contractor may have to provide the following for the electrical utility company's primary (from utility power line to the utility transformer) and secondary (from utility transformer to the service) electrical lines in accordance with the electrical utility company's specifications and requirements:
 - 1. Conduits and cables (verify quantity and sizes)
 - 2. Trenching, backfill, and compacting (verify trench size(s), backfill material, and compaction percentage requirements)
 - 3. Concrete pad(s) (for pad mounted transformer(s))
 - 4. Cable protection along the vertical drop at the utility company's pole (if pole mounted transformer(s))
 - 5. Other items required by the power utility company's specifications

6. The Contractor shall also submit copies of service entrance shop drawings to the utility, per utility submittal requirements, prior to submittal to the Engineer. The Contractor shall obtain written approval from the power utility company that the service entrance equipment is acceptable prior to release the order to the supplier for fabrication. A copy of the approval letter from the utility shall be transmitted to the Engineer along with the submittal.

3.02 INSTALLATION OF ELECTRICAL EOUIPMENT

- A. Coordinate the installation of electrical equipment with other trades.
 - 1. Arrange for the building in of equipment during structure construction.
 - 2. Where equipment cannot be built-in during construction, arrange for sleeves, box-outs, and other openings, as required to allow installation of equipment after structure construction is complete.
- B. Verify that equipment will fit support layouts indicated.
- C. Equipment Dimensions and Clearances:
 - 1. Do not use equipment that exceeds the indicated dimensions.
 - a. Except as approved in writing by the Engineer.
 - 2. Do not use equipment or arrangements of equipment that reduce required clearances or exceed the space allocation.
- D. Install equipment in accordance with the manufacturer's instructions.
- E. Equipment Access:
 - 1. Install equipment so it is readily accessible for operation and maintenance.
 - 2. Equipment shall not be blocked or concealed.
 - 3. Do not install electrical equipment such that it interferes with normal maintenance requirements of other equipment.
- F. Equipment shall be installed plumb, square and true with the building construction, and shall be securely fastened.
- G. Outdoor wall-mounted equipment, and indoor equipment mounted on earth, or water bearing walls, shall be provided with corrosion-resistant spacers to maintain ¹/₄-inch separation between the equipment and the wall.
- H. Screen or seal all openings into outdoor equipment to prevent the entrance of rodents and insects.
- I. Equipment fabricated from aluminum shall not be imbedded in earth or concrete.
- J. Provide all necessary anchoring devices and supports.
 - 1. Use supports as detailed on the Plans and as specified.
 - 2. Supports and anchoring devices shall be rated and sized based on dimensions and weights verified from approved equipment submittals.

- 3. Hardware shall be stainless steel.
- 4. Do not cut, or weld to, building structural members.
- 5. Do not mount safety switches and external equipment to other equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.
- K. Contractor shall verify exact rough-in location and dimensions for connection to electrical items furnished by others.
 - 1. Shop drawings shall be obtained from those furnishing the equipment.
 - 2. Proceeding without proper information may require the Contractor to remove and replace work that does not meet the conditions imposed by the equipment supplied.
 - 3. Provide sleeves wherever openings are required through new concrete or masonry members. Place sleeves accurately and coordinate locations with the Engineer.
 - 4. Should any cutting and patching be required on account of failure of the Contractor to coordinate penetrations, such cutting and patching shall be done at the expense of the Contractor.
 - a. The Contractor shall not endanger the stability of any structural member by cutting, digging, chasing, or drilling and shall not, at any time, cut or alter the work without the Engineer's written consent.
 - 1) Provide additional reinforcing if required.
 - 2) Cutting shall be done neatly using proper tools and methods.
 - b. Subsequent patching to restore walls, ceilings, or floors to their original condition shall be done by the Contractor.
- L. Provide concrete foundations or pads required for electrical equipment as indicated or specified.
 - 1. Floor-mounted equipment shall be mounted on a 3-inch concrete housekeeping pad unless otherwise noted on the drawings. Pad shall be poured on top of the finished floor or slab. Contractor shall verify the distance to all equipment from the finished floor meets the current NEC requirements. All modifications shall be made to the electrical equipment as required.
 - 2. All conduits penetrating concrete floors shall have a 3-inch concrete housekeeping pad unless otherwise noted on the drawings. Conduits should be grouped as allowed to limit the number of housekeeping pads required.

3.03 TEMPORARY POWER

A. The Contractor shall furnish, install, and maintain, temporary power and lighting systems needed for construction. This temporary system shall include weatherproof panel(s) for the Contractor's main breakers and distribution system. Ground fault interrupting equipment shall be installed. Connections shall be watertight, with wiring done with Type SO portable cable. After construction is completed, the Contractor shall remove temporary power equipment and devices.

3.04 CUTTING AND REPAIRING

- A. Where it becomes necessary to cut into existing work for the purpose of making electrical installations, core drills shall be used for making circular holes. Other demolition methods for cutting or removing shall be reviewed by the Engineer prior to starting the work.
- B. The Contractor shall repair damage caused by construction, or demolition work, and restore damaged areas to original condition.

3.05 CORROSION PROTECTION

- A. Wherever dissimilar metals, except conduit and conduit fittings, come in contact, the Contractor shall isolate these metals, as required, with neoprene washers, 9 mil polyethylene tape, or gaskets. Where fastening conduit, electro plated, or equivalent fasteners and stainless steel bolts shall be used.
- B. Factory finishes damaged during shipping, or construction, shall be restored to original new condition. Rust shall be removed, and bare metal surfaces shall be primed and painted to match the original surrounding finish.
- C. Electrical panels, switchgear, motor control centers, and other electrical equipment, shall be shipped in sealed dust and moisture proof plastic sheet enclosures, and the seal maintained until units are installed. Said units shall be new and free of any dirt, dust, water, grease, rust, damaged parts or components. Relays, starters, circuit breakers, switches, contacts, insulators, mechanisms, and buses shall be free of dust, dirt, oil, moisture, metal shavings, and other debris before testing and energizing.
- D. Equipment shall be protected at all times with plastic sheet covers until the area is free of dirt, dust, paint spray, water, heat, and other trades. Heat shall be provided to eliminate condensation. All repairs due to storage will be the responsibility of the contractor.

3.06 COORDINATION OF THE ELECTRICAL SYSTEM

A. The Contractor shall verify actual equipment, and motor full-load, and locked-rotor current ratings. The necessary minimum equipment, wire, and conduit sizes are indicated on the Plans. If the Contractor furnishes equipment of different ratings, the Contractor shall coordinate the actual current rating of equipment furnished with the branch circuit conductor size, the overcurrent protection, the controller size, the motor starter, and the branch circuit overcurrent protection. The branch circuit conductors shall have a current carrying capacity of not less than 125 percent of the actual full-load current rating. The size of the branch circuit conductors shall be such that the voltage drop from the overcurrent protection devices, up to the equipment, shall not exceed 2 percent, when the equipment is running at full-load and rated voltage.

3.07 TESTING

A. The electrical work shall be free from improper grounds, and from short circuits. The correctness of the wiring shall be verified first by visual comparison of the conductor connections with connection diagrams. Next, individual circuit continuity checks shall be made by using electrical circuit testers. Last, the correctness of the wiring shall be verified by the actual electrical operation of the electrical and mechanical devices. Any deviation from the

- wiring indicated on the Plans, or accepted Drawings, shall be corrected and indicated on the record drawings.
- B. Each conductor shall be identified as required by the Contract Documents. This identification shall be indicated on the record drawings to enable rapid and accurate circuit tracing by maintenance personnel.

3.08 ONE-LINE DIAGRAMS

A. One-line diagrams, as indicated on the Drawings, show circuit voltages, circuit protection rating, and other pertinent data. Where conflicts exist on the Drawings, the one-line diagrams shall take precedence. Grounding conductors are not necessarily indicated. See grounding requirements specified elsewhere herein.

END OF SECTION

SECTION 26 01 27 - ELECTRICAL ACCEPTANCE TESTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

- 1. Requirements for electrical acceptance testing of electrical equipment and materials.
- 2. It is the intent of the tests described herein to assure that all electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.
- 3. Acceptance testing performed by equipment vendors at the point of manufacturer must conform to all requirements of this specification. Testing performed at the point of manufacture which conforms to generally accepted industry practices is also acceptable so long as adequate test result documentation is provided.

B. Scope

- 1. All of the Acceptance Tests are required to be performed whether they are described in this Section or other applicable Sections. At a minimum, the following electrical systems are to be tested:
 - a. Service Entrance Section
 - b. Switchboards, Lighting and Panelboards
 - c. Transformers, Dry Type and Oil Filled
 - d. Feeders
 - e. Transfer Switches, Manual and Automatic
 - f. Transient Voltage Surge Suppression Systems
 - g. Grounding and Bonding System
 - h. Lighting Fixtures and associated controls
 - i. Other systems as listed under Part 3 of this specification

C. Related Documents

- 1. Drawings and general provisions of the contract, including General and Supplementary Conditions and other Division 1 Specification sections, apply to the work of this section.
- 2. All work performed under this Section of the work is subject to all requirements contained under Section 26 00 00 "General Electrical Requirements".
- 3. All Division 26 specifications for electrical equipment provided for this project that requires electrical acceptance testing.

1.02 REFERENCES

- A. NETA ATS Acceptance Testing Specifications, 2003 Edition
- B. NFPA 70 National Electrical Code, 2011 Edition

C. Incorporated by reference all Codes, Standards, and Specifications referred to in the "APPLICABLE REFERENCES" section of NETA ATS-2003.

1.03 DEFINITIONS

- A. NETA InterNational Electrical Testing Association Inc.
- B. NEC National Electrical Code

1.04 SYSTEM DESCRIPTION

A. Conditions

- 1. Provide all items, articles, materials, operations or methods listed, mentioned or scheduled on drawings and/or herein including all labor, materials, equipment and incidentals necessary and required for Electrical Acceptance Testing.
- 2. Following established procedures, equipment shall be energized after certification by the testing organization that the installation is satisfactory.
- 3. Correct or replace any current-carrying circuit, electrical equipment, or system which is defective or grounded and correct all other troubles encountered by these tests. All defects, whether through faulty workmanship or materials furnished, shall be corrected under this Section at the Contractors expense.

1.05 SUBMITTALS

A. Test Report Forms

- 1. All test reports shall be submitted using NETA or approved similar format and, where appropriate, test forms. Reports shall be legible using permanent ink. Pencil is not acceptable.
- 2. Provide for engineers review and approval a copy of each test form to be used on the project. No testing shall be started prior to approval of all test forms.
- 3. All test reports shall include the following information:
 - a. Summary/Description of the Project
 - b. Description of equipment tested.
 - c. Description of the tests.
 - d. Test data and analysis of the data indicating whether the equipment passed or failed the test.
- 4. All test data records shall include the following minimum requirements:
 - a. Equipment identification including tag numbers.
 - b. Humidity, temperature, and other conditions that may affect the results of the tests and/or calibrations.
 - c. Date of inspections, tests, maintenance, and/or calibrations.
 - d. Identification of the testing technician and their employer.

- e. Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.
- f. Indication of expected results when calibrations are to be performed.
- g. Indication of "as-found" and "as-left" results, as applicable.
- h. Sufficient spaces to allow all results and comments to be indicated.

B. Closeout Submittals

- 1. Provide one copy each to engineer and owner of all testing reports organized as follows:
 - a. Bind report in 3-ring binder(s).
 - b. Identify project name, description, testing organizations name, and submittal date on front face and back cover of binder.
 - c. Provide all test reports, organized by equipment tag number.
 - d. Separate different equipment numbers with colored or numbered tabs.
 - e. Provide an index/table of contents.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Any materials provided as part of the testing shall be new, unused, and in manufacturer's original packing.

2.02 TEST INSTRUMENT CALIBRATION

- A. Contractor performing the testing shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy for each test instrument calibrated.
- B. Contractor performing the testing shall maintain up-to-date instrument calibration instructions and procedures for each test instrument calibrated.
- C. It is preferred that instrument calibration accuracy be directly traceable to the national Institute of Standards and Technology (NIST).
- D. Instruments shall be calibrated in accordance with the following frequency schedule:
 - 1. Field instruments: Analog, 12 months maximum. Digital, 12 months maximum
 - 2. Laboratory instruments: 12 months maximum
 - 3. Leased specialty equipment: 12 months maximum.
- E. Dated calibration labels shall be visible on all test equipment.
- F. Records, which show date and results of instruments calibrated or tested, must be kept up to date.
- G. Calibrating standard shall be better accuracy than that of the instrument tested.

PART 3 - EXECUTION

3.01 QUALIFICATIONS

- A. It is preferred that the testing organization shall be an independent, third party entity which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems being evaluated. When such testing organization is used, it must meet the following requirements:
 - 1. The testing organization shall be regularly engaged in the testing of electrical equipment, devices, installations, and systems.
 - 2. The testing organization shall use technicians who are regularly employed for testing purposes.
 - 3. The testing organization shall be a member of NETA or be able to prove qualifications equal to or better than required for membership in NETA.
 - 4. Submit appropriate documentation demonstrating that the testing organization meets the requirements listed above.
 - 5. Technicians performing these electrical tests and inspections shall be trained and experienced concerning the apparatus and systems being evaluated. These individuals shall be capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved. They must evaluate the test data and make a judgment on the serviceability of the specific equipment.
 - 6. Technicians shall be certified in accordance with ANSI/NETA ETT-2000, "Standard for Certification of Electrical Testing Personnel". Each on-site crew leader shall hold a current certification, Level III or higher, in electrical testing.
- B. Contractor may perform the electrical acceptance testing under the following conditions:
 - 1. Contractor's personnel performing the testing and their testing equipment meets all other requirements of this specification.
 - 2. Written approval is received from engineer after review of testing personnel qualifications. At a minimum, contractor's testing personnel must have specific instruction on the testing instruments, accessories, and tests being performed and must be able to evaluate the test results.

3.02 NOTIFICATION

A. Notify engineer and construction manager at least 2 days prior to testing so that they may be present during testing.

3.03 SAFETY AND PRECAUTIONS

- A. Safety practices shall include, but are not limited to, the following requirements:
 - 1. Occupational Safety and Health Act OSHA
 - 2. Accident Prevention Manual for Industrial Operations, National Safety Council, Chapter 4
 - 3. Applicable State and Local safety operating procedures

- 4. NETA Safety/Accident Prevention Program
- 5. National Fire Protection Association –NFPA 70E
- 6. ANSI Z244.1 American National Standards for Personnel Protection
- B. All tests shall be performed with apparatus de-energized except where otherwise specifically specified.
- C. The testing firm shall have a designated safety representative on the project to supervise operations with respect to safety.

3.04 EQUIPMENT TESTING REQUIREMENTS

- A. The intent of this specification is not to duplicate testing performed at the point of manufacture or to impose additional burden on the contractor which does not benefit the project. The intent is to verify that electrical equipment has been securely fastened down, supported, and installed in accordance with the manufacturer's requirements. The intent is also to verify that all electrical connections are correctly torqued, properly aligned, properly insulated, and properly supported and that equipment is clean and ready for operation.
- B. Except as noted below or as approved by engineer, test the following equipment and assemblies in full accordance with NETA-ATS 2003.
- C. Cables, Low-Voltage, 600 Volt Maximum
 - 1. Perform tests only on cables size #4 AWG and larger.
- D. Circuit Breakers, Air, Insulated-Case, Molded-Case
 - 1. Perform visual and mechanical inspections in accordance with NETA for all circuit breakers.
 - 2. Perform electrical tests only on circuit breakers rated 100 amps or higher provided in power distribution and lighting/receptacle panelboards.
 - 3. No testing is required for circuit breakers provided as part of any of the following:
 - a. A UL listed control panel.
 - b. UL listed factory supplied motor control centers.
 - c. Stand-alone combination motor starters.
- E. Rotating Machinery, AC Motors and Generators
 - 1. Motors provided as part of valve actuators do not require testing.
 - 2. Perform visual and mechanical inspections on all motors.
 - 3. Perform rotation tests on all motors.
 - 4. Perform electrical tests only on motors 50 horsepower and larger.
- F. Motor Control, Motor Starters, Low-Voltage

3.05 CONSTRUCTION

- A. Interface with Other Work
 - 1. Coordinate all testing activities with other disciplines. Retest any equipment disturbed or damaged in any manner after initial testing.

3.06 CLOSEOUT REPORT

A. Provide comprehensive bound test report in accordance with Part 1 of this specification.

END OF SECTION

SECTION 26 05 05 - CONDUITS

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish and install conduits as required, and as shown on the Plans. Materials employed shall be as shown on the Plans.

1.02 SUBMITTALS

- A. Submit product literature including manufacturer part number, model number, material, size, and specifications. Material shall not be installed until the Engineer has reviewed the submittal data.
- B. Shop Drawings shall be submitted for review and acceptance showing routing, conduit size, and number and size of wires in each conduit before installation of conduit and any related work.
- C. Proposed routing of conduits buried under floor slabs-on-grade.
- D. Identify conduit by tag number of equipment served or by circuit schedule number.
- E. Proposed routing and details of construction including conduit and rebar embedded in floor slabs, columns, etc. Identify conduit by tag number of equipment served or by circuit schedule number.
- F. Proposed location and details of construction for openings in slabs and walls for raceway runs.
- G. Refer to **Section 26 00 00** for further submittal requirements.

1.03 REFERENCES

- A. American National Standards Institute (ANSI): C80.1, Rigid Steel Conduit Zinc-Coated.
- B. National Electric Manufacturers Association (NEMA): RN-1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit.
- C. Underwriters Laboratories Inc. (UL):
 - 1. 1. Flexible Metal Conduit.
 - 2. 6, Rigid Metal Conduit.
 - 3. 360, Liquid-Tight Flexible Steel Conduit.
 - 4. 467, Grounding and Bonding Equipment.
 - 5. 514, Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers.
 - 6. 651, Schedule 40 and 80 Rigid PVC Conduit.
 - 7. 870, Wireways, Auxiliary Gutters, and Associated Fittings.
 - 8. 884, Underfloor Raceways and Fittings.
 - 9. 886, Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

PART 2 - PRODUCTS

2.01 RACEWAYS

- A. Exposed conduit in an unclassified or hazardous area shall be galvanized rigid steel (GRS) unless specifically indicated otherwise on the Plans. Conduits in the corrosive areas shall be PVC coated GRS unless otherwise indicated. Underground and/or concrete encased conduits shall be PVC, unless otherwise indicated. All wiring, except as otherwise noted, shall be in conduit. Conduit size shall not be less than the National Electrical Code (NEC) size required for the conductors therein and shall not be smaller than 3/4-inch. No underground conduit shall be less than one inch.
- B. Condulet type fittings shall be Crouse-Hinds, Appleton, or equal with wedge nut covers. All condulets located outdoors or in wet locations shall be weathertight.
- C. In unclassified areas, flexible conduit shall be grounding type, weatherproof, corrosion resistant, and watertight.
- D. Couplings, connectors, and fittings shall be standard types specifically designed and manufactured for the purpose. They shall be installed to provide a firm mechanical assembly and electrical conductivity throughout.
- E. Expansion fittings shall be OZ type AX with jumper for exposed locations and type DX at structural expansion joints, Spring City, or equal. Conduits shall have expansion fittings in accordance with NEC.
- F. The conduits and fittings shall be supported per NEC requirements as a minimum.

2.02 GALVANIZED RIGID STEEL (GRS)

- A. Conduit and couplings shall be hot-dipped galvanized with zinc coated threads and outer coating of zinc bichromate, in accordance with ANSI C80.1 standards, as manufactured by Jones & Laughlin Steel Corporation, Allied Tube & Conduit Corporation, Triangle PWC, or equal.
- B. Steel conduit shall not be buried in earth without concrete encasement and additional corrosion protection. A half lapped rapping of 20 mil PVC based corrosion protection tape shall be used.

2.03 PVC COATED GALVANIZED RIGID STEEL (PVC-GRS)

- A. PVC coated GRS conduit shall be installed where shown on the Plans or elsewhere specified and shall conform to NEMA RN-1 and ANSI C80.1 standards.
- B. The zinc surface of the conduit shall remain intact and undisturbed on both the inside and the outside of the conduit throughout the preparation and application processing. A Polyvinyl Chloride (PVC) coating shall be bonded to the galvanized outer surface of the conduit. The bond between the PVC coating and the conduit surface shall be greater than the tensile strength of the plastic. The thickness of the PVC coating shall be a minimum of 0.040-inch (40 mil).
- C. A loose coupling shall be furnished with each length of conduit. A PVC coating shall be bonded to the outer surface of the coupling and a PVC sleeve equal to the outside diameter of the

- uncoated conduit shall extend beyond both ends of the coupling approximately one pipe diameter or 1-1/2 inches, whichever is smaller. The wall thickness of the coating on the coupling and the sleeve shall be a minimum of 0.055-inch (55 mil).
- D. A PVC coating shall be bonded to the inner and outer surface of all conduit bodies and fittings and a PVC sleeve shall extend from all hubs. The wall thickness of the coating on conduit bodies and fittings and the sleeve walls shall be identical to those on couplings in length and thickness. The covers on all conduit bodies shall be coated on both sides and shall be designed to be completely interchangeable. The inside of conduit bodies shall remain undisturbed in the processing.
- E. Type 304 stainless steel screws shall be furnished and used to attach the cover to the conduit body. All coated material shall be installed and patched according to the manufacturer's recommended installation and patching instructions.
- F. Conduit straps shall be PVC coated or stainless steel.
- G. PVC coated conduit and fittings shall be as manufactured by Kor Kap Corporation, Occidental Coating Company, Rob-Roy, or equal.
- H. PVC coated flexible conduits shall be liquid and vaportight and manufactured in accordance with UL 360 standards.

2.04 RIGID NONMETALLIC - PVC

- A. Where specifically indicated on the Plans, or elsewhere specified, conduit may be high density Schedule 40, 90 degrees C, heavy-duty PVC. The conduit shall be manufactured from virgin polyvinyl chloride compound which meets ASTM D1784, NEMA TC-2, ANSI C33.91, and UL 651 standards. Smoke emissions shall be limited to less than 6 grams per 100 grams of material tested.
- B. Where conduit concrete encasement is indicated on the Plans, conduit supports shall be installed at five-foot intervals. PVC conduit shall be manufactured by Carlon, Triangle Conduit & Cable, or equal.

2.05 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Liquidtight flexible metal conduit shall be liquid and vaportight, oil and ultraviolet ray resistant and manufactured in accordance with UL 360 standards. Liquidtight flexible metal conduit shall be formed of a continuous, spiral wound, galvanized steel core with an extruded PVC jacket. The PVC jacket shall be rated for high ambient heat applications, 90 degrees Celsius.
- B. For corrosive locations, liquidtight flexible metal conduit shall be formed of a continuous, spiral wound, aluminum core with an extruded PVC jacket. The PVC jacket shall be impervious to corrosive liquids and vapors.
- C. An external bonding conductor shall be required for flexible conduit connections containing circuits rated at 60 amps or greater and for sizes 1 1/2 " or larger. Flexible conduit and connectors for 1 1/4 " and smaller shall be listed for grounding.

D. Connectors for liquidtight flexible conduit shall be galvanized, furnished with a sealing ring and locknut, and suitable for wet locations.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Conduit runs are schematic only, and shall be modified as required to suit field conditions, subject to review and acceptance by the Engineer.
- B. Conduit shall run continuously between outlets and shall be provided with junction boxes where connections are made. Couplings, connectors, and fittings shall be acceptable types designed and manufactured for the purpose, and shall provide a firm mechanical assembly, and electrical conductivity throughout.
- C. Conduit runs shall be straight and true. Elbows, offsets, and bends shall be uniform and symmetrical. Changes in direction shall be made with long radius bends, or with fittings of the condulet type.
- D. Conduit runs in buildings and structures shall be exposed except as specifically noted, or accepted by the Engineer.
- E. Conduit runs shall not interfere with the proper and safe operation of equipment, and shall not block or interfere with ingress or egress, including equipment removal hatches.
- F. Exposed conduits shall be securely fastened with clamps, or straps, intended for conduit use. All exposed conduit shall be run on the walls and ceiling only and shall be parallel to the planes of the walls or ceiling. No diagonal runs will be permitted. Flexible conduit shall be used only for short lengths required to facilitate connections between rigid conduit to motors from junction boxes, or control equipment. The maximum length of flexible conduit shall be 3 feet.
- G. Conduit runs on water-bearing walls shall be supported one inch away from the wall on an accepted channel. When channel galvanizing, or other coating, is cut or otherwise damaged, it shall be field coated to original condition. No conduit shall be run in water-bearing walls, unless specifically designated otherwise.
- H. Conduit shall be thoroughly reamed to remove burrs. IMC or GRS shall be reamed during the treading process, and Rigid Nonmetallic PVC shall be reamed before applying fittings. A zinc rich cold galvanizing shall be used to restore corrosion protection on field cut threads. Bushings and lock nuts or hubs shall be used at conduit termination's. The total number of bends in any run between pull points shall not exceed 360 degrees. Junction boxes and pull boxes shall be installed at points acceptable to the Engineer. Conduit ends shall be plugged to prevent the entrance of moisture or debris during construction. All spare conduits shall be adequately capped and shall contain a suitable pull string.
- I. Joints shall be set up tight. Hangers and fastenings shall be secure, and of a type appropriate in design, and dimensions, for the particular application.
- J. Conduit runs shall be cleaned and internally sized (obstruction tested) so that no foreign objects, or obstructions remain in the conduit prior to pulling in conductors.

- K. After installation of complete conduit runs 2 inches and larger, conduits shall be snaked with a conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85 percent of the nominal diameter of the conduit. Conduits through which the mandrel will not pass shall not be used.
- L. Expansion fittings shall be installed across all expansion joints and at other locations where necessary to compensate for thermal expansion and contraction.
- M. Provide trenching, backfill, and compaction for conduits installed underground.

END OF SECTION

SECTION 26 05 15 – INSTRUMENTATION AND COMMUNICATION CABLE

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section covers cable use for process signal and controls.

1.02 SUBMITTALS

A. Products shall be submitted in accordance with **Section 26 00 00**, and elsewhere in the Contract Documents, prior to installation.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with Contract Documents, the instrumentation cable shall be as manufactured by Belden, Okonite, or equal. Communication cable shall be by Belden, Smartech, Southwire, True Cable, or equal.

2.02 INSTRUMENTATION CABLE

- A. Instrument cable shall be Type TC and have the number of individually shielded twisted pairs indicated on the Plans and shall be insulated for not less than 600 volts. Unless otherwise indicated, conductor size shall be No. 18 AWG minimum. Shielded, grounded instrumentation cable shall be used for all analog and low voltage digital signals.
- B. The jacket shall be flame retardant with 90 degrees C temperature rating. The cable shield shall be a minimum of 2.3 mil aluminum or copper tape overlapped to provide 100 percent coverage and a tinned copper drain wire.
- C. The conductors shall be bare soft annealed copper, Class B, 7 strand minimum concentric lay with 15 mils nominal thickness, nylon jacket, 4 mil nominal thickness, 90 degrees C temperature rating. One conductor within each pair shall be numerically identified.
- D. Pairs shall be assembled with a nominal 2-inch lay and shall then be group shielded with a minimum of 1.3 mil aluminum or copper tape overlapped to provide 100 percent coverage. All group shields shall be completely isolated from each other.

2.03 COMMUNICATION CABLE

- A. Communication cable shall be type CAT 6, and have four twisted pairs of 23 AWG solid copper conductors. Pairs shall be blue white/blue; green white/green; orange white/orange; and brown white/brown.
- B. Cable shall be shielded with a aluminum fold shield and copper drain wire.

C. Jacket shall be HDPE insulation (CMI-75E) with nominal wall thickness of 0.585 mm or greater. Jacket shall be rated for 75deg C operation.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Feeder and branch circuits shall be isolated from each other, and from instrumentation and control circuits. Instrumentation cables shall be installed in separate raceways from other cables and wiring. This includes portions running through manholes. Instrumentation cable shall be continuous between instruments or between field devices and instrument enclosures. There shall be no intermediate splices or terminal boards, unless otherwise shown on the Plans.
- B. Maintain electrical continuity of the shield when splicing twisted shielded pair conductors. Drain wires shall be terminated inside enclosures at grounded terminal blocks. Only one end of each instrument loop cable drain wire shall be grounded. Ground drain wire of shielded conductors at one end only.
- C. Terminate instrumentation and control wiring, including spare wires, at control panels and motor control centers on terminal boards mounted inside the equipment.
 - 1. Contractor shall supply terminal boards as required.
 - 2. Do not field wire directly to devices.

END OF SECTION

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section covers the furnishing and installation of 600 Volt Class cables and conductors, terminations and splicing, and pulling lubricants.

1.02 SUBMITTALS

A. Products shall be submitted in accordance with Section 26 00 00, and elsewhere in the Contract Documents, prior to installation.

1.03 REFERENCES

- A. Insulated Cable Engineers Association/National Electrical Manufacturers Association (ICEA/NEMA):
 - 1. S-68-516/WC 8, ethylene-propylene rubber-insulated wire and cable for the transmission and distribution of electrical energy.
 - 2. S-61-402/WC 5, thermoplastic-insulated wire and cable for the transmission and distribution of electrical energy.
 - 3. S-66-524/WC 7, cross-linked thermosetting-polyethylene-insulated wire and cable for transmission and distribution of electrical energy.
- B. Underwriters Laboratory, Inc.
 - 1. 44, rubber insulated wires and cables.
 - 2. 83, thermoplastic-insulated wires and cables.
 - 3. 486A, wire connectors and soldering lugs for use with copper conductors.
 - 4. 486B, wire connectors for use with aluminum conductors.
 - 5. 510, insulating tape.
- C. National Electrical Code

PART 2 - PRODUCTS

2.01 ACCEPTED MANUFACTURERS

A. Conductors and Multi Conductor Cables (MCC), subject to compliance with Contract Documents, the following manufacturers are acceptable: American Insulated Wire Corporation, Cablec Corporation, Okonite Company, Southwire Company, Encore, or equal.

2.02 CONDUCTORS

A. Wire sizes shall be American Wire Gauge (AWG) sizes with Class B stranded construction. Number 2 AWG and smaller shall be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables shall be

- coded by the use of colored tape. Conductors sized # 1 and larger shall be Type 2, rated for 90 degrees C. All circuit conductors, #6 or smaller shall be "THWN" stranded copper. All other conductors shall be "XHHW-2" stranded copper.
- B. Individual or multiple conductor cables for power, control, and alarm circuits of 480 volts or less shall be insulated for not less than 600 volts and shall have insulation type as indicated on the Drawings. "THHW" shall conform to ICEA S-61-402/NEMA WC 5 and UL 83 and "XHHW" shall conform to ICEA S-66-524/NEMA WC 7 and UL 44. Where wire size is not indicated, they shall be of the size required by the NEC, except that no wire external to panels and motor control centers shall be less than No. 12 AWG, unless specifically noted on the Drawings. Panel control wiring shall not be less than No. 14 AWG.
- C. All wiring shall be as indicated on the Drawings. Wires shall be new and shall be soft drawn copper with not less than 97 percent conductivity. The wire and cable shall have size, grade of insulation, voltage, and manufacturer's name permanently marked on the outer covering at not more than 2-foot intervals. All wires shall conform to the latest Standards of the ASTM, and ICEA, and shall be tested for their full length by these Standards. Insulation thickness shall be not less than that specified by the National Electrical Code.
- D. Power conductors for lighting and receptacles only may utilize "THWN" solid conductors.

2.03 TERMINATIONS AND SPLICES

- A. Cable shall be rated 600 volts. Other parts of cable systems such as splices and terminations shall be rated at not less than 600 volts. Splicing shall join conductors mechanically and electrically to provide a complete circuit prior to installation of insulation.
- B. Splices in wires No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, Type I, Class 1, Grade B, Style G, or Type II, Class 1 of FS W-S-610 and conforming to the applicable requirements of UL 486A.
- C. Splices in wires No. 8 AWG and larger shall be made with non-insulated, solderless, pressure type connector, Type II, Class 2 of FS W-S-610, conforming to the applicable requirements of UL 486A and UL 486B. They shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket.
- D. Insulated conductor splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.
- E. Bare conductor splices in wet locations or below grade shall be of the exothermic type.

2.04 PULLING LUBRICANT

- A. All cables shall be properly coated with pulling compound such as ClearGluide, Aqua Gel, Polywater, or equal before being pulled into conduits so as to prevent mechanical damage to the cables during installation. "Yellow 77" is not acceptable.
- B. Other lubricants to be substituted must be accompanied by a statement from the cable manufacturer as to its acceptable use with the cable being installed.

2.05 IDENTIFICATION

- A. All conductors shall be numbered with "tube sleeve" type tags with heat impressed letters and numbers.
- B. Color code all wiring as follows:
 - 1. Lighting and power wiring:

CONDUCTOR	120/208 VAC	<u>480VAC</u>	<u>24V DC</u>	120 VAC Control/ Power
Phase 1	Black	Brown	Blue	Red
Phase 2	Red	Orange	(-) Blue w/ white	
			stripe	
Phase 3	Blue	Yellow		
Neutrals	White	White or Gray		White

2. Color code ends of feeder phase conductors only.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The pulling tension and side-wall pressures, as recommended by the cable manufacturer, shall not be exceeded.
- B. As far as practical, all circuits shall be continuous from origin to termination without splices in intermediate pull boxes. Sufficient slack shall be left at the termination to make proper connections. In no case shall a splice be pulled into the conduit. Conductor splicing shall not be permitted without the Engineer's approval.
- C. Install all cables in conduit.
- D. Each feeder and branch circuit shall be installed in its own individual conduit unless combining feeder and branch circuits is permitted as defined in the following:
 - 1. As specifically indicated on the Drawings.
 - 2. For lighting, multiple branch circuits may be installed in a conduit as allowed by the NEC and with the wire ampacity derated in accordance with the requirements of the NEC. Conduit fill shall not exceed the limits established by the NEC.
 - 3. When field conditions dictate and written permission is obtained from the Engineer.
- E. Feeder and branch circuits shall be isolated from each other and from all instrumentation and control circuits.
- F. Control circuits shall be isolated from all other feeder, branch and instrumentation circuits, except as noted below.
 - 1. 12 V DC, 24 V DC and 48 V DC control circuits may be combined in common conduit.
 - 2. 125 V DC control circuits shall be isolated from all other DC and AC control circuits.

- 3. 120 V AC control circuits shall be isolated from all DC control circuits.
- G. Make splices only at pull or junction boxes.
 - 1. Crimp or indented-type connectors are not allowed, except for control circuits landed on terminal strips.

3.02 TESTING

A. In accordance with Specification 26 01 27 – ELECTRICAL ACCEPTANCE TESTING.

END OF SECTION

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. A ground grid system consisting of the indicated configuration of copper wires, and ground rods, or concrete encased grounding electrodes ("UFERs") shall be provided to minimize station potential gradient irregularities and drain leakage and fault currents to earth.
- B. Whether indicated on the Plans or not, neutral conductors, cable shields, metallic conduits, cable terminations, junction boxes, poles, surge arresters, and other noncurrent-carrying metallic parts of equipment shall be grounded.

1.02 SUBMITTALS

A. Products shall be submitted in accordance with **Section 26 00 00**, and elsewhere in the Contract Documents, prior to installation.

1.03 REFERENCES

A. National Electrical Code (NEC) Article 250

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. A resistance of not greater than 25 ohms shall be provided, unless otherwise specified. Ground resistances shall be measured as herein described. Resistances of systems requiring separate ground rods, rather than a counterpoise, shall be measured separately before bonding below grade. The combined ground resistance of separate systems bonded together below grade may be used to meet the specified ground resistance, but the minimum number of rods indicated must still be provided.

2.02 GROUND RODS

A. Ground rods shall be copper-clad steel conforming to UL 467, 3/4 inch in diameter by 10 feet in length. Unless otherwise indicated, ground rods shall be driven into the ground until tops of rods are approximately 6 inches below finished grade. In counterpoise systems, tops of ground rods shall be approximately at elevations of counterpoises. Where the specified ground resistance cannot be met with the indicated number of ground rods, additional ground rods, longer ground rods, or deep-driven sectional rods shall be installed and connected until the specified resistance is obtained, except that not more than three additional ground rods shall be required at any one installation. Ground rods shall be spaced as evenly as possible at least 6 feet apart and connected below grade.

2.03 CONNECTIONS

A. Connections above grade shall be made with bolted solderless connectors, and those below grade shall be made by a fusion-welding process. In lieu of a fusion-welding process, a compression ground grid connector of a type which uses a hydraulic compression tool to provide the correct circumferential pressure may be used. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

2.04 GROUNDING ELECTRODE CONDUCTOR

A. Service entrance ground wires shall be sized in accordance with NEC Table 250-94, unless otherwise indicated on the Plans. After being located to provide maximum physical protection, exposed ground wires shall be securely attached to structural supports at not more than 2-foot intervals with suitable fasteners. Bends greater than 45 degrees in ground wires are not permitted. Routing of ground conductors through concrete should be avoided, except where specifically called for in these Documents. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit, so as to provide an opening for the ground wire. The opening shall be sealed with a suitable compound after installation of the ground wire.

2.05 EQUIPMENT GROUNDING CONDUCTOR

A. Neutral conductors shall be grounded where indicated. Equipment grounding conductors shall be sized in accordance with NEC Table 250-95, unless otherwise indicated. Ground wires shall be protected by conduit, where such wires run exposed above grade in non-fence-enclosed areas, or are run through concrete construction. Where concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit, so as to provide an opening for the ground wire. The opening shall be sealed with a suitable compound after installation of the ground wire. Bends greater than 45 degrees in ground wire connections to the ground rods, or counterpoises are not permitted.

2.06 EQUIPMENT GROUNDING

A. Equipment frames of motor housings, metallic tanks, metallic equipment enclosures, metal splicing boxes, chain-link fencing, and other metallic noncurrent-carrying metal items, shall be grounded. Connections to earth shall be made in the same manner as required for system grounding. Equipment or devices operating at less than 750 volts may be connected to secondary neutral grounding electrodes.

2.07 SURGE ARRESTER GROUNDING

A. Surge arresters shall be grounded. Resistance to ground for intermediate-class arresters shall be not more than 10 ohms and for distribution-class arresters shall be not more than 25 ohms. Ground wire connections shall be not less than No. 4 AWG for distribution arresters and No. 1/0 AWG for intermediate arresters. Connections to earth shall be made in the same manner as required for neutral conductors. Surge arrester grounds may use the same ground wires provided for equipment operating at more than 750 volts. Surge arrester and secondary neutral grounds

shall be separate from and independent of each other but both grounds shall be bonded together below grade at the ground rods or may utilize a common counterpoise.

2.08 LIGHTING POLE GROUNDING

A. Base of lighting poles shall be connected to an adjacent ground rod as indicated on Plans. A ground connection from poles back to neutral ground points shall also be provided utilizing equipment grounding conductor.

2.09 METALLIC STRUCTURES

A. Metallic structures and buildings shall be grounded per NEC.

2.10 GROUNDING RINGS

A. When required, grounding rings shall be installed using bare copper cable with ground rods at least 25 feet intervals using thermoweld connecting means as indicated on Plans in accordance with NEC requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. It is the intent of these Contract Documents that all device and equipment grounds shall be run as a separate conductor in the conduit from the equipment to the distribution panels or system ground. Wireways and enclosures shall be properly bonded and grounded, and ground conductors shall be run for all circuits.
- B. Equipment cases and devices shall be grounded. Ground rods shall be driven, and concrete encased conduits installed, before a building, or structure is built, and ground conductors brought through the concrete to accessible points for grounding equipment. These systems shall be installed at each structure, where transformers, switchboards, panelboards, and MCCs are installed.
- C. Duct banks shall contain a concrete encased system bare copper ground conductor. The system ground conductors shall run continuously in duct banks, through handholes and other raceway boxes. The system ground shall be connected to the structure grounding systems to provide a continuous grounding system. Each metallic raceway, panel, switchboard, and other metallic devices associated with the electrical and control systems shall be bonded to this grounding system.
- D. Ground rod shall be installed not less than 6 inches below grade. Equipment, neutral, and surge arrester ground wires shall be connected to the ground grid as indicated.

3.02 TESTS

A. Pre-Energization Tests — Pre-energization tests shall include, but shall not be limited to tests that the equipment engineer is required to perform under paragraph "GENERAL REQUIREMENTS." No part of the electrical system shall be energized until all station

- grounding system components have been tested and demonstrated to comply with the requirements specified, and until associated test reports have been submitted and approved.
- B. Operating Test After the installation is completed, the Contractor shall conduct an operating test for approval. Equipment shall be demonstrated to operate in accordance with the requirements herein. Tests shall be performed in the presence of the Engineer. The Contractor shall furnish instruments and personnel required for the test.
- C. Ground-Resistance Measurements Ground-resistance measurements of each ground rod shall be taken and certified by the Contractor to the Engineer. No part of the electrical distribution system shall be energized prior to the resistance testing of that system's ground rods and grounding system and submission of test results to the Engineer. Test reports shall indicate the location of the ground rod and grounding system and the resistance and the soil conditions at the time the test was performed. When the building water service is used as a ground or part of the grounding system, ground-resistance measurements shall also be made of this connection. Ground-resistance measurements shall be made in normally dry weather, not less than 48 hours after rainfall, and with the ground under test isolated from other grounds. The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 142 and Std 81.

3.03 TEST RESULTS

A. The Contractor shall perform the above tests and submit a certified test report prior to energizing the equipment.

END OF SECTION

SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Electrical identification work specified in this section covers the following:
 - 1. Buried cable warnings
 - 2. Electrical power, control and communication conductors
 - 3. Operational instructions and warnings
 - 4. Danger signs
 - 5. Equipment/system identification signs

1.02 SUBMITTALS

- A. Submittals to the engineer shall include the following:
 - 1. Manufacturers data on electrical identification materials and products.
 - 2. Samples of each color, lettering style and other graphic representation required for each identification material or system.

1.03 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering electrical identification products maybe incorporated in the work include, but not limited to, the following:
 - 1. Brady, W.H. Co.
 - 2. Ideal Industries, Inc.
 - 3. Panduit Corp.
 - 4. Or equal

1.04 QUALITY COMPLIANCE

- A. Comply with applicable requirements of UL Std. 969, "Marking and Labeling Systems", pertaining to electrical identification systems.
- B. Comply with applicable requirements of NEMA Std. No's WC-1 and WC-2 pertaining to identification of power and control conductors.

PART 2 - PRODUCTS

2.01 GENERAL

A. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

2.02 COLOR-CODED CONDUIT MARKERS

- A. Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, plastic-sheet conduit markers, extending 360 degrees around conduits; designed for attachment to conduit by adhesive, adhesive lap joint of marker, matching adhesive plastic tape at each end of marker, or pretensioned snap-on. Except as otherwise indicated, provide lettering that indicates voltage of conductor(s) in conduit. Provide 8" minimum length for 2" and smaller conduit, 12" length for larger conduit.
- B. Unless otherwise indicated or required by governing regulations, provide white markers with black letters.

2.03 CABLE AND CONDUCTOR WIRE MARKERS

A. Cable and conductor wire markers shall be self laminating vinyl on white background, printed using a Brady TLS2200 printer, Seton printer, or equal. Handwritten wire markers are not acceptable.

2.04 SELF-ADHESIVE PLASTIC SIGNS

- A. Provide manufacturer's standard, self-adhesive or pressure-sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g., 208V, EXHAUST FAN, RECTIFIER.
- B. Unless otherwise indicated or required by governing regulations, provide white signs with black lettering.

2.05 LETTERING AND GRAPHICS

A. Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install electrical identification products as indicated, in accordance with manufacturer's written instructions, and requirements of NEC.
- B. Where identification is to be applied to surfaces that require finish, install identification after completion of painting.
- C. Comply with governing regulations and requests of governing authorities for identification of electrical work.

3.02 CONDUIT IDENTIFICATION

A. Where electrical conduit is exposed in spaces with exposed mechanical piping that is identified by a color-coded method, apply color-coded identification on electrical conduit in manner similar to piping identification. Except as otherwise indicated, use white as coded color for conduit.

3.03 CABLE/CONDUCTOR IDENTIFICATION

A. Apply cable/conductor identification, including voltage, phase and feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project's electrical work.

3.04 EQUIPMENT/SYSTEM IDENTIFICATION

- A. Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication-control-signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, 1/2" high lettering on 1-1/2" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:
 - 1. Panelboards, electrical cabinets and enclosures.
 - 2. Access panel/doors to electrical facilities.
 - 3. Major electrical switchgear.
- B. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with brass or stainless steel screws, except use adhesive where screws should not or cannot penetrate the substrate.

3.05 CIRCUIT IDENTIFICATION

- A. The 3-phase wires shall be identified at the switchgear, panelboards and motor control centers as Phases A, B, and C. At 277/480V, Phase A shall be brown, Phase B shall be orange, and Phase C shall be yellow. The neutral shall be gray.
- B. In addition to color coding all conductors, each conductor shall be identified in each pull box, manhole, panelboard, cable tray, or termination with circuit identification markers. This identification is applicable to all power, control, alarm, and instrumentation conductors and these markings shall be recorded on the Record Documents. Markers shall be slip-on PVC sleeve type as manufactured by Brady, Seton, or equal.
- C. Markers for other cabling shall be B-292 vinyl as manufactured by Brady, Seton, or equal.

D. Exposed medium voltage conduits shall be labeled at 50-foot intervals with 1-inch letters stating the voltage - example - "12,470 volts". Labels shall be vinyl plastic as manufactured by Brady, Seton, or equal.

3.06 AUTOMATIC EQUIPMENT WARNING SIGNS

- A. Permanent warning signs shall be mounted at all mechanical equipment that may be started automatically or from remote locations. Signs shall be in accordance with OSHA regulations and shall be suitable for exterior use. The warning signs shall be fastened with round head brass screws or bolts, located and mounted in a manner acceptable to the Engineer.
- B. Warning signs shall be 7 inches high by 10 inches wide, colored yellow and black, on not less than 18 gauge vitreous enameling stock. Sign shall read:

CAUTION
THIS EQUIPMENT STARTS
AUTOMATICALLY
BY REMOTE CONTROL

3.07 HIGH VOLTAGE WARNING SIGNS

- A. Permanent and conspicuous warning signs shall be mounted on all equipment, doorways to equipment rooms, pull boxes, manholes, where the voltage exceeds 600 volts.
- B. Signs shall be in accordance with OSHA regulation, and shall be suitable for exterior use. The warning signs shall be fastened with round head brass screws or bolts, located and mounted in a manner acceptable to the Engineer.
- C. Signs shall be 7 inches high by 10 inches wide, colored red and white, on not less than 18 gauge vitreous enameling stock. Sign shall read:

WARNING HIGH VOLTAGE KEEP OUT

3.08 CONDUCTOR FASTENERS

A. Glue-on type conductor fasteners shall not be used in any panels, panelboards, switchboards, switchgear, motor control centers, or other enclosures containing electrical devices and/or conductors.

END OF SECTION

SECTION 26 05 73 – ELECTRICAL SYSTEM STUDY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

- 1. Short Circuit fault analysis study
- 2. Protective device coordination study.
- 3. Arc-flash hazard study
- 4. Harmonic Distortion Testing

B. Related Sections

- 1. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work
- 2. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
 - a. Section 31 of the General Conditions
 - b. Section 3 General Electrical Requirements

1.02 REFERENCES

- A. As specified in Section 3.
- B. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. 141 IEEE Recommended Practice for Electric Power Distribution for Industrial Plants (Red Book).
 - 2. 242 IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).
 - 3. 399 IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis (Brown Book).
 - 4. 1584 IEEE Guide for Performing Arc Flash Hazard Calculations.
- C. National Fire Protection Association (NFPA):
 - 1. 70E 2018 Standard for Electrical Safety in the Workplace.

1.03 DEFINITIONS

A. As specified in Section 3.

1.04 SYSTEM DESCRIPTION

A. General study requirements:

- 1. Scope:
 - a. The short-circuit fault analysis, protective device coordination and arc-flash hazard studies shall include all new, modified, and existing equipment in the power distribution system including but not limited to:
 - 1) Utility equipment.
 - 2) Switchboards.
 - 3) Generators.
 - 4) Transformers.
 - a) Including all dry-type transformers.
 - 5) Motor control Centers.
 - 6) Free standing variable frequency drives and starters.
 - 7) Disconnect switches.
 - 8) Motors.
 - 9) Panelboards:
 - a) Including all 240 and 208 volt systems.
 - 10) Vendor control panels.
 - 11) HVAC equipment.
 - b. Study scenarios:
 - 1) The studies shall include all possible electrical system configurations, for example:
 - a) Operation on normal (utility) source.
 - b) Operation on generator source.
- 2. Obtain, for all equipment, the required data for preparation of the study, including, but not limited to:
 - a. Transformer kilovolt-ampere (kVA) and impedances.
 - b. Generator impedances.
 - c. Generator decrement curves.
 - d. Bus withstand ratings. Cable and bus data.
 - e. Protective device taps, time dials, instantaneous pickups, and time delay settings.
- 3. Obtain the Electric Utility information on the minimum and maximum available fault current, minimum and maximum utility impedances, utility protective device settings including manufacturer and model number, and X/R ratios.
- 4. The individual performing the studies shall visit the site and collect all necessary field data in order to perform and complete comprehensive electrical system studies.

- 5. Obtain equipment layouts and configurations from the manufacturer's final submittal requirements and project layout drawings as required.
- 6. Bus and conductor data:
 - a. Use impedances of the actual installed or specified conductors, unless otherwise indicated.
- 7. Motors:
 - a. Each motor shall be individually modeled:
 - b. Motors with variable frequency drives may be assumed to have no contribution to fault current.
 - c. Motors rated less than 50HP can be modeled as lumped electrical loads.
- 8. Use the equipment, bus, and device designations as indicated on the Drawings for all studies.
- B. Short-circuit fault analysis study requirements:
 - 1. Calculate 3-phase bolted fault, line-to-line fault, line-to-ground fault, double line-to-ground fault, short-circuit 1/2 cycle momentary symmetrical and asymmetrical RMS fault.
 - 2. Evaluate bus bracing, short circuit ratings, fuse interrupting capacity and circuit breaker adjusted interrupting capacities against the fault currents.
 - a. Identify and document all devices and equipment as either inadequate or acceptable.
 - 3. Provide calculation methods, assumptions, one-line diagrams, source impedance data, recommendations, and areas of concern.
- C. Protective device coordination study additional requirements:
 - 1. Furnish protective device settings for all functions indicated on the Drawings, including, but not limited to:
 - a. Current.
 - b. Negative sequence.
 - c. Reverse power.
 - 2. Provide log-log form time-current curves (TCCs) graphically indicating the coordination proposed for the system:
 - a. Include with each TCC a complete title and one-line diagram with legend identifying the specific portion of the system covered by the particular TCC:
 - 1) Typical time-current curves for identical portions of the system, such as motor circuits, are acceptable as allowed by the Engineer.
 - b. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics:
 - 1) These details can be included on the TCC.
 - c. Include a detailed description of each protective device tap, time dial, pickup, instantaneous, and time delay settings:
 - 1) These details can be included in the TCC.

- 3. TCCs shall include all equipment in the power distribution system where required to demonstrate coordination. Include medium voltage equipment protective relay and fuse characteristics, cable damage curves, low-voltage equipment circuit breaker trip device characteristics, transformer characteristics, motor and generator characteristics:
 - a. Include all devices down to the largest branch circuit and largest feeder circuit breaker in each motor control center, main breaker in branch panelboards and fused disconnect switches.
 - b. For new installations provide ground fault TCCs with all adjustable settings for ground fault protective devices.
- D. Arc-flash hazard study additional requirements:
 - 1. Obtain available short circuit current from electric utility transformer, apply to study, and document in report submittal.
 - 2. Include the calculated arc-flash boundary and incident energy (calories/square centimeter) at each piece of equipment in the distribution system:
 - a. Perform study with 15 percent arcing fault variation as defined by IEEE 1584.
 - b. Perform arc-flash calculations at minimum and maximum utility and generator fault contributions.
 - c. Perform arc-flash calculations for both the line side and load side of switchgear, switchboard, motor control center main breakers.
 - d. Protective device clearing time shall be limited to 2 seconds, maximum.
 - 3. Provide executive summary of the study results.
 - a. Provide summary based upon worst case results.
 - 4. Provide a detailed written discussion and explanation of the tabulated outputs.
 - a. Include all scenarios.
 - 5. Provide recommended protective device settings to reduce arc flash energy to less than 8 cal/cm² where feasible.
- E. Short Circuit Protective Device, and Arc Flash Analysis shall be submitted to owner for review and shall be modified based on Owner-provided or Engineer-provided review comments.
- F. Harmonic Distortion Testing
 - 1. Conduit a harmonic distortion test on the MCC bus following completion of construction. Testing shall be in accordance with IEEE-519-2014. Testing shall be made and recorded of each harmonic maximum level as the total harmonic distortion (THD) level for both current and voltage waves. Testing shall be performed with motor variable frequency drive is operating at both minimum speed and maximum speed. Testing agencies shall verify that the following levels are not exceeded:
 - a. Individual voltage distortion level for any harmonic shall not exceed 5%,
 - b. Total voltage distortion level (THD) shall not exceed 8%.
 - c. Individual current distortion level for harmonics 3 thru 11 shall not exceed 4%.
 - d. Total current distortion level (TDD) shall not exceed 5%.

1.05 1.5 SUBMITTALS

- A. Furnish submittals as specified in Sections 31 of the General Conditions and Section 3 of the Technical Specifications.
- B. Final studies and reports:
 - 1. Format and quantity:
 - a. Provide 1 bound copies of all final reports.
 - b. Provide 1 complete set of electronic files on CD including any other files used to perform the studies and produce the reports. Also provide an electronic version of the bound reports in PDF format.
 - 2. Include the sections below in the final report:
 - a. Copies of correspondence and data obtained from the Electric Utility Company.
 - b. One-line diagrams:
 - 1) The following information shall be included at a minimum:
 - a) Motor horsepower.
 - b) Transformer data:
 - I. kVA.
 - II. Configuration.
 - c) Cable data:
 - I. Insulation.
 - II. Size.
 - III. Length.
 - 2) One-line diagrams shall be fully legible at 11-inch by 17-inch size.
 - c. Include in the short-circuit fault analysis study:
 - 1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
 - 2) Tabulation of circuit breaker, fuse, and other protective device ratings compared to maximum calculated short-circuit duties.
 - d. Protective device coordination study shall include:
 - 1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
 - 2) List all requirements used in the selection and setting criteria for any protective devices.
 - 3) Manufacturer's time-current curves for circuit breakers, fuses, motor circuit protectors, and other protective devices for all new equipment.
 - 4) TCCs graphically indicating the coordination proposed for the system on log-log graphs.
 - 5) A one-line diagram to display area coordination.

- 6) Where coordination could not be achieved, an explanation shall be included in the report to support the statement along with recommendations to improve coordination. Recommended equipment modifications or settings shall be in a tabulated form.
- e. Include in the arc-flash study:
 - 1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
 - 2) Normal system connections and those, which result in maximum arc- flash conditions.
 - 3) Arc-flash raw data, calculations, and assumptions.
 - 4) Arc-flash label data:
 - a) Identifying the content of each label.
 - b) Identifying the location of each label.
- C. After review, the Engineer may make recommendations and/or require changes to be made to the short-circuit analysis, protective device coordination or arc-flash studies. These changes shall be provided as part of the scope of work.
- D. Harmonic Distortion Test results shall be provided to Engineer at the conclusion of the project. Documentation provided shall consist of one bound copy and one electronic file copy.

1.06 1.6 QUALITY ASSURANCE

- A. As specified in Section 3.
- B. Qualifications of the entity responsible for electrical system studies:
 - 1. The studies shall be performed, stamped, and signed by a professional engineer registered in the state where the project is located.
 - 2. A minimum of 5 years experience in power system analysis is required for the individual in responsible charge of the studies.
 - 3. The short-circuit analysis, protective device coordination, and arc-flash hazard studies shall be performed with the aid of a digital computer program.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Electrical system study software, or equal:
 - 1. EasyPower of Tualatin, Oregon
 - 2. SKM Power Tools for Windows of Redondo Beach, California.

2.02 COMPONENTS

A. Arc-flash hazard labels:

- 1. Dimensions:
 - a. Minimum 5 inches by 3.5 inches.
- 2. Materials:
 - a. Polyester with polyvinyl polymer over-laminate.
 - b. Self-adhesive.
 - c. Resistant to:
 - 1) UV.
 - 2) Chemicals and common cleaning solvent resistant.
 - 3) Scuffing.
 - 4) Wide temperature changes.
- 3. Contents:
 - a. Short-circuit bus identification.
 - b. Calculated incident energy (calories/square centimeter) range.
 - 1) Based on worst-case study results.
 - c. Date
 - d. Arc-flash protection boundary.
 - e. Nominal Voltage
 - f. Limited Approach Boundary
 - g. Restricted Approach Boundary
 - h. Insulating Glove Class
- 4. Color scheme:
 - a. White label with red "DANGER" strip across the top.
 - b. Black lettering on white background.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. As specified in Section 3.
- B. After review and acceptance of the arc-flash hazard study by the Engineer, install all arc-flash hazard labels:
 - 1. Install labels at all locations required by NFPA 70E 2018.
 - 2. At a minimum install labels in the following locations:
 - a. The front of each main or incoming service compartment.
 - b. The front of each low voltage switchgear section.
 - c. The front of each medium voltage circuit breaker door.
 - d. The front of each accessible auxiliary or conductor compartment.

- e. Each accessible rear or side vertical section.
- f. Each motor control center section.
- g. Each panelboard covered by the study.
- h. Each control panel, individual starter or VFD or other equipment covered by the scope of the study.
- C. After review and acceptance of the arc-flash hazard study and coordination study by the Engineer, adjust protective device settings per final study.

3.02 FIELD QUALITY CONTROL

- A. As specified in Section 3.
- B. The individual performing the arc-flash hazard study shall direct the installation of the arc-flash hazard labels:

END OF SECTION

SECTION 26 24 13 – SWITCHBOARDS

PART 1 - GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install, where indicated, a free-standing, dead-front type low-voltage distribution switchboard, utilizing group mounted circuit protective devices as specified herein, and as shown on the contract drawings.

1.02 RELATED SECTIONS

- A. Section 26 62 53 Service Entrance Station
- B. Section 26 28 16 Enclosed Switches and Circuit Breakers

1.03 REFERENCES

- A. The low-voltage distribution switchboards and all components shall be designed, manufactured and tested in accordance with the latest applicable following standards:
 - 1. NEMA PB-2
 - 2. UL Standard 891.

1.04 SUBMITTALS

- A. The following information shall be submitted to the Engineer for review:
 - 1. Master drawing index
 - 2. Front view elevation
 - 3. Floor plan
 - 4. Top view
 - 5. Single line
 - 6. Schematic diagram
 - 7. Nameplate schedule
 - 8. Component list
 - 9. Conduit entry/exit locations
 - 10. Assembly ratings including:
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current
 - 11. Major component ratings including:
 - a. Voltage

- b. Continuous current
- c. Interrupting ratings
- 12. Cable terminal sizes.
- 13. Busway connection
- 14. Connection details between close-coupled assemblies
- 15. Composite floor plan of close-coupled assemblies
- 16. Key interlock scheme drawing and sequence of operations.
- B. Submit copies of the following information for record purposes:
 - 1. Final as-built drawings and information for items listed in section 1.04, A
 - 2. Wiring diagrams
 - 3. Certified production test reports
 - 4. Installation information
 - 5. Seismic certification and equipment anchorage details.

1.05 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the circuit protective devices within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9000, 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- 1.06 REGULATORY REQUIREMENTS
 - A. The low-voltage switchboard shall be UL labeled.
- 1.07 DELIVERY, STORAGE AND HANDLING
 - A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.
- 1.08 OPERATION AND MAINTENANCE MANUALS
 - A. Provide Operation and Maintenance manuals as specified in Sections 01 78 23 and 26 00 00.
 - B. Operation and maintenance manuals shall include the following information:
 - 1. Instruction books and/or leaflets
 - 2. Recommended renewal parts list

3. Drawings and information required by section 1.04.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. TESCO Controls, Inc.

2.02 RATINGS

- A. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current of 65,000 amperes symmetrical at rated voltage. Rating should be 65,000 unless otherwise noted on the drawings.
- B. Voltage rating to be as indicated on the drawings.

2.03 CONSTRUCTION

- A. Switchboard shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.
- B. All sections of the switchboard shall be rear aligned with depth as shown on the drawings. All protective devices shall be group mounted. Devices shall be front removable and load connections front accessible enabling switchboard to be mounted against a wall.
- C. The assembly shall be provided with adequate lifting means.
- D. The switchboard shall be UL listed.

2.04 BUS

- A. All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA current density of 1000A per square inch.
- B. Provide a full capacity neutral bus where a neutral bus is indicated on the drawings.
- C. A copper ground bus (minimum 1/4 x 2 inch), shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard.
- D. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

2.05 WIRING/TERMINATIONS

A. Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks,

- relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
- B. Mechanical-type terminals shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of the size as indicated on the drawings.
- C. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.
- D. All control wire shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminals blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

2.06 MOLDED CASE PROTECTIVE DEVICES

- A. Main, tie, and feeder protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics and shall have ground fault protection where indicated or as required by NEC.
- B. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make/quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy, and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
- C. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the drawings.
- D. Where indicated circuit breakers shall be UL listed for series application.
- E. Where indicated circuit breakers shall be current limiting.
- F. Circuit breakers 400 ampere frame and below shall be thermal-magnetic trip units and inverse time-current characteristics.
- G. Circuit breakers 600 ampere through 1200-ampere frame shall be microprocessor-based with RMS sensing trip units.

2.07 ACCESSORIES

- A. Provide shunt trips, bell alarms and auxiliary switches as shown on the Plans.
- B. Circuit Breaker Energy Monitoring
- C. Provide transient voltage surge suppression.

2.08 MISCELLANEOUS DEVICES

- A. Control power transformers with primary and secondary protection shall be provided, as indicated on the drawings, or as required for proper operation of the equipment.
- B. Each section of the switchboard shall be provided with a space heater thermostatically controlled. Power for the space heaters shall be obtained from a control power transformer within the switchboard. Supply voltage shall be 120 volts AC.

2.09 CUSTOMER METERING

- A. Where indicated on the Plans, provide a separate customer metering compartment with front hinged door and include the following:
- B. Current transformers for each meter. Current transformers shall be wired to shorting-type terminal blocks.

2.10 ENCLOSURES

- A. Indoor NEMA 1 Enclosure
- B. Outdoor NEMA 3R Enclosure
 - 1. Outdoor enclosure shall be non-walk-in and meet applicable NEMA 3R UL requirements.
 - 2. Enclosure shall have sloping roof downward toward rear.
 - 3. Outer sections shall be the same widths as indoor structures, except each end of the outdoor assembly shall have an end trim.
 - 4. The enclosure shall be provided with bolt-on rear covers for each section.
 - 5. Doors shall have provisions for padlocking.
 - 6. Ventilating openings shall be provided complete with replaceable fiber glass air filters.
 - 7. Provide space heaters thermostatically controlled for each structure with adequate wattage to prevent the accumulation of moisture.
 - 8. Power for space heaters, shall be obtained from a control power transformer within the switchboard.
 - 9. Each exterior door shall have a limit switch for intrusion monitoring. Switch shall be SPDT and rated for minimum 120VAC, 3A.

2.11 NAMEPLATES

A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background. Characters shall be 3/16-inch high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating. Furnish master nameplate giving switchboard designation, voltage ampere rating, short-circuit rating, manufacturer's name, general order number, and item number.

B. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

2.12 FINISH

A. All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 light gray.

PART 3 - EXECUTION

3.01 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
 - 1. The switchboard shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchboard will be tested for operation under simulated service conditions to assure the accuracy of the wiring and the functioning of all equipment. The main circuits shall be given a dielectric test of 2200 volts for one (1) minute between live parts and ground, and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1500 volts for one (1) minute between live parts and ground.
 - 2. The manufacturer shall provide certified copies of factory test reports.

3.02 INSTALLATION

- A. The Contractor shall install all equipment per the manufacturer's instructions, Contract Documents, and National Electrical Code.
- B. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to the floor without the use of floor sills provided the floor is level to 1/8 inch per 3-foot distance in any direction. All necessary hardware to secure the assembly in place shall be provided by the Contractor.

3.03 FIELD ADJUSTMENTS

- A. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study and protective device coordination study.
- B. Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with an approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the owner.

3.04 MANUFACTURER'S CERTIFICATION

A. A certified test report of all standard production tests shall be available to the Engineer upon request.

3.05 TRAINING

- A. The Contractor shall provide a training session for up to 6 Owner's representatives for 1 normal work days at a jobsite location determined by the Owner.
- B. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of instruction on operation of the assembly, circuit breakers, fused switches, and major components within the assembly.

END OF SECTION

SECTION 26 24 16 – PANELBOARDS

PART 1 - GENERAL

- 1.01 SCOPE OF WORK
 - A. This section covers electrical panelboards.

1.02 SUBMITTALS

- A. Products shall be submitted in accordance with **Section 26 00 00**, and the Contract Documents, prior to installation.
- B. Panel layout with alphanumeric designation, branch circuit breaker sizes and types, AIC rating, bus sizes, and other characteristics.

1.03 QUALITY ASSURANCE

- A. NEMA PB-1, Panelboards
- B. NEC
- C. UL67, Panelboards

PART 2 - PRODUCTS

2.01 PANELBOARDS

- A. Dead-front panelboards, including lighting distribution and control panels, shall be furnished and installed as indicated on the Plans. Buses shall be copper. Mounting and type of enclosures shall be as indicated on the Plans. Where not indicated, indoor enclosures shall be NEMA 12 and outdoor enclosures shall be NEMA 4. The minimum interrupting capacity of any device shall be as indicated on the Plans.
- B. Protective devices shall be replaceable without disturbing adjacent units. Wire connectors shall be suitable for wire sizes indicated. Branch circuits shall be numbered as indicated on the Plans, and a complete typed circuit schedule shall be furnished under a transparent cover, and affixed to the panel. Phase busing shall be full height without reduction. Full size neutral bars shall be included, and shall have suitable lug for each outgoing circuit requiring neutral connection. Spaces for future protective devices provided in lighting panels shall be bused for the maximum device that can be fitted into them.
- C. Panelboards shall be finished with a primer, rust resistant phosphate undercoat and two coats of oven baked enamel with finish ANSI grey. They shall be sized to provide a minimum of 4 inches of gutter space on all sides. Doors shall not uncover any live parts, and shall be hinged and have latches that require no tool to operate. Panelboard doors shall be lockable. Lock and two keys shall be furnished.

PANELBOARDS 26 24 16 - 1

- D. Each panelboard shall have, on the outside of the door, a lamicoid nameplate with 3/4 inch letters as specified elsewhere in these Contract Documents.
- E. Panelboards shall be as manufactured by Schneider Square D, ABB General Electric, Eaton Cutler-Hammer, Siemens, or equal.
- F. Panelboards shall be service entrance rated where required, and as shown on the Plans.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Panelboards shall be installed as indicated on the plans and according to manufacturer's instructions.
- B. Provide grounding per NEC, and Section 26 05 26.
- C. Contractor shall verify all NEC clearance requirements prior to installation.

END OF SECTION

PANELBOARDS 26 24 16 - 2

SECTION 26 24 19 – MOTOR CONTROL CENTERS (MCC)

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish and install, ready to use, motor control centers for use as indicated on the Plans and specified herein.
- B. Circuit breaker ratings, and modifications, shall be as indicated on the Plans.
- C. MCP ratings, and modification, shall be as indicated on the Plans.

1.02 SUBMITTALS

- A. The motor control centers shall meet the requirements of the latest edition of Standards for Industrial Control No. ICS published by the National Electrical Manufacturers Association. The following minimum information and drawings shall be submitted for review:
 - 1. Plan, front, side views and overall dimension of each motor control center.
 - 2. Weight.
 - 3. Internal wiring diagram of each plug-in unit.
 - 4. Internal wiring diagram of the motor control centers.
 - 5. External connection diagram showing the wiring to the external controls and devices associated with the motor control center.
 - 6. A one-line and a schematic diagram for each motor control center.
 - 7. Bill of material list and Manufacturer's Product Data.
 - 8. Installation instructions.
 - 9. Manufacturer's certification that the following items are capable of interrupting and/or withstanding the specified short circuit condition:
 - a. Bus bar bracing
 - b. Feeder tap units
 - c. Starter units
- B. Product information shall be submitted in accordance with **Section 26 00 00**, and elsewhere in the Contract Documents.

PART 2 - PRODUCTS

2.01 MOTOR CONTROL CENTERS

A. Motor Control Center shall be an integrated system consisting of main breaker, disconnect switches, pump breakers, combination motor starters with controls, distribution transformer, panelboard programmable pump controller, level monitors, power supplies, battery back up,

relays and other automatic controls and devices. The pump controller and instrumentation shall be furnished as an integral part of the motor control center by the motor control center manufacturer. The completed motor control center shall contain a U/L 508 label. The enclosure shall be rated NEMA 12 for indoor applications, U.L. labeled Industrial Control, and meet all the requirements of local, state, and county ordinances. Each motor control section shall have 1 1/2" x 1 1/2" x 1/4" minimum angle iron frame base. Each cubicle shall be individually barriered with wireways on both sides, line on left and load on right. All connections shall be front accessible. All hinges and screws shall be stainless steel. Dead front latches shall be 1/4 turn adjustable latches with 1/8" thick latching dog and knurled knob. Screw type fasteners will not be acceptable. The complete motor control center shall be painted with a polyester dry powder, electrostatically applied and baked on at 400 degree Fahrenheit to provide a corrosion resistive polypore finish. Interior color including separation barriers and mounting backpans shall be white. The painting process shall include five stages of metal preparation using dip tanks as follows: 1) Alkaline cleaner/iron phosphate application, 2) De-ionized water rinse #1, 3) Deionized water rinse #2, 4) De-ionized water rinse #3, and 5) Inhibitive rinse to seal phosphated surfaces. Exterior color shall be ANSI 61 gray, interior surfaces shall be white.

- All miscellaneous control and instrument wiring shall be protected by fuses or circuit breakers. B. Wiring shall be neatly bundled or run in plastic wireways. Wires shall be color coded per U.L. standards and shall be 600 volt MTW or THHN with 19 strands of copper. All wires shall be permanently numbered with Brady slip clip wire markers. Terminal strips shall be numbered to match wire numbers. Common wires shall be of a common color and number throughout the system. All devices shall be permanently labeled. All door mounted devices shall be labeled with black and white, screw fastened, engraved, plastic nameplates. Stick on labels, wire fasteners, or wire numbers are not acceptable. All wiring shall be to NEMA Class II C requirements. Complete wiring diagrams shall be provided drawn with computer aided design (CAD) techniques. All components associated with a particular compartment's function shall be mounted in that compartment; i.e. control relays, motor starters, etc. shall be mounted in the control section compartment. Spacing of components shall be in accordance with U.L. standards. Provide each motor with a suitable controller and devices that will perform the functions as specified for their respective motors. Controllers shall conform to the applicable requirements of NEMA ICS, ANSI C19.1, the NEC, and UL. Anticipated horsepower ratings are shown on the contract documents. This information is for guidance only and does not limit the equipment size. When motors furnished differ from the expected ratings indicated, make the necessary adjustments to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate the motors actually installed, at no additional cost to the Owner.
- C. Provide each motor with a suitable controller and devices that will perform the functions as specified for their respective motors. Controllers shall conform to the applicable requirements of NEMA ICS, ANSI C19.1, the NEC, and UL. Anticipated horsepower ratings are shown on the contract documents. This information is for guidance only and does not limit the equipment size. When motors furnished differ from the expected ratings indicated, make the necessary adjustments to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate the motors actually installed, at no additional cost to the Owner. Provide each motor with a suitable controller and devices that will perform the functions as specified for their respective motors. Controllers shall conform to the applicable requirements of NEMA ICS, ANSI C19.1, the NEC, and UL. Anticipated horsepower

ratings are shown on the contract documents. This information is for guidance only and does not limit the equipment size. When motors furnished differ from the expected ratings indicated, make the necessary adjustments to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate the motors actually installed, at no additional cost to the Owner. Each motor control system shall be equipped with a hand-off-auto control switch, indicating lights, elapsed time meter, ammeter, motor starter, control transformer with primary fuses and secondary control power fuse. Control switches and indicating lights shall be U.L. listed oil-tight devices rated heavy duty. Provide Idec, Westinghouse, or equal.

- D. Control power transformers shall be sized as shown on the plans, minimum size shall be 100VA where not designated. Provide Micron, G.E., or equal. Time on delay relays for staggered start. Time delay relays are to delay the pump motors from starting upon resumption of service power, such that only one motor can be started at a time. Time delay relays shall be furnished for pump fail indication, set to interface with limit switches and ride through normal starting time. Ammeters with phase to phase/phase to ground switch shall be provided for each motor. Appropriately sized current transformers shall be installed. Ammeters with switch shall be mounted on the corresponding motor starter MCC cubicle door.
- E. Distribution blocks shall be furnished and installed as required for "fan-out" of control power and other 120V sources within the enclosure. The blocks shall be rated 300V at a minimum of 20 amperes and sized for the conductors served. Distribution blocks shall be similar to Square D, Connectron NFT, or equal.
- F. All 480 volt circuit breakers shall have interrupting capacities as shown on the drawings but no smaller than 14,000 amperes. All 120 volt breakers shall be rated 10,000 amperes interrupting capacity. Circuit breakers shall be of the indicating type, providing ON, OFF and TRIPPED positions of the operating handle. Circuit breakers shall be quick-make, quick-break, with a thermal-magnetic action, except when protecting motor feeders where motor circuit protector (MCP) breakers may be used. Circuit breakers shall be the bolted on type. The use of tandem or dual circuit breakers in a normal single- pole space to provide the number of poles or spaces specified is not acceptable. All multiple-pole circuit breakers shall be designed so that an overload on one pole automatically causes all poles to open. Circuit breakers shall meet the requirements of UL and NEMA AB I. Breakers shall be Westinghouse EHD, MCP, or equal. All circuit breakers shall be heavy duty molded case circuit breakers conforming to Federal specification W-C-375B and shall be UL listed. A button shall be provided on the cover for mechanically tripping the breaker.
- G. Nameplates shall be black phenolic with white lettering. Nameplates shall be stainless steel screw mounted. Glue type will not be acceptable.
- H. Panelboard shall be circuit breaker type custom constructed to utilize minimum enclosure space with breakers as shown. Circuit breakers shall be bolted on type. The panelboard shall be furnished with phenolic nameplates. The panelboard transformer shall be dry type construction sized as shown on the plans with primary breaker protection. The panelboard transformer shall be a Jefferson 211, G.E., or equal.
- I. Furnish and install push-to-test lights to indicate status and alarm conditions locally as shown on drawings. Engraved phenolic nameplates shall specify each light's function. Lights shall be wired as shown on drawings. Panel lights shall be full voltage IDEC ALD or equal.

- J. Push-buttons, and selector switches, for non hazardous indoor dry locations shall be U/L listed oil-tight type, Westinghouse Type OT, Idec ASN, General Electric Type CR 240, Square D Class 9001, or equal. These devices shall have individual, extra large nameplates indicating their specific function.
- K. Receptacles shall be of specification grade and of NEMA configuration and rated 2 pole, 3 wire grounding, 20 amperes, 125 volts, such as Pass & Seymour 5252, Leviton 6898, Bryant 5252, or equal. Contact arrangement shall be such that contact is made on two sides of each inserted blade. Bases shall be of ivory phenolic composition. Wire terminals shall be suitable for 10 AWG wire and shall be screw type. Receptacles shall be UL listed. The receptacles shall have corrosion resistant conducting parts of nickel-plated brass and other metal parts of stainless steel. All external and dead front receptacles shall be installed on ground fault interrupter circuits "GFCI".
- L. Control relays shall be Potter and Brumfield KU, Square D Type KU, Idec Type RH or equal. Two form-C contacts (minimum) shall be provided on each relay. Provide relay energized neon lamp (inside relay case).
- M. The power fail relay shall continuously monitor the three phases for power loss, low voltage, phase loss, phase reversal and have automatic reset. The power fail monitor shall have a drop-out voltage adjustment and a failure indicating LED. Provide Diversified model SLA, or equal.
- N. Time delay relays shall be solid state relays with a timer adjustable over the range 1 to 60 seconds unless other ranges are indicated or required. Provide LED relay energized indicator lamp. Time delay relays shall be IDEC RTE, Agastat STA, or equal.
- O. The motor control center fabricator shall be the manufacturer of the major components therein, such as circuit breakers and starters. Engineered motor control centers shall be by the component and housing manufacturer. The manufacturer shall comply with equipment specifications contained elsewhere in these Contract Documents.
- P. Each component, as well as the complete assembly, shall be constructed and tested in accordance with latest NEMA Standards for Industrial Control. The type of construction of the control centers shall be NEMA Class II, Type B. Lifting eyes shall be provided on each section to facilitate handling.
- Q. Unit doors shall be mounted on the stationary structure and hinged on the side away from the vertical wireway. They shall be held closed with slotted thumbscrews.
- R. Unit doors shall have positive action linkage with disconnect operating mechanism. Mechanism shall be designed so that it can be locked in the OFF position with up to 3 padlocks. When the handle is not padlocked, it shall be possible to open the door by releasing the door interlock with a small tool. The control units shall be of the plug-in type. When doors are closed, the operating mechanism shall clearly indicate the ON or OFF position of the disconnect, and the door interlock mechanism shall engage. The disconnect operating mechanism shall be designed against inadvertent operation when the door is open. Each plug-in unit door shall be provided with a nameplate, specified elsewhere herein, that indicates the circuit number and circuit name. The

MOTOR CONTROL CENTERS (MCC)

- nameplate shall be attached to the door with brass or stainless screws. Each motor starter door shall be provided with an externally operated manual reset pushbutton for the overload relay.
- S. It shall be possible to install up to 6 NEMA size one units in one vertical section. Units shall be completely enclosed with sheet steel. A small wireway shall be provided inside the unit, so all wiring can be laid in place without removing barriers or plates. Each vertical section that holds the units shall be rigidly formed of minimum 12 gauge, cold-rolled sheet steel. The vertical front-of-board-construction shall be supplied with minimum 20-inch depth.
- T. Continuous horizontal wiring troughs shall be provided at both top and bottom of each section. These troughs shall line up to form a continuous wireway for the full length of the MCC. A large continuous, full-height vertical wiring trough shall be provided in the right side of each section.
- U. All starter wiring, control, and power shall be terminated in terminal strips in this trough for size 2 and smaller starters. Size 3 and larger starters shall have control leads terminating on the terminal strips in the trough. Terminal strips shall be split-type to facilitate wiring connections without disconnecting factory or field conductors. Terminal strips shall be rated to accept conductor sizes as indicated on the Plans.
- V. Bus bars shall be silver plated copper, and shall be of the ampacity indicated on the Plans. Unit bus bar stabs shall insure high contact pressure. The vertical bus bars shall be effectively isolated from accidental contact by plastic insulating medium. Horizontal bus shall be silver-plated at every joint. The entire vertical bus shall be silver-plated copper.
- W. Bus bar supports shall be of high impact strength, non-carbonizing insulating material mounted on padded steel brackets and shall provide adequate dielectric strength and creepage distance.
 The bus structure shall be capable of withstanding short circuit current in accordance with NEMA standards, and as indicated on the Plans.
- X. Horizontal bus amperage rating shall be as indicated on the Plans.
- Y. Each section shall be equipped with horizontal ground bus that shall be continuous across the MCC.
- Z. The MCCs shall be supplied as indicated on the Plans, and as specified herein and in accordance with NEMA Standard Pub. IS 1.1, latest edition. The MCCs shall be enclosed in NEMA Type 1 gasketed industrial use enclosures, unless otherwise shown. NEMA 3R enclosures shall provide sufficient depth for air conditioning units to be mounted on the end of the structures. If the MCCs contain VFDs or Solid State Starters that require cooling, their respective sections shall be louvered top and bottom, and fans shall remove heat from within the sections. NEMA 3R lineups for outdoor use shall be non-walk-in type. All exterior doors for NEMA 3R lineups shall be equipped with limit switches for intrusion monitoring. Switches shall be SPDT and have minimum rating of 120VAC, 3A.
- AA. All metal surfaces and structural parts shall be given a phosphatizing, or equal, treatment prior to painting. The control centers shall then be given a gun-metal gray undercoat which is equal to zinc chromate. The exterior of the enclosure shall be finished in standard ANSI Grey.

- BB. Spaces for future combination starters shall have all the hardware necessary so that a future plug-in control unit can be installed without having to modify the vertical sections. The number of spaces for future control units shall be as indicated on the Plans.
- CC. Devices, such as, but not limited to, starters, circuit breaker, relays, timers, conductors, shall conform to other sections of these Contract Documents.
- DD. Provide customer metering instruments, as indicated on the Plans. Unless otherwise indicated on the Plans, metering units shall be electronic, capable of displaying volts line-to-line and line-to-neutral, and amps per phase.
- EE. Each section shall be equipped with horizontal neutral bus that shall be continuous across the MCC if the MCC is designated as 277/480 volt 4 wire.
- FF. MCCs shall be as manufactured by TESCO Controls, Inc..

PART 3 - EXECUTION

3.01 GENERAL

- A. The MCCs shall be erected in accordance with the recommendations of the manufacturer and with the details specified herein.
- B. Cables larger than No. 6 AWG, which hang from their vertical connections, shall be supported within 2 feet of the connection.
- C. The motor overload relays shall be provided and sized based on the actual full load amperes of the motor connected to the starter.
- D. The motor circuit protectors shall be adjusted to the lowest settings that do not cause false tripping.

3.02 FIELD TESTS

A. MCCs shall be tested in accordance with Section 26 24 21.

END OF SECTION

SECTION 26 24 21 – MOTOR CONTROL SYSTEMS

PART 1 - GENERAL

1.01 APPLICABLE SECTIONS

- A. The General Conditions, Supplementary General Conditions, Special Conditions, Alternates and Addenda, applicable drawings and the technical specifications herein shall apply to all work under this **Division 26**.
- B. The contractor shall be familiar with all sections of these electrical specifications. He shall adapt his work to the work required of other trades to effect a complete and working system. Where this contractor furnishes equipment, materials or installation which comprises a part of another contractor's system, the item so furnished shall meet or exceed the requirements imposed on the other systems.

1.02 SCOPE

A. Provide all operations, methods, labor and equipment and provide and install all materials and incidentals necessary for the completion of the work as specified herein or included on the drawings.

1.03 RELATED WORK

- A. Section 26 01 00 Operation and Maintenance of Electrical Systems
- B. Section 26 05 00 Common Work Results for Electrical
- C. Section 26 05 27 Secondary Grounding
- D. Section 26 05 53 Identification for Electrical Systems
- E. Section 26 29 31 Programmable Logic Controllers
- F. Section 26 62 10 Electrical Testing
- G. Section 26 62 55 Service and Distribution Systems
- H. Section 24 05 00 Instrumentation

1.04 SHOP DRAWINGS/SUBMITTALS

- A. Furnish complete working shop drawings of all motor control systems. Reference design documents for sequence, basic components and suggested piping and wiring. Review the project with the Engineer prior to making submittal. Submit manufacturer's data sheets for all equipment, devices and materials.
- B. After initial review, make corrections requested and resubmit in clean format. Work only from final review set.

- C. Maintain record drawings in the field. Clean up originals at completion of work and resubmit for Owner's use in operation of the systems.
- D. All drawings shall be provided in printed and AutoCAD Rev 14 electronic format.

1.05 CONTRACTOR QUALIFICATIONS

- A. The Contractor shall be licensed as such in the Contractor state of origin and in the state where the work is performed.
- B. All workmen on the project shall be licensed journeymen, qualified in electrical work as appropriate.
- C. Acceptable Pneumatic/Electric/Electronic Product Lines: Honeywell, Brown, Johnson Controls, Penn, Staefa (Institutional grade), other specific products note.

1.06 CONTROL SEQUENCES

- A. Control sequences are as indicated in the Elementary Control Diagrams on the drawings.
- B. Clarification of any function or device of any system not fully understood or recognized as being undefined should be requested from the Engineer during the bidding period.

1.07 CLEANING AND LUBRICATION

A. All instruments, MCCs, and control panels shall be thoroughly cleaned by this contractor before final acceptance. This contractor shall provide lubrication if required for all equipment furnished by him.

1.08 TESTING AND ADJUSTING OF SYSTEM

A. During the testing and commissioning of the various systems this contractor shall have a representative present and available to adjust controls and protective devices as required. The integrity and accuracy of each function and control point shall be demonstrated and reported.

1.09 INTEGRATION OF CONTROL AND PLC INTO MCC

- A. Where so indicated on the drawings, custom control, VFD, or PCL equipment shall be factory integrated into the MCC structure. Mounting of separate enclosures and field wiring between enclosures is not allowed.
- B. All control wiring to the PLC inputs and outputs shall be factory pre-wired to MCC starter buckets as shown on the control schematics.
- C. All PLC inputs and outputs shall be functional tested at the factory prior to shipment to the job site.
- D. Owner shall be notified in advance of testing and provided with written test procedures. Owner shall be allowed to witness final testing of MCC.
- E. Final MCC product shall be UL or ETL labeled.

1.10 CODES AND STANDARDS

A. The following standards shall be considered to be part of this specification insofar as they give definitions and describe requirements and tests which equipment supplied shall meet. They shall be the latest edition, including any addenda, supplements, or revisions thereto, in effect at the time of award of the purchase order. The equipment shall also meet any laws or requirements of the State of Utah or other regulatory bodies having jurisdiction over such apparatus, unless otherwise specified.

ANSI C57.13 Requirements for Instrument Transformers Specialty Transformers (except General Purpose Type) ANSI C89.1 (NEMA ST1) Molded Case Circuit Breakers NEMA AB-1 NEMA ICS1 General Standards for Industrial Control and Systems NEMA 1CS2 Industrial Control Devices, Controllers and Assemblies ANSI C1 (NFPA70) National Electrical Code UL 489 Molded Case Circuit Breakers and Circuit Breaker Enclosures UL 508 **Industrial Control Equipment** UL 845 Standard for Motor Control Centers Ground Fault Sensing and Relaying Equipment UL 1053 Mine Safety and Health Administration **MSHA**

- B. Supplement: The following supplement is included with and forms a part of this specification:
 - 1. Appendix D: Engineering Data Motor Control Center

PART 2 - PRODUCTS

2.01 MOTOR CONTROL CENTER

A. General:

- 1. Motor control center assembly and all components shall meet the material selection, construction and testing requirements given by the industry standards listed in this specification.
- 2. Requirements and rating of individual components and equipment shall be as indicated on drawings and Appendix D.
- 3. Motor control centers shall be manufactured by Allen Bradley, Schneider Square D, ABB General Electric or Eaton Cutler Hammer.
- 4. Where drawings indicate that the metering switchboard section is close coupled with the outgoing distribution (motor control center) section, lineup may be fabricated as an "all-in-one" lineup using components from the major equipment manufacturers listed in previous paragraph. Fabricators of lineup are Benjamin Electric, Powell Industries, RSE-Sierra, Royal Industrial Solutions, Myers Power Products, or equal.

B. Enclosures:

- 1. Motor control centers shall be dead-front type and shall be Vendor's latest standard design. Sections shall be approximately 90" high and 20" wide, joined together to form a rigid, free-standing assembly.
- 2. Access to wiring space, terminal blocks and connections shall be from the front only.

- 3. Each unit compartment shall have a hinged door with stiffening members as required to insure rigidity. Spaces shall be fully equipped with bus and rails ready for future insertion of a unit.
- 4. Unit compartments shall be separated by isolating barriers, removable for wiring, and shall be of standard dimensions to add to either end of the control center, replace or interchange sections.
- 5. A vertical wireway shall be provided in each vertical section and shall extend the full length. The wireway shall have a full length door, separate from individual controller doors. All outgoing wiring will be top or bottom entry.

C. Motor Control Center Units:

- 1. Motor control center units shall be standardized, removable and interchangeable. Line connections to the vertical bus shall be plug-in type designed to disconnect the unit automatically when the unit is removed from the control center. Each combination motor starter contactor unit or branch circuit breaker unit shall be mounted with associated control devices in an individual compartment. Each breaker/switch shall be operable from the front with the compartment door closed.
- 2. The position of the operating handle shall clearly indicate the condition of the breaker/switch "ON", "OFF", or "TRIPPED". The door and operating handle shall be interlocked to prevent opening the door when the breaker is in the "ON" position. Means shall be provided to permit padlocking the operating handle on the "OFF" position. A maintenance release shall be provided.

D. Combination Starter:

- 1. Each combination motor starter unit shall include:
 - a. Motor circuit protector. Motor circuit protector with current limiter shall be used when specified.
 - b. Starter, 3-pole magnetic for 3-wire control with 120 volt, 60 hertz coil and a 3 pole, external manual reset, overload relay for solid state motor overload protection. The overload relays to have a single manual reset button mounted on the starter door to permit external reset with the compartment door closed.
 - c. Multi-speed and reversing starters shall have mechanical and electrical interlock. Contacts shall be spring loaded to have positive contact and shall be readily replaceable.
 - d. Control power transformers with two primary and one secondary control fuses.
 - e. Overload protection shall be supplied and installed in starters by equipment supplier. Solid state overloads shall be supplied based on latest motor nameplate data and motor service factor 1.15. Overloads shall include, phase imbalance, phase loss, and over current, Class 10 or Class 20 as required by driven equipment.
 - f. Ground fault protection shall be provided for size 4 and larger starters.

E. Contactor Units:

1. Contactor units shall be the same as combination starters described herein except that molded case circuit breakers shall replace motor circuit protectors and units shall be without overload relays.

F. Branch Circuit Breakers:

 Branch circuit breakers shall be molded case, 3-pole, manually operated and trip free, with an inverse time thermal element for overload protection and an instantaneous magnetic element for short-circuit protection. Circuit breakers up to 250A shall be drawout type. Higher frame size circuit breakers shall be bolted-on type. Breakers may be tandem mounted, two per bucket, provided NEC clearances and bending radius are met

G. Buses:

- 1. Bus ratings shall be as shown on drawings. Bus shall be copper. All bus connections shall be tin plated.
- 2. A copper ground bus shall extend the full length of each motor control center structure. Pressure type lugs for No. 4/0 copper ground wire shall be supplied at each end of the ground bus.

H. Metering:

- 1. Solid state programmable power monitor relay shall be provided to meter the incoming line of each MCC.
- 2. Power monitor relay shall have the following features:
 - a. 2 line, 16 character minimum digital display with membrane type keys for programming and scrolling through screens.
 - b. Values to be monitored and displayed:

Current per phase	A, B, C
Volts L-N	A-N, B-N, C-N
Volts L-L	A-B, B-C, C-A
Real Power (KW)	A, B, C, Total
Reactive Power (KVAR)	A, B, C, Total
Apparent Power (KVA)	A, B, C, Total
Power Factor (True)	A, B, C, Total
Frequency	
Real Energy (KWH)	3 Phase Total
Reactive Energy (KVARH)	3 Phase Total
Apparent Energy (KVAH)	3 Phase Total

c. Communications:

- 1) The power monitor relay shall have an RS 485 two wire multi drop port available for user interface to SCADA equipment.
- 2) The RS 485 port shall allow remote access to all measured values via MODBUS RTU protocol.
- 3) The port shall communicate up to 19.2 Kbaud.

d. Sensors:

1) Meter shall monitor all 3 phases of current using standard 5 amp secondary current transformers.

- 2) Meter shall monitor all 3 phases of voltage plus Neutral by direct input or through the use of potential transformers.
- 3) Voltage inputs weather direct or through PT's shall be fused. PT's shall be fused both primary and secondary.

3. Mounting:

a. Meter shall be mounted in face of MCC as indicated on drawings.

I. Miscellaneous:

1. Pilot devices such as selector switches, pushbuttons and indicating lights shall be furnished when specified.

J. Nameplates:

- Nameplates shall be provided for each cubicle and motor control center. Nameplates shall be lamicoid engraved on white face to black cores in accordance with drawings.
 Relay types shall also be identified with nameplates on the panels above the relay case to show device number.
- 2. In addition, another nameplate shall bear the purchase order number and the purchase order item number for each motor control center.
- 3. An additional nameplate showing project motor control center identification number in characters not less than 1/2" high shall be permanently attached to each motor control center following final painting.

K. Wiring:

- 1. When Standard Elementary Diagram(s) are provided, the wiring shall be in accordance with those diagrams.
- 2. All wiring shall be stranded copper conductor insulated with highly flame retardant insulation. Type SIS or XHHW, or Tefzel are considered suitable.
- 3. Wiring for control circuits shall be minimum No. 16 AWG, except CT wiring not less than No. 10 AWG, single conductor stranded copper. These shall be trained neatly and grouped in racks using wire cleats or straps supported along panel. Terminal blocks for each unit shall have screw type connectors.
- 4. Wiring shall be complete, with every contact of each device, including spare contacts, wired to terminal blocks for external connections.
- 5. Wire connectors shall be self-insulated, flanged spade, crimp-on-type.
- 6. Internal wiring shall be identified with the Vendor's wire number at each end of each wire by a plastic sleeve or heat shrink permanent marker. Dymo tape is not acceptable.
- 7. Because of the possibility of corrosive off gassing at higher in-service temperatures over an extended period, PVC is not acceptable for wire insulation of jacketing, insulating skirts on crimp-on wire connectors, or the wire marker sleeves called for in Subparagraph J.6 above.
- 8. Suitable extra-flexible wiring shall be provided over door hinges or other locations where leads may be subjected to flexing.

- 9. Control wire bundles shall be formed without sharp bends and shall be adequately supported and protected.
- 10. Wiring and components shall be arranged so that instruments or devices may be removed and/or serviced without disturbing the wiring. No control wire shall be routed across the face or rear of an instrument, junction box, or other device in a manner which will prevent the opening of covers or obstruct access to leads, terminals, devices of instruments.
- 11. 15% or 20 spare terminals (whichever is less) shall be provided.

2.02 PAINTING

- A. Motor control center shall be painted in accordance with the Vendor's standard specification.
- B. A sufficient quantity of touch-up paint shall be furnished.

2.03 SHIPPING, HANDLING AND STORAGE

- A. Preparation for shipment shall protect the equipment and accessories against corrosion, dampness breakage or vibration injury in transportation and handling. Packaging shall prevent tampering or pilfering and shall be approved and accepted by transportation companies.
- B. Each shipping section shall be provided with suitable steel section supports, lifting eyes, etc., to maintain alignment of parts during shipping, handling, hoisting and installation. The location of lifting points shall be clearly identified on shipping containers and on drawings. Each shipping section shall have its weight clearly marked on the container.
- C. Necessary bus connections, wire jumpers, bolts, nuts, washers, etc., shall be furnished, suitably packaged and marked to facilitate field assembly. Each shipping container shall be identified with the name of contents, purchase order number, and purchase order item number.

2.04 INSPECTION AND TESTING

A. Design Test:

1. Motor control centers, each size combination motor starter unit, contactors and feeder breakers shall be tested for adequacy of design in accordance with NEMA ICS 2 and UL 845. The Vendor at the time of bid shall provide design test documentation certifying that all equipment provided has been tested in accordance with ANSI, NEMA, UL, ICS 2-322.41 AND 322.42 and the results of the tests prove that all equipment meets ratings and requirements of the industry codes and standards.

B. Production and Conformance Tests:

- Owner's inspector has the right to inspect, at all reasonable times and at all locations, including Subcontractor's premises, during fabrication and assembly, and to witness all testing and quality control procedures which may take place during fabrication and final testing.
- 2. The Vendor shall perform all standard production and conformance tests including applicable NEMA, ANSI and UL standard and functional tests to ensure proper function, performance and operation of the supplied equipment.

2.05 EQUIPMENT DATA SHEET

- A. The Vendor shall provide the following:
 - 1. Descriptive literature and/or pamphlets covering circuit breakers, magnetic contactors, overload relays, control and instrument transformers, transducers, and instruments.
 - 2. Descriptive literature and/or pamphlets covering the design and general construction of the motor control centers.
 - 3. Information on terminal blocks, nameplates, etc., normally used for this type of equipment.

2.06 MOTOR CONTROLS NOT IN MOTOR CONTROL CENTERS

- A. Furnish stainless steel with gasketed hinged door control cabinets to protect and conceal all control devices. Arrange components neatly to provide adequate maintenance opportunity and proper device function. Label all components, numerically code all piping and wiring. Terminate all wiring at terminal blocks. Provide engraved plastic labels for all panel face devices.
- B. Auxiliary relays shall be:
 - 1. Light Duty: Honeywell R4222/R8222.
 - 2. Heavy Duty: Square D, Class 8501, Type X.
- C. Manual switches shall have:
 - 1. Pilot lights.
 - 2. Overload Protection: Melting alloy type thermal overload relays.

PART 3 - EXECUTION

- 3.01 WIRING
 - A. All control wiring, 120 volt and below, shall be installed in conduit and wiring boxes.
 - B. Use no wiring smaller than #16 AWG and no conduit smaller than 3/4 inch.
- 3.02 MCC INSTALLATION
 - A. Anchor to floor and building structural members for seismic restraint.
 - B. Provided a 4 inch housekeeping pad for MCC.
- 3.03 ATTACHMENTS
 - A. The following documents are attached and are considered a part of this specification:
 - 1. Appendix D Engineering Data Motor Control Center

APPENDIX D

ENGINEERING DATA - MOTOR CONTROL CENTER

MCC Tag Numbers
 Service Conditions
 All shown on drawings
 35°F to 105°F

4300 Feet Elevation Indoor

Other Uniform Building Code Seismic Zone 3

3. Structure NEMA Enclosure Type 1A,

Minimum 18 Gauge Steel

4. Mounting Front Only

5. System Characteristics 480 Volts, 3 Phase, 4 Wire

60 Hertz, solidly grounded neutral

6. Control Voltage 120 Volts, 1 Phase, 60 Hertz

7. Wiring 1B

8.1 Type B Wiring Pull-apart Terminals

8. Vertical Sections 20" Deep

9. Horizontal Wireway Top and Bottom

10. Bus Bars Temperature Rise - 50°C per UL 845

10.1 Main Bus Rating 600A or As shown on drawings

10.2 Vertical Bus Rating 300A

10.3 Neutral Bus Not required

10.4 Ground Bus 1//4" x 1"

10.5 Bus Material Copper, Tin Plated Connections

10.6 Bus Braced for Amp Sym 22,000 minimum or as shown on drawings

11. Incoming Feeder As shown on drawings

12. Main Service Disconnect Shall be as shown on drawings

13. Metering Shall be as shown on drawings

14. Combination Starters*

14.1 22,000 Amp. Sym. Interrupting rating unless otherwise specified.

14.2 Type Motor Circuit Protector

Ground Fault Protectors on Motors 30 HP

and larger

Interposing Relays for NEMA size 4 and above starters

14.3 Overload Relays Ambient Compensated, solid state, with phase

imbalance, phase loss, overcurrent, class 10 or 20

14.4 Control Transforms One size larger than Standard

14.5 Number of Auxiliary Contacts in NO Contacts*
Addition to the Seal-in-Contacts
NC Contacts*

*As shown on typical elementary diagrams

- 15. Branch Circuit Feeders (for other than motor loads)**
 - 15.1 Minimum 22,000 Amp. Sym. Interrupting Rating, unless otherwise specified higher on drawings.
 - 15.2 Ground Fault Protection for welding and power receptacles.
- 16. Special Features
 - 16.1 Low Watt Density Space Heater 240V for operation at 120V, 1 phase, 60 Hz supply to prevent condensation in each section if required on drawings.

With thermostat Space heater power supply 120 volts, 1 Phase

16.2 Ventilation None

16.3 Maintenance Receptacles None

16.4 Illumination None

16.5 1-phase current transducers with 4-10 mA totally isolated output shall be provided when specified on drawings.

**Equipment supplier must provide interrupting rating of each device and complete unit.

END OF SECTION

SECTION 26 27 26 – WIRING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Light switches, receptacles, device plates, dimmers, plug-in strips, and tele-power poles.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 Procurement and Contracting Requirements
 - 2. Division 01 General Requirements
 - 3. Section 26 00 00 General Electrical Requirements
 - 4. Section 26 05 26 Grounding and Bonding for Electrical Systems
 - 5. Section 26 05 33 Raceway and Boxes for Electrical Systems

1.02 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Section 26 00 00 General Electrical Requirements

1.03 SUBMITTALS

- A. Shop Drawings:
 - 1. Refer to Division 01 General Requirements and Section26 00 00 General Electrical Requirements.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Light switches (except explosion proof):
 - a. Hubbell
 - b. Slater
 - c. P&S
 - d. Arrow Hart
 - e. General Electric
 - f. Leviton
 - 2. Explosion proof light switches:
 - a. Crouse-Hinds

	b. Appleton Electric Co.	
	c. Killark	
3.	Door switches:	
	a. General Electric	
	b. Slater	
	c. P&S	
	d. Arrow Hart	
	e. Micro-switch	
4.	Receptacles (except explosion proof):	
	a. Hubbell	
	b. Slater	
	c. P&S	
	d. Arrow Hart	
	e. General Electric	
	f. Leviton	
5.	Explosion proof receptacles:	
	a. Crouse-Hinds	
	b. Appleton Electric Co.	
	c. Killark	
6.	Welding receptacles:	
	a. Crouse-Hinds	
	b. Appleton Electric Co.	
7.	Tele-power poles:	
	a. Wiremold	
	b. Walker	
8.	Dimmers:	
	a. Lutron	
	b. General Electric	
	c. P&S	
9.	Plug-in strip:	
	a. Wiremold	
	b. Walker	

2.02 MATERIALS

A. Light Switches for Unclassified Areas:

- 1. Toggle type, quiet action, specification grade with grounding terminal.
- 2. Back and side wired.
- 3. Solid silver cadmium oxide contacts.
- 4. One-piece switch arm rated 20 A, 120/277 V AC.
- 5. UL listed.
- 6. Color: Ivory.
- 7. Wall plate: Type 304 stainless steel.
- 8. Type: As indicated on Drawings.

B. Receptacles for Unclassified Areas:

- 1. Straight blade, grounding type, specification grade.
- 2. Back and side wired with wrap-around bridge.
- 3. Rated 20 A, 125 V AC.
- 4. UL listed.
- 5. Color:
 - a. For use on normal power: Ivory.
 - b. For use on UPS systems: Red.
 - c. For use on isolated ground systems: Orange.
- 6. Wall plate: Type 304 stainless steel.
- 7. Type: As indicated on Drawings.

C. Light Switches for Wet Areas:

- 1. Presswitch type, quiet action, specification grade, with grounding terminal.
- 2. Back and side wired.
- 3. Solid silver cadmium oxide contacts.
- 4. One-piece switch arm rated 20 A, 120/277 V AC.
- 5. UL listed.
- 6. Color: Ivory.
- 7. Wall plate: Gray weatherproof presswitch type.
- 8. Type: As indicated on Drawings.

D. Receptacles for Wet Areas:

1. Straight blade, grounding type, specification grade.

- 2. Back and side wired with wrap around bridge.
- 3. Rated 20 A, 125 V AC.
- 4. UL listed.
- 5. Color: Ivory.
- 6. Wall plate: Weatherproof, cast aluminum, UL listed, WDL open and closed.
- 7. Type: As indicated on Drawings.

E. Ground Fault Circuit Interrupter Receptacles:

- 1. Straight blade, grounding type, specification grade.
- 2. Rated 20 A, 125 V AC.
- 3. UL listed.
- 4. Test and reset buttons.
- 5. Wall plate: Indoor or weatherproof as required.
- 6. Feed-through type.

F. Light Switches for Corrosive Areas:

- 1. Corrosion-resistant NEMA 4X enclosure with switch consisting of:
 - a. Fiberglass reinforced polyester enclosure.
 - b. Fiberglass reinforced polyester gasketed wall plate with built-in toggle lever switch with stainless steel shaft.
 - c. Grounding bushing.
 - d. Rated 20 A, 125 V AC.
 - e. UL listed.
 - f. Type: As indicated on Drawings.
 - g. Color: Yellow.
- 2. Optional: Corrosion-resistant enclosure and switch consisting of:
 - a. Cast copper-free aluminum "FS" or "FD" ridge type hub box.
 - b. Toggle type, quiet action, specification grade with grounding terminal.
 - c. Rated 20 A, 125 V AC with solid silver cadmium oxide contacts.
 - d. UL listed.
 - e. Neoprene gasket.
 - f. Cast aluminum cover with stainless steel screws and lever to activate switch.
 - g. Type: As indicated on Drawings.
 - h. Color: Yellow.

G. Receptacles for Corrosive Areas:

- 1. Corrosion-resistant straight blade, grounding type, specification grade.
- 2. Back and side wired with wrap-around bridge.
- 3. Rated 20 A, 125 V AC.
- 4. UL listed.
- 5. Color: Yellow.
- 6. Box: "FS" or "FD" ridge type cast hub box of copper-free aluminum.
- 7. Gasket: Neoprene.
- 8. Wall plate: Weatherproof, cast aluminum, UL listed, WDL open or closed.
- 9. Type: As indicated on Drawings.
- H. Explosion proof Light Switches for Use in Hazardous Areas:
 - 1. Explosion proof, UL listed for Class I, Division 1 and 2, Groups B, C, and D; and Class II, Division 1 and 2 areas, Groups E, F, and G.
 - 2. EDS factory sealed.
 - 3. Malleable iron body and cover.
 - 4. Aluminum sealing chamber.
 - 5. Front operated handle with stainless steel shaft.
 - 6. Rated 20 A, 125 V AC.
 - 7. With grounding screw.
 - 8. Type: As indicated on Drawings.
- I. Explosion proof Receptacles for Use in Hazardous Areas:
 - 1. Explosion-proof, UL listed for Class I, Division 1 and 2, Groups B, C, and D; and Class II, Division 1 and 2, Groups F and G.
 - 2. Factory-sealed malleable iron receptacle with spring-loaded cover.
 - 3. Malleable iron mounting box.
 - 4. Rated 20 A, 125 V AC.
 - 5. "Dead-front" construction requiring plug to be inserted and rotated to activate receptacle.
 - 6. Type: As indicated on Drawings.
- J. Welding Receptacles:
 - 1. 60 A, 480 V, 3 pole, 4 wire, grounding type.
- K. Plug-In Strip: Surface steel raceway plug-in strip with single 15 A, 125 V, 3 wire grounding-type receptacles spaced 18 IN on center.
 - 1. Prewired with two #12 TW and one #12 TW green insulated ground.
 - 2. Minimum 1-1/4 IN wide x 3/4 IN deep.

- 3. Suitable fittings and snap-in cover.
- 4. Finish:
 - a. Stainless steel.
- 5. Receptacle color:
 - a. For use on normal power: Ivory.
 - b. For use on UPS systems: Red.
 - c. For use on isolated ground systems: Orange.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Mount devices where indicated on the Drawings.
- B. Surface mount receptacles and light switches in concrete construction.
- C. In masonry and metal stud construction, recess mount receptacles and light switches unless device precludes recessed mounting or unless otherwise noted on the Drawings.
- D. Where more than one receptacle is installed in a room, they shall be symmetrically arranged.
- E. Set switches and receptacles plumb and vertical to the floor.
- F. Set recess-mounted switches and receptacles flush with face of walls.
- G. Do not connect dimmers to loads in excess of 80 percent of the rating of the dimmer.
- H. Provide blank plates for empty outlets.

END OF SECTION

SECTION 26 29 23 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes
 - 1. Variable Frequency Drive (VFD) systems rated 480 VAC or lower.

1.02 VFD FEATURES

- A. The VFDs shall be provided with the following features:
 - 1. Fused control circuit transformer.
 - 2. Provision for 4 to 20 mA input speed reference signal.
 - 3. Electrically isolated auxiliary contacts for ready, running, and trouble status.
 - 4. Adjustable minimum/maximum frequency limits.
 - 5. Independent timed linear acceleration and deceleration.
 - 6. Adjustable motor slip compensation based on motor current.
 - 7. Terminal blocks for control and signal wires entering and leaving the controller.
 - 8. Output transistors shall be insulated gate bipolar transistors (IGBT) type, or Darlington pair.
 - 9. Current limit.
 - 10. Programmable automatic restart.
 - 11. 4 to 20 mA output signal proportional to VFD output frequency.
 - 12. Digital keypad for configuration, programming, local control, and monitoring.
 - 13. Microprocessor-based control for system logic sequencing functions.
 - 14. VFD shall be 18-pulse with a harmonic filter so as to satisfy harmonic mitigation requirements defined elsewhere in this specification.

1.03 FUNCTIONAL REQUIREMENTS

- A. SUPPLY POWER: The VFD shall operate continuously with supply power of 460 volts plus or minus 10 percent, 60 hertz plus or minus 3 percent. The VFD shall remain on line and operate without damage to either the VFD or its connected load during a supply power variation of plus 50 percent lasting for a period of up to 0.01 seconds and minus 100 percent lasting for a period of up to 0.5 seconds.
- B. AMBIENT CONDITIONS: The VFDs shall be rated to operate continuously as specified in an ambient temperature of 0 to +45 degrees C and an ambient humidity of 0 to 90 percent, non-condensing. VFD's are to be upsized as necessary so as to meet operating temperature requirements without the use of A/C units.
- C. LOAD: The VFD system shall be capable of 110% continuous current overload. Variable torque inverters shall be capable of delivering 120 percent of the specified load for up to 60 seconds, and constant torque inverters shall deliver 150 percent overload current for 120 seconds.
- D. POWER FACTOR: Displacement power factor shall be not less than 0.95 at rated full speed and load. Overall power factor, including harmonic distortion, shall be 0.85, or greater.

- Contractor shall provide power factor correction components as necessary to meet this requirement.
- E. EFFICIENCY: Efficiency of VFD systems shall be at least 96 percent at 60 hertz output driving the specified maximum load.
- F. FREQUENCY AND VOLTAGE REGULATION: VFD output frequency shall be regulated to within 0.6 hertz of the frequency set point. VFD output voltage shall be regulated to within ±1.0 percent of that value which will produce minimum motor heating at any operating frequency within the specified range.
- G. FREQUENCY RANGE: VFD shall be capable of continuous operation with the specified load at any frequency between 0.1 hertz and 60 hertz.
- H. SPACE: VFD system size shall not exceed the size allotments specified on the Drawings, nor shall any portion of the VFD system exceed a height of 90 inches. VFD system shall be front accessible and shall not require rear access. The VFD equipment shall be suitable for mounting directly against the wall without any clearance for ventilation or other purposes. VFD units shall be arranged as required for entry of incoming line cables and as required for entry of load cables.
- I. AMBIENT NOISE: Free field noise generated by the VFD shall not exceed 85 dBA at 3 feet out from any point on the VFD cabinet under any normal operating condition.

1.04 PROTECTION AND ANNUNCIATION

- A. OVERCURRENT PROTECTION: The VFD system shall provide electronic current limit at 150 percent of motor nameplate current. Current limit shall be accurate to within 1.0 percent and shall smoothly limit motor speed at whatever value is necessary to limit motor current to that value.
- B. The VFD shall also provide motor running overcurrent protection in compliance with NFPA 70.
- C. SHORT CIRCUIT PROTECTION: The VFD shall be fully protected against load faults. Bolted faults, phase to phase, or phase to ground shall not damage the unit. Any impedance or other current limiting necessary to meet this requirement shall be provided as part of the VFD system, and any losses caused by current limiting devices shall be included in efficiency calculation for the VFD system.
- D. LINE VOLTAGE: The VFD shall be protected against high and low line voltage on one or more phases.
- E. INTERNAL FAULTS: The VFD shall incorporate an internal fault monitoring system to detect malfunctions. This system shall be designed to protect the VFD from transient and sustained faults, and to limit damage that may be caused by these faults.
- F. OVERTEMPERATURE: Overtemperature circuitry shall shut down the VFD upon overheating, and display an overtemperature alarm, or message.
- G. DIAGNOSTICS: The VFD shall be provided with a fault diagnostics system that indicates the cause of any shutdown. The system shall store faults in memory and discard the oldest faults as

new ones fill the memory. Faults shall be accessible via a digital keypad, also used for local control and programming.

1.05 EXTERNAL CONTROL AND MONITORING

- A. SPEED REFERENCE: The VFD shall accept a 4 to 20 milliampere direct current speed reference signal. Speed reference input shall be galvanically isolated and input resistance shall not exceed 250 ohms.
- B. READY SIGNAL: The VFD shall provide a contact closure that indicates that the controller line power supply is within acceptable tolerances, the control circuits are normal, and there are no internal or external fault conditions that have not been reset. Presence of this signal indicates that the controller should start normally.
- C. RUNNING SIGNAL: The VFD shall provide a contact closure which indicates that the controller is running.
- D. SYSTEM TROUBLE: Isolated normally open contacts for remote fault annunciation shall be provided and wired to terminal blocks, which shall be labeled and identified. Contact shall close under fault conditions. Fault conditions that drive the outputs shall be selectable from the digital keypad.
- E. The VFD control circuitry shall shutdown the VFD if the motor overheats. Motor winding temperature switches, or RTDs, shall be connected if provided by the motor manufacturer.

1.06 QUALITY ASSURANCE

A. This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
IEEE 519-1992	Guide for Harmonic Control in Electric Power Systems
NEMA 250-85	Enclosures for Industrial Control and Systems
NEMA ICS 2-83	Industrial Control Devices, Controllers and Assemblies
NEMA ICS 3-83	Industrial Systems
NFPA 70-87	National Electrical Code (NEC)

Underwriters Laboratories UL 508

- B. The VFD shall comply with the applicable requirements of NEMA ICS 3 and additional standards referenced by ICS 3.
- C. The VFDs specified in this section shall be the product of a single vendor. The Contractor shall assign unit responsibility for the adjustable frequency drives in this section. The Contractor shall submit letters of certification with the shop Drawings from the VFD manufacturer, the motor

manufacturer, and the driven equipment manufacturer stating that they have reviewed each application and that the combination will satisfy the application duties required, for the actual motor sizes required, regardless of deviations from the scheduled "nominal horsepower".

D. VFD manufacturing facility shall be ISO 9001 certified.

1.07 SUBMITTALS

- A. The following information shall be provided in accordance with the Contract Documents:
 - 1. Catalog and technical data.
 - 2. Outline dimensions, shipping section dimensions, weight, and foundation requirements for all assemblies.
 - 3. External connection wiring diagram showing function and identification of all terminals requiring field connections.
 - 4. Line harmonic distortion calculations and filter design if applicable.
 - 5. Component fabrication Drawings consisting of detailed circuit schematics, printed circuit board Drawings, and chassis layouts for all electrical and electronic components.
 - 6. Manufacturer's certification that VFD can withstand fault conditions specified in paragraph 16904-1.04.
 - 7. Manufacturer's certification that VFD can withstand environmental conditions specified in paragraph 16904-1.04.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The VFDs shall be manufactured by Eaton Cutler-Hammer, Schneider Square D, Rockwell Allen-Bradley, Toshiba, or equal. Where VFDs are to be installed integrally to a motor control center, VFDs shall be of the same manufacturer as the MCC.
- B. AC reactors shall be TCI, MIRUS, Powersmiths, or equal.

2.02 ENCLOSURES

A. Enclosures shall be as shown on the Drawings, with force ventilated gasketed enclosures. UL approved Class 1 filters shall be provided on ventilation openings. Cabinets shall be fabricated from 14 gauge minimum thickness sheet steel. Cabinet shall be provided with an interior frame or otherwise formed so as to provide a rigid structure. Doors shall be hung on removable-pin hinges and equipped with vault-type latch capable of accepting a 3/8-inch-shackle padlock. Three-point latch hardware shall be provided. Door width shall not exceed 30 inches.

2.03 INVERTER

- A. A door interlocked power disconnecting means shall be provided to protect the inverter against internal faults and as a backup for external load faults. Load faults shall normally be cleared by the inverter assembly.
- B. Harmonic filtering shall be provided on each VFD to reduce total harmonic distortion (THD) of the voltage and current power source. Total voltage and current harmonic distortion, including contribution of notching, and with all VFDs in operation shall not exceed the limits set forth for

a general system in IEEE 519-1992, Tables 10.2 and 10.3. The voltage THD shall not exceed 5% and the current TDD shall not exceed 8%, as measured at the point of common coupling. The point of common coupling (PCC) is defined herein as the circuit breaker feeding VFD, or where VFD connects to the bus.

- C. AC reactor coils in output circuitry of the VFD shall be provided to limit inductive switching surges such that the measured RMS voltage at the motor terminations does not exceed 480 VAC line to line.
- D. Provide EMI/RFI filtering to eliminate radio interference between 10KHZ and 30MHZ.

2.04 CONTROL DEVICES

- A. The following control devices shall be front mounted on the VFD enclosure:
 - 1. Digital keypad.
 - 2. Manual/remote speed control selector switch.
 - 3. VFD run light.
 - 4. Inverter ready light.
 - 5. Inverter fault light
- B. Control devices shall be as specified herein. Indicating lamps shall be high intensity colored LED type with clear lenses.

PART 3 - EXECUTION

3.01 FIELD INSTALLATION

A. Each VFD shall be installed and tested by the Contractor with the assistance of factory-trained engineers in accordance with the manufacturer's specifications and the Contract Documents. The installation shall be certified on forms provided in the Contract Documents.

3.02 TESTING

A. Test in accordance with Specification 26 01 27 – ELECTRICAL ACCEPTANCE TESTING.

3.03 TRAINING

A. Provide four (4) hours of VFD training for the Owner's Operations and Maintenance Staff. Training shall be certified on forms provided in the Contract Documents. Training shall cover VFD theory of operation, features and functions available, normal operation, troubleshooting, and routine maintenance. The Contractor shall submit a syllabus for the training session for approval, within 3 weeks of conducting the class. Provide each attendee with a class syllabus detailing each topic to be discussed.

3.04 SPARE PARTS

- A. The following spare parts shall be supplied with each type, or frame size, of VFD:
 - 1. Three sets of all replaceable fuses
 - 2. One of each type of replaceable printed circuit board
 - 3. Two of each type of output power transistor

applicable)	llters for each typ	- 1111 5120 of W	 	
	End of Section	on		

SECTION 26 43 00 – TRANSIENT VOLTAGE SURGE SUPPRESSION SYSTEM (TVSS)

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This section specifies Transient Voltage Surge Suppression (TVSS) System(s).

1.02 SUBMITTALS

- A. Submit manufacturer's data demonstrating compliance with this specification and the Plans. Information shall include, but not be limited to:
 - 1. An equipment manual with installation, operation, and maintenance instructions for the specified unit.
 - 2. A list of customer-replaceable spare parts.
 - 3. Electrical and mechanical drawings which show unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit.
 - 4. Certification of the MCOV 1-hour burn-in.
 - 5. Certification from an independent laboratory of single-pulse surge current ratings.
 - 6. A copy the UL 1449 compliance document showing UL 1449 Suppression Ratings.
 - 7. Certification of life-expectancy testing.

1.03 QUALITY ASSURANCE

- A. Comply to the following Codes and Standards:
 - 1. ANSI/IEEE (C62.41-1991 and C62.45-1987);
 - 2. NFPA (70 [NEC], 75 and 78);
 - 3. NEMA (LS-1-1992);
 - 4. NEC (240-21 and 110-9);
 - 5. UL (1283 and 1449);
 - 6. All units shall be UL 1449 and UL 1283 Listed.
- B. The specified system(s) shall be manufactured in the USA by a manufacturer engaged in the design and manufacture of the specified system for a minimum of 5 years.

1.04 WARRANTY

A. The manufacturer shall provide a Limited Five (5) Year Warranty from date of shipment against failure when installed in compliance with applicable national and local electrical codes and the manufacturer's Installation, Operation and Maintenance Instructions.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable.
 - 1. Current Technology
 - 2. Liebert
 - 3. Advanced Protection Technologies
 - 4. or Equal.

2.02 ELECTRICAL REQUIREMENTS

- A. Provide TVSS units as indicated on the Plans and specified herein.
- B. The maximum continuous operating voltage (MCOV) of all suppression components utilized in all units shall not be less than 115 % of the nominal operating voltage for 277/480 volt nominal systems.
- C. In accordance with NEMA Standard LS 1-1992, the unit shall provide protection in all modes. The primary mode of protection shall be line-to-neutral. The secondary modes of protection shall be line-to-ground and neutral-to-ground.
- D. Based on ANSI/IEEE C62.41-1991's 8 x 20 microsecond current waveform, and in accordance with NEMA Standard LS 1-1992, the tested single-pulse surge current capacity for each mode of protection of the units (in amps) shall be no less than as follows:

SURGE CURRENT CAPACITY					
PRODUCT	AMP CLASS (L-N + L-G)	L-N	L-G	N-G	
MAIN TVSS	250,000	150,000	100,000	100,000	

SURGE CURRENT CAPACITY				
PRODUCT	AMP CLASS (L-N+L-G)	L-N	L-G	N-G
PANELBOARD	160,000	80,000	80,000	80,000
TVSS				

E. The unit's published performance ratings shall be the UL 1449 Listed suppress ratings. The UL 1449 suppression rating shall be given for the unit, as specified, an Integral Fused Disconnect Switch The UL 1449 suppression rating shall be, for each mode of protection, as follows:

PRODUCT	VOLTAGE	UL 1449 SUPPRESSION RATING		
		L-N	L-G	N-G
MAIN TVSS	277/480	1,000	1,000	800

PRODUCT	VOLTAGE	UL 1449 SUPPRES	UL 1449 SUPPRESSION RATING		
		L-N	L-G	N-G	
PANELBOARD	277/480	1,000	1,000	800	
TVSS	Three Phase				
PANELBOARD	120/208	500	500	500	
TVSS	Three Phase				
PANELBOARD	120/240	500	500	500	
TVSS	Single Phase				

F. The system shall be tested and capable of protecting against and surviving at least 6,000 ANSI/IEEE C62.41-1991 Category C3 surges without failing or degrading the UL 1449 Surge Suppression Ratings by more than 5%.

2.03 PRODUCT

- A. Each unit shall include solid-state suppression system, utilizing a multitude of selenium cells, avalanche diodes, or arrays of fused non-linear voltage dependent metal oxide varistors (MOVs) with similar operating characteristics.
- B. The suppression system's components shall optimally share surge currents in a seamless, low-stress manner assuring maximum, non-degrading voltage clamping and surge current diversion performance and proven reliability. The suppression system shall contain field replaceable fuses.
- C. The unit shall include a high-frequency extended range tracking filter and shall be UL 1283 Listed as an Electromagnetic Interference Filter. The filter shall reduce fast rise-time, high-frequency, error-producing transients and electrical line noise to harmless level, thus eliminating disturbances which may lead to system upset. Standardized insertion loss data shall be obtained using MIL-STD-E220A 50 ohm insertion loss methodology. The filter shall provide attenuation throughout the frequency spectrum of 100 kHz to 100 MHz.
- D. All internal connections associated with the suppression and filter system and subject to surge currents shall be made with compression solderless-type lugs and shall be bolted to the bus bars in order to reduce overall system impedance. No plug-in component modules, quick-disconnect terminals or printed circuit boards shall be used in surge current-carrying paths. Internal wiring associated with the suppression/filter system and subject to surge currents shall utilize low-impedance copper bus bar and #4 AWG copper conductor or larger.
- E. Field Connections: The TVSS shall include mechanical lugs for each phase, neutral and ground. The lugs shall accommodate the conductor sized indicated on the Plans.
- F. Each unit shall include solid-state, long-life, externally mounted LED visual status indicators that indicate the diagnostic status of the following groups of suppression modules:
 - 1. Line to Neutral
 - 2. Line to Ground
 - 3. Neutral to Ground
- G. Each TVSS shall include a disturbance counter for both common mode (L-G) and normal mode (L-N). The Disturbance Counters shall contain-lithium batteries and a reset function.

H. Each unit shall include a lockable fused safety disconnect switch, located in the unit enclosure with an externally mounted manual operator. Each switch shall disconnect all ungrounded circuit conductors from the distribution system to enable testing and maintenance without interruption of power to the facility's distribution system. The switch shall be rated for 600 Vac. Each current-carrying ungrounded circuit conductor connected to the facility's distribution system shall be individually fused with 200,000 AIC rated fuses (One 200,000 AIC Fuse Per Phase) in order to provide maximum fault current protection. The unit shall be UL 1449 Listed with the integral fused disconnect switch and the UL 1449 Suppression Rating for this configuration shall be provided.

PART 3 - EXECUTION

3.01 FIELD INSTALLATION

A. Each unit shall be installed adjacent to the electrical equipment as indicated on the Plans, avoiding unnecessary bends, in accordance with applicable national and local electrical codes, and the manufacturer's recommended installation instructions.

3.02 CERTIFICATION OF ON-LINE STATUS AND SUPPRESSION LEVELS

A. The Contractor shall submit the test results to the Engineer.

END OF SECTION

SECTION 26 50 00 - LIGHTING

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. The General Conditions, Supplementary General Conditions, Special Conditions, Alternates and addenda, applicable drawings and the technical specifications herein shall apply to all work under this **Division 26**.
- B. The Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install lighting fixtures.
- C. Provide all operations, methods, labor and equipment and provide and install all materials and incidentals necessary for the completion of the work as specified herein or included on the drawings.

1.02 QUALITY ASSURANCE

A. Reference Standards:

- 1. National Electrical Code (NEC)
- 2. UL Standard #57, Electric Lighting Fixtures
- 3. UL Standard #844, Electric Lighting Fixtures for Use in Hazardous Location
- 4. UL Standard #1570, Fluorescent Lighting Fixtures
- 5. UL Standard #1571, Incandescent Lighting Fixtures
- 6. UL Standard #1572, High Intensity Discharge Lighting Fixtures
- 7. UL Standard #8750, Light Emitting Diode Equipment for Use in Lighting Products
- 8. Illuminating Engineering Society (IES)
- 9. All applicable local lighting ordinances

B. Miscellaneous:

- 1. Lamps are identified for each luminaire in the Lighting Fixture Schedule on the Plans.
- 2. Lighting fixtures and electrical components:
 - a. UL labeled, complete with lamps.
 - b. Rated for area classification as indicated.
- 3. Location of lighting fixtures on Plans are intended to be used as a guide.
 - a. Field conditions may affect actual locations.
 - b. Coordinate with other trades to avoid conflicts in mounting of fixtures and other equipment.
- 4. The quality standard is established by the fixture listed in the Lighting Fixture Schedule.

a. This quality standard includes, but is not necessarily limited to construction features, materials of construction, finish, and photometrics.

1.03 SUBMITTALS

- A. The following shall be submitted to the Engineer for review:
 - 1. Acknowledgment that products submitted meet requirements of standards referenced.
 - 2. Manufacturer's technical information on products to be used including photometric performance curves for the fixture and ballast data.
 - 3. Acknowledgment that products submitted are UL or ETL listed.
 - 4. When general data sheets constitute part of the submittal, identify the products to be used on this project.
 - 5. Manufacturer's installation instructions.
 - 6. Identification of fixtures by Lighting Fixture Schedule.
 - 7. UL nameplate data (Voltage, wattage, etc.).
 - 8. Finishes, colors, and mounting type.
 - 9. Pole, fixture, and accessories.
 - 10. Pole wind loading.
- B. Contractor shall submit shop drawings, manufacturer's data sheets, and a complete wiring diagram detailing all connections to the electrical system in accordance with **Section 26 00 00**, and other requirements of the Contract Documents.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Incandescent, Fluorescent, and HID Lamps shall be manufactured by General Electric, North American/Phillips, Sylvania, or equal.
- B. Lighting fixtures shall be provided as indicated on the Lighting Fixture Schedule on the Plans.
- C. Lighting ballasts shall be manufactured by General Electric, Advance, Jefferson, Universal, Bodine, Lithonia, or equal.
- D. Light poles shall be as indicated on the Plans. Include base template, anchor bolts, cadmiumplated hardware and pole grounding lug, handhole, anchor base and bolt covers. Pole foundations shall be as indicated on the Plans.

2.02 LIGHTING FIXTURES:

A. General: All new lighting fixtures shall be as scheduled on drawings complete with all required suspension accessories, canopies, casing sockets, holders, reflectors, plaster frames, and other items and shall be completely wired and assembled. Fluorescent and high intensity discharge (HID) fixtures shall be equipped with fused ballasts.

- B. Fluorescent Ballasts: All ballasts shall be electronic type as scheduled on the drawings and shall comply with the following:
 - 1. Fluorescent electronic ballasts: Shall comply with FCC rules and regulations part 18 concerning the generation of both EMI (electromagnetic interference) and RFI (radio frequency interference). Shall be Class "A" sound rated and UL class "P" thermally protected and shall be tested per ETL format. The ballast shall withstand input power line transients as defined in ANSI C62.41. The ballast shall tolerate a line voltage variation of +/-10%, shall have a power factor of 95% or higher and the lamp crest factor shall measure 1.7 or less for rapid start ballasts and 1.85 or less for instant start ballasts. The total harmonic distortion of the input current to the electronic ballast shall not exceed 20% of the input current. The ballast shall operate at 20Khz or higher and shall operate standard lamps at 50 degrees F and energy saving lamps at 60 degrees F. Ballast case temperature shall not exceed 25 degrees C rise above a 40 degrees C ambient temperature. The ballast shall be provided with an internal fuse to protect the electrical power supply from internal component failure. The ballast shall also be short-circuit protected in the event of miss wiring. Each fluorescent ballast shall be fused with Bussman type HLR fuseholder with GLR fuse (or equivalent) connected in the phase line to the ballast and mounted within the fixture. The electronic ballast shall be warranted against defects in material and workmanship for three years. The warranty shall include either a \$15 replacement labor allowance or complete replacement including labor by an agent of the manufacturer.
 - 2. Ballasts shall be #B432I, 120 hpas manufactured by Magnetek or equal of Sylvania, Howard, Advance, Motorola.
- C. HID Fixture Ballasts: shall be high-power-factor type as manufactured by General Electric, Universal, Advance, or approved equivalent. Shall be equipped with integrally mounted primary fuse in totally enclosed fuse holder in each phase line to the ballast.
- D. LED Fixture Drivers: shall be dimmable an will operate as designed in environments up to 40deg C. The driver will operate minimum 80,000 hours and will be housed in an IP66 rated enclosure if it is in an air cooled chamber. Power factor shall be greater or equal to 0.9.
- E. Lighting Fixtures: Shall be as shown in the Lighting Fixture Schedule on the Drawings.
 - 1. All fixtures shall be factory primed and painted. Factory shall provide touch up paint as required for field touch up.
 - 2. Provide complete with all miscellaneous hardware and lamps. Fixtures installed in "layin" grid ceiling shall be fed by conductor in ½" flex conduit from a junction box mounted on the building structure. Coordinate fixture locations with ceiling system. Fixtures shall have seismic supports #9 steel wires at each corner securely fastened to building structure.
- F. Lamps: shall be provided for all lighting fixtures in accordance with the lighting fixtures schedule on the drawings. Unless noted otherwise fluorescent lamps shall be 4100°K "T-8". All incandescent, fluorescent, and HID lamps shall be new at time of final inspection and shall be manufactured by one of the following:

1. General Electric

- 2. Venture Lighting International
- 3. Phillips
- 4. Osram-Sylvania

G. All Fixtures:

- 1. There shall be no live parts normally exposed to contact.
- 2. When intended for use in wet area:
 - a. Mark fixtures "suitable for wet locations."
- 3. When intended for use in damp areas:
 - a. Mark fixtures "suitable for damp locations" or "suitable for wet locations."
- 4. In wet or damp area, install fixtures so that water cannot enter or accumulate in the wiring compartment, lampholder, or other electrical parts.
- 5. Gasket seals: Urethane foam
- 6. Diffusers: UV stabilized acrylic plastic

H. Underground wiring:

- 1. Provide all wiring runs with separate green grounding conductor.
- 2. Ground all pole bases.
- I. Pole wiring from base to ballast:
 - 1. No. 12 type XHHW.
 - 2. Each phase shall be protected by a 30A, 600V, type Tron waterproof fuseholder, Bussman "Limitron" type fuse, size rating 3-times load current.
- J. Incandescent Lamps:
 - 1. Types:
 - a. 30-135 watts: Energy efficient
 - b. 200-500 watts: Standard
 - 2. Inside frost
 - 3. Base: Aluminum or brass
 - 4. PAR/Halogen

K. Fluorescent Lamps:

- 1. Rapid start
- 2. Cool white (F32T8/41K-85CRI and F96T12/41K-70CRI/HO/ES)
- 3. Energy efficient or standard as noted on the lighting fixture schedule.

L. High-Pressure Sodium Lamps:

- 1. Bulb finish: Clear
- 2. Any burning position

M. Metal Halide Lamps:

- 1. Bulb finish: Clear
- 2. Any burning position

N. LED Lamps:

- 1. Color Temperature: Correlated, 3,500K to 5,000K.
- 2. Minimum efficiency: 80 lumens/watt
- 3. Color Rendering Index: >65
- O. Furnish a minimum of 2 lamps, or ten percent spare lamps of each type and wattage, whichever is greater.

2.03 FIXTURES

- A. Fluorescent Lighting Fixtures:
 - 1. Ballast:
 - a. Rapid start, high power factor type
 - b. CBM/ETL certified
 - c. Sound rating A
 - d. Two internal automatic-resetting thermal switch devices for coil and capacitor
 - 2. 2. Internal wiring: AWM, TFN or THHN
 - 3. Channel and end plates: 22 GA steel
 - 4. 4. Steel door frame and socket track: 20 GA steel
 - 5. Channel cover: 24 GA steel
 - 6. 6. Emergency ballast:
 - a. Integral rechargeable nickel-cadmium battery, battery charger, and automatic transfer circuitry.
 - b. Charging indicator light.
 - c. Test Switch.
 - d. Provide a minimum of 900 lumen output for 90 minutes upon loss of normal power.
 - e. Mounted integral to the fixture.
 - f. UL 924 listed.
 - 7. Provide fixtures with emergency ballasts with permanent caution labels warning that the fixture is fed from an unswitched source.
 - a. Provide emergency ballast also with a similar caution label.

B. HID Lighting Fixtures:

- 1. Ballasts for high pressure sodium lighting fixtures:
 - a. Type: Regulating
 - b. Ballast design center variance: Maximum 5 percent from rated lamp wattage.
 - c. Lamp wattage regulation spread at the lamp voltage: Maximum 10 percent for +/- 10 percent line voltage variation.
 - d. Ballast primary current during starting not to exceed normal operating current.
 - e. Lamp current crest factor: Maximum 1.8 for +/-10 percent line voltage variation at any lamp voltage, from nominal through life.
 - f. Power factor shall not drop below 90 percent for +/-10 percent line voltage variations at any lamp voltage, from nominal through life.
 - g. Capacitor variance: Tolerance of +/-6 percent which will not cause more than a +/-8 percent variation in regulation throughout rated lamp life for nominal line voltage.
 - h. Capable of operation with an open circuit condition for a maximum of 6 months without significant loss of ballast or starting circuitry life.
- 2. Ballasts for metal halide/mercury vapor lighting fixtures:
 - a. Type: Auto-regulator
 - b. Voltage input range: +/-10 percent
 - c. Lamp regulation spread: 20 percent maximum
 - d. Power factor: 90 to 90 percent
 - e. Input voltage dip (4sec.): 40 to 50 percent
 - f. Crest factor of lamp current: 1.6 to 2.0
- 3. Ballasts for exterior HID lamps:
 - a. UL approved
 - b. High power factor designed for -20 Deg F temperature starting
- 4. Fixtures for non-hazardous locations:
 - a. Type: Industrial low bay
 - b. Ballast housing: Die-cast
 - c. Filter: Activated charcoal
 - d. Refractor: UV stabilized molded acrylic

2.04 MISCELLANEOUS ELECTRIC DEVICES

- A. PHOTOELECTRIC CONTROL UNITS shall meet the following requirements:
 - 1. Cadmium sulfide photocell
 - 2. Aluminum weatherproof enclosure
 - 3. 30 amp rated contacts

- 4. 120-volt AC power
- 5. The Photoelectric control unit shall be Tork Model 2100, or equal.
- B. MOTION SENSORS shall meet the following requirements:
 - 1. 110 degree field of view, 60 foot range
 - 2. Adjustable time setting from 15 seconds to 15 minutes
 - 3. Operating temperature of -20 to +130 degrees F.
 - 4. Complete outdoor, weather proof sensor with complete mounting hardware
 - 5. UL listed
 - 6. The motion sensor(s) shall be manufactured by Leviton Model 50500-H or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Install all lighting fixtures complete and ready for service, in accordance with the Fixture Schedule on the Drawings:
 - 1. Wire all fixtures with fixture wiring of at least 150°C rating. Conductors in wiring channels of fixtures mounted in rows shall be the same size as the circuit wiring supplying the rows.
 - 2. Install all fluorescent fixtures straight and true with reference to adjacent walls.
 - 3. Install all lighting fixtures, including those mounted in continuous rows, so that the weight of the fixture is supported either directly or indirectly by a sound and safe structural member of the building, using adequate number and type of fasteners to ensure a safe installation. Screwed fastenings and toggles through ceiling or wall material are not acceptable. Provide suitable connectors or collars to connect adjoining fixtures in continuous rows.
 - 4. Do not support fixtures from top level roof deck. Provide unistrut channels spanning space between roof joists to support fixtures and outlets.
 - 5. Fixtures mounted in lay-in grid ceilings shall have safety support wires to structural roof members as detailed for seismic restraint.
- B. All single outlets shall be properly centered in each room. Where two or more outlets occur, they shall be spaced uniformly and in straight lines with each other.
- C. Consult reflected ceiling plans for placement of fixtures with respect to ceiling tile patterns and equipment of other trades.
- D. Provide plaster frames and support channels around ceiling openings for recessed fixtures. Securely fasten to ceiling structural members.
- E. Terminate circuits for recessed fixtures in an extension outlet box adjacent to ceiling opening and connect to fixtures with flexible steel conduit.

- F. Where lighting fixtures and other electrical items are shown in conflict with locations and structural members and mechanical or other equipment, provide all required supports and wiring to clear the encroachment.
- G. Install lamps in all luminaires.
- H. Replace all failed fluorescent, incandescent, metal halide, mercury vapor and high pressure sodium lamps with new lamps prior to final acceptance by Owner.
- I. Surface and flush mounted fixtures shall be solidly connected to a junction box. Suspended fixtures shall be hung utilizing pendant mounting or stainless steel chains and hooks. Each suspended fixture shall be electrically connected by a length of Type SO flexible cord. 3 conductor No. 14 AWG, minimum, with a twist-lock receptacle mounted in an individual junction box. Plugs and receptacles shall be as manufactured by Hubbell, General Electric Company, or equal.
- J. Provide mounting brackets and/or structural mounting support for fixtures.
 - 1. Do not support fixture from conduit system.
 - 2. Do not support fixture from outlet boxes.
- K. Install with approved mounting hardware following manufacturer's recommendations.
- L. Pole mounted fixtures shall be mounted on steel or aluminum poles as indicated on the Plans. All metal poles shall be bonded to the facility ground system. Poles shall have adequate handholes and weatherproof receptacles where indicated.
- M. All anchor bolts and nuts shall be stainless steel. Contractor shall paint all steel poles with aluminum paint or other color in accordance with these Contract Documents.
- N. Fixture mounting heights and locations indicated on the Plans are approximate and are subject to revision in the field where necessary to avoid conflicts and obstructions.

3.02 TESTING

- A. General: Upon completion of this portion of the work, test all parts of the electrical system in the presence of the Engineer.
- B. Test Requirements: All systems shall test free from short circuits and grounds, shall be free from mechanical and electrical defects, and shall show an insulation resistance between phase conductors and ground of not less than that required by the National Electrical Code.

3.03 ADJUSTING AND CLEANING

A. Wipe all lighting fixture reflectors, lenses, lamps, and trims clean after installation and prior to acceptance of Project by Owner.

3.04 FINAL INSPECTION

- A. This **Division 26** contractor's job foreman shall be present at the final inspection of the work by the Owner.
- B. Electrical job foreman shall have pad and pencil to list all deficient items noted. Corrections and adjustments of deficient items shall be done after the inspection, not during.

END OF SECTION

SECTION 26 05 10

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 Work Included

- A. Materials, tools, equipment, supplies, installation, and testing of electrical Work.
- B. The following systems and equipment are typical, but not inclusive, for materials furnished in accordance with this section:
 - 1. 480VAC, 3φ, 4 wire service entrances.
 - 2. Lighting/Power switchboard and panelboards.
 - 3. Standby generator system.
 - 4. Control and alarm Systems.
 - 5. Raceways and fittings.
 - 6. Wires and cables.
 - 7. Lighting systems.
 - 8. Underground conduit systems.
 - 9. Grounding systems.
 - 10. Instrumentation systems.
 - 11. Pumping power and control systems.
 - 12. Motor operated valve systems.
 - 13. HVAC power and control systems.
 - 14. Temporary electricity, lighting, and telephone as required during construction operations.
 - 15. Conduit, wire, and control equipment as required for motors and equipment.
- C. Refer to the following sections for Work not covered herein.
 - 1. Section 01 73 24 for seismic anchorage requirements.
 - 2. Section 01 78 39 for project record document requirements.
 - 3. Section 26 05 26 for grounding and bonding requirements.
 - 4. Section 26 08 00 for requirements for commissioning electrical systems.
 - 5. Section 26 09 43 for requirements for offsite underground electrical Work.
 - 6. Section 31 05 50 for requirements for protecting existing utilities.

1.2 Utility Coordination

- A. Servicing Electrical Utility (Electrical Utility) will be Southern California Edison.
 - 1. Servicing Electrical Utility contact is:
 - 2.

Tim Fleckenstein Planner 1 Covina Dist. 800 West Cienega Ave San Dimas, Ca 91773 909-746-6096

- B. Immediately upon mobilization, contact Servicing Electrical Utility and other servicing utilities to coordinate construction and tie-in to their facilities.
- C. Owner will make application for permanent electrical, broadband Internet, and permanent telephone service, where required.
- D. Owner will / Contractor shall pay for connection costs and application fees, electrical utility fees, cable charges and added facilities charges.
- E. Where any 1 incidental electrical utility fee exceeds \$1,000, reimbursement provisions of Section 01 22 00 shall apply.
- F. Obtain service requirements from Electrical Utility and abide by service and installation agreements required by Electrical Utility.

- G. Construct new electrical service and service entrance equipment per SCE
 - 1. Coordinate with Electrical Utility to ensure timely connection by Utility.
 - 2. Obtain Electrical Utility approval of service entrance and metering equipment Shop Drawings before starting fabrication.
 - 3. Copy of Service Plan for offsite power is attached in Appendix C of Contract Documents.
 - 4. Construct conduit from SCE transformer to service meter and associated hand hole per SCE requirements.
 - 5. Coordinate and schedule electrical service installation and removal of existing electrical service including transformer and service section with Owner and
 - 6. Provide at least 14 Calendar Days' prior notice to Owner to allow for completion of working electrical service prior to construction of new on-site electrical facilities.
- H. Perform Work shown on Electrical Utility drawings to be performed by Contractor unless otherwise noted, including required electrical demolition and construction of transformer pad, protective bollards, on-site primary and secondary boxes, duct banks, conduit and cables, electrical grounding, and metering cabinet or pedestal as shown.
- I. Electrical Utility will be responsible for:
 - 1. Isolating electrical supply to existing transformer.
 - 2. Furnishing and installing new transformer on Contractor-constructed pad.
 - 3. Providing electrical meters in Contractor-furnished switchboard metering cabinet.
 - 4. Connecting new electrical supply at service pole.
- J. Provide for or purchase power for construction.

1.3 Related Work

- A. Section 01 10 01: Summary of Work and Sequence of Construction
- B. Section 01 22 00: Unit Prices
- C. Section 01 33 00: Submittal Procedures
- D. Section 01 35 26: Governmental Safety Requirements
- E. Section 01 40 00: Quality Requirements
- F. Section 01 61 00: Common Product Requirements
- G. Section 01 65 00: Product Delivery Requirements
- H. Section 01 66 00: Product Storage and Handling Requirements
- I. Section 01 73 00: Execution
- J. Section 01 73 24: Seismic Restraint
- K. Section 01 78 39: Project Record Documents
- L. Section 01 78 43: Spare Parts
- M. Section 01 79 00: Demonstration and Training
- N. Section 09 90 00: Painting and Coating
- O. Section 26 05 19: Low-Voltage Electrical Power Conductors and Cables
- P. Section 26 05 26: Grounding and Bonding for Electrical Systems
- Q. Section 26 05 33: Raceway and Boxes for Electrical Systems
- R. Section 26 08 00: Commissioning of Electrical Systems
- S. Section 26 08 01: Short Circuit and Coordination Report
- T. Section 26 09 43: Offsite Underground Electrical Work
- U. Section 26 28 00: Low-Voltage Circuit-Protective Devices
- V. Section 26 42 00: Cathodic Protection
- W. Section 31 05 50: Protecting Existing Utilities
- X. Section 31 23 33: Trenching and Backfilling
- Y. Section 40 90 10: Common Work Results for Instrumentation and Control

1.4 <u>Definitions</u>

- A. The following definitions apply:
 - 1. <u>Architecturally Finished Interior Locations:</u> Offices, laboratories, conference rooms, restrooms, corridors, and similar occupied spaces.

- 2. <u>Corrosive Locations:</u> Chlorination building interiors, chemical storage rooms, and other spaces so identified on Plans or classified by NEC Article 505.
- 3. <u>Damp Locations:</u> Indoor or vault-enclosed spaces wholly or partially >24" below grade.
 - a. Also, spaces housing liquid handling equipment regardless of grade elevation.
- 4. <u>General Purpose (Indoor Dry) Locations:</u> Indoor areas not defined below as wet, damp, corrosive locations.
- 5. <u>Nonarchitecturally Finished Interior Areas:</u> Pump, chemical, mechanical, electrical, utility, and similar process type rooms.
- 6. <u>Outdoor or Wet Locations:</u> Locations exposed to weather, whether under a roof or not, including below grade structures, maintenance holes, handholes, below-ground pump rooms, and vaults unless otherwise designated on Plans.
- 7. <u>Shop-Fabricated:</u> Manufactured or assembled equipment for which no UL test procedure has been established.

1.5 System Description

- A. Furnish and install complete operating electrical system including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building, fire, and electrical codes and standards.
- B. Plans indicate connections for typical equipment only.
 - 1. If equipment furnished differs from that shown, provide modifications necessary for safe and properly operating installation in accordance with Manufacturer's recommendations.
- C. Use equipment, materials, and wiring methods suitable for types of locations in which they are located as defined below.

1.6 Quality Assurance

- A. Electrical Work shall conform to applicable codes and standards.
 - 1. Conform to Cal/OSHA Safety Orders (Title 8 CCR)
 - 2. Conform to California Electrical Code
 - 3. Conform to applicable local codes and regulations.
 - 4. Equipment and materials shall bear labels to indicate manufacturing conformance to specified standards or equal.
 - a. UL label or listing is required for electrical conductors, except where UL- or ETL- listed products meeting Contract requirements are not manufactured.
 - b. In such case, submittals shall state products are not UL- or ETL-listed and no UL- or ETL-listed products are available.
 - c. Where UL-or ETL-listed products are not manufactured, Work shall conform to independent testing laboratory acceptable to Owner.
 - 5. Where 2 codes or standards are at variance, conform to more restrictive requirements:
- B. Electrical materials and equipment shall be subject to factory inspection by Owner's Representative or Owner-designated testing agency representatives.
- C. Use appropriate conduit and conductor entry fittings with enclosures which maintain specified enclosure environmental capability after proper installation.
- D. Use adequate number of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- E. Refer to Sections 01 75 00 and 26 08 00 for commissioning and testing requirements.

1.7 References

A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.

- Certified Ballast Manufacturers.
- 2. ANSI/IEEE C2 National Electrical Safety Code
- 3. ANSI/IEEE C57.109 Guide for Transformer Through-Fault-Current Duration
- 4. ANSI B16.5 Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy, and Other Special Alloys.
- 5. ANSI Z55.1 Gray Finishes for Industrial Apparatus and Equipment
- 6. ANSI Z244-1 Personnel Protection
- 7. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California, Cal-OSHA Low Voltage Electrical Safety Orders
- 8. California Building Code (CBC)
- 9. California Electrical Code (CEC)
- 10. California Energy Code (CEnC)
- 11. California Fire Code (CFC)
- 12. City, County and District Electrical Codes.
- 13. ETL Electrical Testing Laboratories standards
- 14. IEEE C2 National Electric Safety Code (NESC)
- 15. IEEE 45 Testing Insulation Resistance of Rotating Machinery
- 16. IEEE 86 Airborne Sound Measurement on Rotating Electric Machinery
- 17. IEEE 112 Test Procedure for Polyphase Induction Motors and Generators
- 18. IEEE 115 Test Procedure for Synchronous Machines
- 19. IEEE 241 Electric Power Systems in Commercial Buildings
- 20. IEEE 242 Protection and Coordination of Industrial and Commercial Power Systems
- 21. IEEE 1584 Performing Arc-Flash Hazard Calculations
- 22. Illuminating Engineering Society (IES) Standards.
- 23. Insulated Cable Engineers Association (ICEA) Standards.
- 24. National Electrical Manufacturers Association (NEMA) Standards.
- 25. National Electrical Safety Code.
- 26. NECA Standard of Installation
- 27. NEMA WD-1-1.10 General Requirements for Wiring Devices.
- 28. NEMA AB1 Molded Case Circuit Breakers.
- 29. NEMA KS1 Enclosed Switches.
- 30. NETA ATS Acceptance Testing Specifications for Electrical Power Equipment and Systems
- 31. NFPA 70 National Electric Code (NEC)
- 32. NFPA 70B Electrical Equipment Maintenance
- 33. NFPA 70E Electrical Safety Requirements for Employer Workplaces
- 34. NFPA 78 Lighting Protection Code
- 35. NFPA 101 Life Safety Code
- 36. NEMA/ANSI 250 Enclosures for Electrical Equipment
- 37. NEMA MG1 Motor s and Generators
- 38. NEMA MG2 Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators.
- 39. NEMA MG10 Energy Management Guide for Selection and Use of Polyphase Motors
- 40. OSHA CFR 1910 Occupational Safety and Health Standards
- 41. OSHA CFR 1926 Occupational Safety and Health Standards
- 42. Public Utilities Service Requirements.
- 43. Underwriter's Laboratories Inc.(UL) Standards.

1.8 Submittals

1. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
	MOBILIZATION SUBMITTALS	
QA/QC Plan	On Owner's request, submit QA/QC procedures for composite fabrication, including: 1. Qualifications of plant staff directly involved in Work, including cable splicer qualifications. 2. Current and anticipated plant workload. 3. State how other Work will impact hoist fabrication schedule for this contract. 4. Plant QA/QC recordkeeping and means for transmitting records to Owner. 5. Shop Drawing submittal process. 6. Materials sources. 7. Plant QA/QC procedures regarding sources of materials. 8. Fabrication schedule.	

SUBMITTAL	DESCRIPTION	
	Procedures for materials handling and storage at plant.	
	10. Fabrication process.	
	11. Cable splicing procedures.	
Factory Training	On Owner's request, submit evidence installation technicians are factory trained on	
Certification	models installed prior to technicians performing Work.	
Madia Davis	DRAWINGS AND PART SCHEDULES	
Working Drawings for Redesign Work	Submit for proposed redesign Work proposed by Contractor to accommodate product substitutions or alternate arrangements or equipment layouts from Contract	
	Documents. Costs for redesign, including additional electrical and mechanical Work, shall be	
	Contractor's responsibility.	
	Redesigned or altered drawings, reviewed by Owner's Representative, shall not relieve Contractor of responsibility for proper and complete installation and operation	
	of materials and equipment, including related accessories.	
Shop Drawings	Submit under electrically-controlled equipment Shop Drawing requirements.	
	Dimensional Outlines Show front, side, and rear elevations, footprints, and top views of panels, enclosures, MCC's and electrically powered equipment.	
	Single Line Diagrams and Metering Diagrams	
	Show local and remote devices associated with each installation.	
	Wiring and Control Diagrams,	
	Schematic wiring diagrams	
	2. Connection diagrams	
	Terminal diagrams showing numbering of terminal blocks Conductor wire numbers, sizes and types.	
	4. Conductor wire numbers, sizes and types5. Grounding diagrams	
	Grounding diagrams Logic diagrams for programmable controllers or relays.	
	7. Drawings shall reference instrument tag numbers shown on Plans	
	List of Nameplates and Identification Tags	
	1. Starters	
	2. Relays	
	3. Conductors	
	4. Push buttons	
	5. Switches	
	6. Indicating lights	
	7. Show nameplate material, height of letters, number of lines, inscriptions and	
	dimensions	
Materials and	Materials and Equipment List	
Equipment Schedule	1. Manufacturers,	
	2. Brand names,	
	3. Catalog, model, or part numbers4. Sizes, and other information needed to identify manufactured items proposed for	
	use.	
	5. Show instrument tag numbers applicable.	
	Environmental Ratings	
	Including temperature, humidity, and elevation ratings	
	Electrical Ratings	
	Voltage, continuous current, and wattage ratings.	
	2. Conduit entry restrictions,	
	Enclosure types and dimensions	
	4. UL or ETL listing or identification of non UL- or ETL-Listed Products	
	Finish Information	
	Information on Dielectric Connections and materials used to isolate dissimilar metals	
	MANUFACTURER'S LITERATURE	
Product Data	Submit the following for items of standard manufacture:	
	Product name or identification in sufficient detail to facilitate reordering.	
	List of parts and construction materials referenced by ANSI, NEMA, ASTM, SAE	
	or CDA specification and grade.	

SUBMITTAL	DESCRIPTION	
	Standard test reports for mass-produced equipment.	
Motor Data	Submit in tabular form for each motor:	
	General	
	Equipment driven and specification number of driven machine	
	2. Motor Manufacturer	
	3. Nominal horsepower	
	4. Service factor	
	Lists of special features being provided as specified Enclosure and Frame	
	1. Frame size	
	Motor type or model, and dimension drawing	
	Net motor weight	
	Shipping weight if motors are shipped separate from driven equipment	
	Type of enclosure	
	Motor housing material and winding material.	
	Electrical	
	Voltage, phase, and frequency rating	
	Motor locked rotor current at rated voltage	
	Motor no-load current at rated voltage	
	Motor full load current at rated horsepower for rated voltage	
	5. Motor full-load current at 110% voltage	
	6. NEMA design letter	
	7. Starting code letter or locked rotor kVA or current	
	Winding insulation class and treatment	
	Special winding configuration such as part-winding, star-delta.	
	10. Include winding diagram.	
	Temperature	
	1. Rated ambient design temperature and maximum elevation for which motor is	
	designed to operate continuously	
	2. Temperature rise	
	Time in seconds motor can withstand locked rotor current at rated voltage without	
	motor damage with motor initially at rated ambient temperature	
	4. Time in seconds motor can withstand locked rotor current at rated voltage without	
	motor damage with motor initially at rated temperature rise	
	5. Cycle time requirements based on motor heating and cooling characteristics.	
	Power Factors and Efficiencies	
	Guaranteed power factors & efficiencies at full load	
	2. Expected power factors and efficiencies at ¾-load and ½ load	
	3. Energy efficiency rating.	
	Speed and Torque	
	Rated full-load speed. Speed torsus aurice.	
	Speed-torque curves. Slip at full load.	
	3. Slip at full load.4. Speed/torque/current at 100% voltage.	
	Noise and Balance	
	Noise and Balance Noise certification and data sheets	
	Noise certification and data sneets Dynamic balance test results.	
	Bearings	
	Bearings Bearing types and catalog numbers	
	Thrust bearing life	
	Type of thrust bearing lubrication	
	Type of under boaring labrication 4. Type of guide bearing lubrication	
	If water cooling is required for motor thrust bearings, Shop Drawings shall	
	indicate this requirement.	
	Overload Devices	
	Overload device catalog number	
	Overload device current range and setting.	
	Nameplate	
l	Replica of motor nameplates	
	Submit mounting details and templates where required for proper motor installation.	

Installation Instructions Material Samples Submit per Installation Instruction requirements. Submit upon request. QUALITY ASSURANCE AND CONTROL SUBMITTALS Engineering Calculations — Seismic Restraint Motor Factory Test Transcripts Submit Test Record Transcripts for identical prototype of each motor over 2 horsepower. Test per NEMA MGI §12.53a and IEEE 112, Test Method B, showing full load efficiency not less than specified. Submit Test Record Transcripts for short commercial tests of actual motors furnished. Include no load current at rated voltage, full load current, locked rotor current, winding resistance and high potential. Overcurrent Protection Fault Study and Coordination Study Are Flash Hazard Analysis and Report System Demonstration Plan Demonstration Plan Eer to Section 26 08 13. Refer to Section 26 08 16. Analysis and Report Submit written plan for demonstrating each equipment item provided under Division 26 meets specified operational requirements. Plan shall detail procedures to be used in final operation testing of entire systems including description of each system, test methods and materials, testing instruments and recorders, and list of equipment involved with functional parameters to be recorded on each item. Submit written notice to Owner's Representative for each motor verifying phasing has been checked and corrected if necessary. Testing and check-out forms 1. List procedures with instructions for checking and testing of each electrical component of each system. 2. Include job safety rules in test procedures. 3. Provide Ist of qualified personnel for testing and checkout documentation. 4. Submit test results for specified testing. CLOSEOUT SUBMITTALS Submit als hall include: Product Data, drawings, descriptions, and schematic drawings. Include name, address, and telephone number for nearest distributor of each equipment item. Expanded parts drawings of electrical parts. Parts list and part changeout instructions. List of recommended spare parts. Specifications and	SUBMITTAL	DESCRIPTION	
Submit upon request		Submit per Installation Instruction requirements.	
Culculations – Seismic Restraint Motor Factory Test Transcripts Submit Test Record Transcripts for identical prototype of each motor over 2 horsepower. Test per NEMA MG1 §12.53a and IEEE 112, Test Method B, showing full load efficiency not less than specified. Submit Test Record Transcripts for short commercial tests of actual motors furnished. Include no load current at rated voltage, full load current, locked rotor current, winding resistance and high potential. Refer to Section 26 08 13. Refer to Section 26 08 16. Analysis and Report System Demonstration Plan Every Submit Written plan for demonstrating each equipment item provided under Division 26 meets specified operational requirements. Plan shall detail procedures to be used in final operation testing of entire systems including description of each system, test methods and materials, testing instruments and recorders, and list of equipment involved with functional parameters to be recorded on each item. Submit written notice to Owner's Representative for each motor verifying phasing has been checked and corrected if necessary. Testing and check-out forms 1. List procedures with instructions for checking and testing of each electrical component of each system. 2. Include job safety rules in test procedures. 3. Provide list of qualified personnel for testing and checkout documentation. 4. Submit test results for specified testing. CLOSEOUT SUBMITTALS Record Drawings O & M Instructions Submit per Section 01 78 39. Submit test results for specified testing. Fersi list and part changeout instructions. List of recommended spare parts. Specifications and part numbers for replacement parts and motors. Name, address, and phone number for nearest distributor of each equipment item. Preventative maintenance schedules. Troubleshooting checklists.		SAMPLES	•
Refer to Section 01 73 24.	Material Samples	Submit upon request.	
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Fault Study and Coordination Study Arc Flash Hazard Analysis and Report System Demonstration Plan Submit written plan for demonstrating each equipment item provided under Division 26 meets specified operational requirements. Plan shall detail procedures to be used in final operation testing of entire systems including description of each system, test methods and materials, testing instruments and recorders, and list of equipment involved with functional parameters to be recorded on each item. Submit written notice to Owner's Representative for each motor verifying phasing has been checked and corrected if necessary. Testing and check-out forms 1. List procedures with instructions for checking and testing of each electrical component of each system. 2. Include job safety rules in test procedures. 3. Provide list of qualified personnel for testing and checkout documentation. 4. Submit test results for specified testing. CLOSEOUT SUBMITTALS Record Drawings O & M Instructions Submit per Section 01 78 39. Submittal shall include: Product Data, drawings, descriptions, and schematic drawings. Include name, address, and telephone number for nearest distributor of each piece of equipment. Theory of operation. Expanded parts drawings of electrical parts. Parts list and part changeout instructions. List of recommended spare parts. Specifications and part numbers for replacement parts and motors. Name, address, and phone number for nearest distributor of each equipment item. Preventative maintenance schedules. Troubleshooting checklists. Training Plan Submit per Section 01 79 00.		winding resistance and high potential.	
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Troubleshooting checklists. Training Plan Submit per Section 01 79 00.		item.	
Training Plan Submit per Section 01 79 00.			
•		Troubleshooting checklists.	
	Training Plan	Submit per Section 01 79 00.	
Warranty Unless otherwise stated, furnish 1-year warranty from date of final acceptance	Warranty	Unless otherwise stated, furnish 1-year warranty from date of final acceptance	

- 8. Refer to Section 01 33 00 for definition of requirements for Shop Drawings, Product Data, Installation Instructions, O&M Instructions, and Test Record Transcripts.
- 9. Standard test reports for mass-produced equipment shall be submitted along with Shop Drawings for such equipment.

1.9 Delivery, Storage, and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Strictly follow Manufacturer's instructions and warranty requirements for delivery, storage, and handling of electrical products.
- C. Cover and protect materials and equipment to ensure no finished surfaces are damaged, marred, or splattered with water, foam, plaster, or paint.
 - 1. Protect nameplates to prevent defacing.
- D. Protect electrical equipment against loss, weather, or mechanical and moisture damage.
 - 1. Do not store electrical equipment outdoors.
 - 2. Store electrical equipment in clean, dry, indoor, locations.
 - 3. Store products containing electrical insulation such as transformers, conductors, motors, and controls in clean, dry, indoor heated locations.
 - 4. Keep rotating and moving parts clean and dry.
- E. Provide temporary heating, sufficient to prevent condensation, in transformers, switchgear, switchboards, motors, and motor control centers which do not have space heaters.
- F. Replace Work evidencing moisture damage.
- G. Ensure electrical equipment will pass through building openings to reach Plan locations.
 - 1. Equipment shall be shipped and handled, and assembled, if necessary, at job site in accordance with Manufacturer's requirements to maintain functional integrity.

1.10 **Project Site Conditions**

A. Refer to Section 01 10 01 for full list of project site conditions.

1.11 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for electrical systems.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

- A. Electrical equipment Manufacturers shall have manufactured similar electrical equipment for ≥5 years.
 - 1. On Owner's Representative's request, provide acceptable list of installations with similar equipment to verify compliance.

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Furnished electrical system shall be complete and functional.
 - 1. Furnish material incidental to Work of this section.
- C. Electrical equipment and panels shall be factory finished with Manufacturer's standard primer and enamel topcoats, unless stated otherwise in individual equipment specifications.
- D. The following product design criteria, options and accessories are required for nameplates:

ITEM		DESCRIPTION
Nameplates	Nameplates on Switchgear	Provide engraved laminated plastic nameplates secured to cabinet exterior face. Provide nameplate on door front for each disconnect switch, switchboard, motor controller, and panelboard showing switch or panelboard designation, service voltage, and phases. Provide nameplate for instruments, timers, relays, contactors, control switches, push-buttons, and indicating lights to identify each item by service or function. Provide nameplate inside each panelboard door listing its designation, voltage, feeder number, and load served.

ITEM		DESCRIPTION
	Nameplates on	Provide nameplate on each transformer showing designation, voltage,
	Transformers	feeder number and load served.
	Lettering	Provide nameplates with engraved lettering not less than 1/4" high, legible
	_	from reasonable angles of observation to distances of at least 10'
	Color	Use white-engraved-to-black-core laminated plastic (so letters will be
		black with white background)
	Attachment	Secure with at least 2 stainless steel panhead sheet metal screws,
		escutcheon pins, or rivets.
		Do not use adhesives.
		Do not use embossed plastic adhesive tape.
Nameplates on	Stainless Steel	SAE Type 316
Motors and		Permanently attacd to motor frame with information impressed, engraved
Equipment		or embossed into plate
		Show information required by NEMA MG1-10.39 through 39,
		Manufacturer's name, model and serial number, year of manufacture,
		rpm, horsepower, voltage, phase, full load current, locked-rotor kVA
		code, motor type, frame, insulation class, centigrade degree rise and
		motor connection diagram.
		Also show bearing numbers for both bearings, efficiency, power factor at
		full load, and maximum recommended kVAR of power capacitors to result in a 90% power factor.
Arc-Flash Warning	Specification	Conform to ANSI/NEMA Z535.4 and NEC
(Orange) or Danger	Locations	New switchboards, panelboards, control panels, and motor control
(Red) Label	Locations	centers
	Lettering	Label shall be legible in both indoor and outdoor environments for at
	_	least 3 years
	Color	(orange<40cal/cm ²) or (red ≥40cal/cm ²)
	Required	Equipment name and ID code based on Drawings
	Information (480-	Flash hazard protection boundary (inches)
	VAC equipment)	3. Arc-flash incident energy at 18" (cal/cm ²)
		4. Required personnel protective equipment (PPE) category, including
		class rating for insulating gloves based on system voltage
		5. Working distance (inches)
		6. Hazard/risk category number
		7. System phase-to-phase voltage
		Condition(s) exposing workers to electrical shock hazard Limited shock approach boundary (inches)
		Limited shock approach boundary (inches) Postrigted shock approach boundary (inches)
		10. Restricted shock approach boundary (inches)11. Prohibited shock approach boundary (inches)
		12. Name and address of supplier
		13. Date label was prepared
		10. Date lanel was prepared

PART 3 - EXECUTION

3.1 Preparation

- A. Provide supervision on-site to lay out, check, coordinate, and supervise electrical Work.
 - 1. Plan installation of electrical Work, considering Work of other trades to minimize interference.
- B. Lay out Work in advance.
 - 1. Plans were developed from Record Drawings and information received from Owner.
 - a. Plans diagrammatically show desired locations and arrangements of panelboards, pull boxes, lighting, outlets, conduit runs, equipment, and other items.
 - b. Where apparatus and equipment, switchboards and transformers, are shown on Plans, dimensions have been taken from typical equipment of class shown.
 - c. These Plans diagrammatically show desired location and arrangement of outlets, conduit runs, equipment, and other items.

- 2. Make field measurements needed to install electrical system and components before submitting Shop Drawings or ordering.
 - a. Determine exact locations in field based on size and arrangement of equipment, finished elevations, required NEC Article 110-26 clearances and other obstructions.
 - b. Adhere as closely as possible to Plan locations.
 - c. Verify equipment contemplated for installation will fit into spaces provided.
 - d. Verify exact rough-in location and dimensions for connection to electrified equipment provided by others.
- 3. Field determine and verify exact location based on physical size and arrangement of equipment, finished elevations, and obstructions, and submit such location for acceptance by Owner's Representative prior to installation.
 - a. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
 - b. Minor adjustment entails changes of ≤ 5 ' in any direction.
 - c. Install electrical equipment, including pull or junction boxes ≥ 6" from process gas, air, water, wastewater, or drainage piping and equipment.
 - d. Do not use equipment exceeding dimensions shown or reducing clearances to less than those shown on Plans or required by NEC Article 110-26.
- 4. Where necessary to adjust Plan locations of electrical equipment the following adjustments may be made without securing Owner's acceptance provided NEC Article 110-26 mandated code clearances are maintained.:
 - a. Adjustments ≤12" at grade, floor and roof level in any direction in horizontal plane.
 - b. Adjustments ≤12" for non-lighting equipment at ceiling level in any direction in horizontal plane.
 - c. Adjustments ≤12" for lighting fixtures at ceiling level in any direction in horizontal plane.
 - d. Adjustments≤12" on walls in horizontal direction within vertical plane.
 - e. Obtain acceptance form Owner's Representative for changes in location outside the above limits.
- C. Install conduit and equipment to avoid obstructions, preserve head room, and keep openings and passageways clear.
 - 1. Where equipment installed without Owner's direction must be moved, it shall be moved at Contractor's expense.
- D. Confer with Owner's Representative to verify location of existing underground utilities at each area of construction activity
 - 1. Protect existing underground utilities throughout construction.
- E. Complete Work involving shutdown of existing services to equipment now functioning or tiein of equipment to existing system at such time as to minimize downtime and inconvenience to Owner.
 - 1. Do such work when directed by Owner's Representative.
- F. Do not start Work involving existing electrical system without first obtaining and completing coordination forms required by facility.
 - 1. Submit coordination forms with drawings and procedures showing information about what, where, why, and how Work will be done.
- G. Do not cut, notch, or weld to structural members or building surfaces without acceptance from Owner's Representative.
 - 1. Carry out cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment.
 - 2. Following such Work, restore surfaces neatly to original condition.
- H. Contract Documents show circuiting to electrical loads and distribution equipment.
 - 1. Balance electrical load between phases as nearly as possible on switchboards, panelboards and motor control centers.
- I. Provide scaffolding, rigging, hoisting, and erection equipment necessary for electrical Work.

- 1. Remove same from premises when no longer required.
- J. Maintain continuity of electric service to functioning portions of process or buildings during hours they are normally in use.
 - 1. Temporary outages will be permitted during cutover Work at such times and places as can be prearranged with Owner's Representative and electric utility company providing service to facility.
 - 2. Minimize outages and their duration.
 - 3. Make no outages without prior written authorization of Owner's Representative.
 - 4. Include costs for temporary wiring and overtime Work required in Contract price.
 - a. Remove temporary wiring at completion of Work.

3.2 <u>Installation</u>

- A. Refer to Sections 01 73 00 and 01 73 24 for basic execution and installation requirements.
- B. Install and wire all electrical equipment, including pre-purchased equipment.
 - 1. Perform tests as necessary to assure compliance with Contract Documents and ensure Work is ready and safe for energizing.
- C. Refer to Section 31 23 33 for open trench requirements.
- D. Conform to NECA Standard of Installation unless otherwise specified.
- E. Make connections to equipment as required and in accordance with accepted Shop Drawings.
- F. Analyze systems components, identify terminals, and prepare plans or wiring tables necessary for component interconnection.
 - 1. Furnish and install component interconnections.
- G. Conform to the following installation standards:
 - 1. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 2. Other applicable OSHA and Cal OSHA regulations
 - 3. IEEE C2 National Electric Safety Code (NESC)
 - 4. California Electrical Code (CEC)
 - 5. NFPA 70 National Electric Code (NEC)
 - 6. Applicable building and fire code requirements
 - 7. Servicing electrical utility requirements
 - 8. Manufacturer's installation and warranty requirements
- H. Refer variances between above documents and Contract Documents to Owner's Representative.
- I. Plans indicate connections for typical equipment only.
 - 1. If equipment furnished differs from that shown, provide modifications necessary for safe and properly operating installation in accordance with equipment Manufacturer's recommendations.
- J. Plans indicate diagrammatically desired locations and arrangement of outlets, conduit runs, equipment, and other items.
 - 1. Field determine exact location based on physical size and arrangement of equipment, finished elevations, and obstructions.
 - 2. Work or equipment not indicated or specified but needed for proper operation of electrical systems shall be accomplished at no additional cost to Owner.
 - 3. Do not mount safety switches or other equipment to equipment enclosures unless enclosure mounting surface is properly braced to accept mounting of external equipment.
- K. Install electrical system components to tolerances recommended by Manufacturer.
 - 1. Unless otherwise shown, install components true, plumb, and level using precision gauges and levels.
- L. Install equipment to be accessible for operation and maintenance

- 1. Electrical equipment shall not be blocked or concealed, nor interferie with normal operating and maintenance requirements of other equipment.
- M. Accomplish Work required to seal penetrations of waterproofing after part penetrating waterproofing is set in place.
 - 1. Seal and make watertight openings made for this purpose.
 - 2. Seal weather-tight equipment or components exposed to weather.
- N. In damp, wet, or below-grade areas, provide corrosion-resistant spacers to maintain 1/4" separation between metallic equipment and metallic equipment supports and mounting surfaces.
 - 1. Do not place equipment fabricated from aluminum in direct contact with earth, concrete, or steel.
 - 2. Do not use materials that may cause building walls, ceilings, or roofing to discolor or rust.
- O. Screen or seal openings into outdoor-mounted equipment to prevent entrance of rodents, birds, and insects.
- P. Provide foreign power circuit isolation devices including protection of independently powered PLC input/output circuits located in equipment enclosures.
 - 1. Circuits which are sources of foreign power shall pass through isolation device where wiring penetrates equipment enclosures including control cabinets, and MCC buckets.
 - a. Provide easily accessible isolation point for foreign power sources for circuits in enclosure.
 - b. Clearly label isolation devices.
 - 2. Manufacturers shall supply isolation devices integral with their equipment whenever possible, such as isolation switches integral with disconnect handles on MCC buckets.
 - 3. Devices shall allow for operation of equipment with doors open to allow for testing and/or maintenance.
- Q. Mark panelboards, motor controllers, power panels, transformers, circuit breakers, disconnect switches, timer, relays, and contactors to identify each item with its respective service or function and unique identification number as shown on Plans.
 - 1. Provide nameplates with engraved lettering not less than height specified.
 - 2. Use black-on-white laminated plastic, attached with sheet metal screws or self-adhesive backs.
 - 3. Minimum label lettering heights as follows:
 - a. Main panel identification: ≥3/8".
 - b. Panel compartments with hinged doors, and MCC buckets: ≥1/4".
 - c. Device tags: ≥1/8"
- R. Repair affected surfaces to conform to type, quality, and finish of surrounding surface in neat and workmanlike manner.
- S. Upon completion of Work, remove materials, scraps, and debris from premises and from interior and exterior of devices and equipment.
 - 1. Touch up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes closely matching type, color, consistency, and type of surface of original finish.
 - 2. If damage is done to equipment paint surfaces, refinish entire equipment in manner that provides finish equal to or better than factory finish, that meets requirements of Contract Documents, and is acceptable to Owner's Representative.
- T. Where existing materials and equipment are removed or relocated, remove materials no longer used including studs, straps, conduits, and wires.
 - 1. Remove or cut off concealed or embedded conduit, boxes, or other materials and equipment to ≥12" below final finished surface and ≥ 24" below ground surface.
 - 2. Coordinate such removal with owner's Representative.

3.3 Field Quality Control

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- A. Refer to Section 26 08 00 for field testing and commissioning requirements.
- B. Schedule tests and inspections as job progresses.
 - 1. Allow Owner's Representative to inspect materials, equipment, and workmanship.
 - 2. After each electrical system installation is complete, perform tests to verify system is in proper working order and in accordance with Contract Documents, Manufacturer's Installation Instructions, and applicable codes.
 - 3. Conduct tests in presence of Owner's Representative.
 - a. Notify Owner's Representative ≥7 days in advance of tests scheduled to be performed.
 - 4. Perform insulation and ground resistance tests before operating tests.
 - 5. Where motors ≥10hp are part of packaged equipment such as pumps, qualified motor Manufacturer's representative shall supervise unpacking, installation and field testing.

3.4 Protection

- A. Protect Work against corrosion, physical damage, and effects of moisture on insulation until Final Acceptance.
 - 1. If partial dismantling of equipment is required for installation, box or wrap removed parts until reinstalled.
 - 2. Cover materials and equipment, both in storage and during construction, so no finished surfaces are damaged, marred, or splattered with water, foam, plaster, or paint.
 - 3. Protect factory-painted surfaces from impact, abrasion, discoloration, and other damage.
 - 4. Protect Work from corrosion, and effects of moisture on insulation.
 - 5. Cap conduit runs and equipment outlets during construction with manufactured seals, plugs, or caps where Work at these locations is not in progress.
 - a. Keep openings in boxes or equipment closed during construction.
 - 6. Keep electrical equipment, materials, and insulation dry.
 - Maintain heaters in equipment connected and operating until equipment is placed in operation.
 - 7. Repair or replace damaged Work as directed.
 - a. Repair stainless steel components using zinc-rich paint.
 - b. Repair painted components using touch-up paint provided by or approved by equipment Manufacturer.
 - c. Repair PVC-coated components using patching compound of same material as coating, provided by Manufacturer of component.
 - d. Replaced damaged nameplates.
- B. When equipment intended for indoor installation is installed at Contractor's convenience in areas subject to dampness, moisture, dirt, or adverse atmosphere until completion of construction, provide protection from these atmospheres.
 - 1. Provide temporary heating, sufficient to prevent condensation, in transformers, switchgear, switchboards, motors, and motor control centers which do not have space heaters.
 - 2. Energize space heaters furnished with equipment.
 - 3. Keep moving parts clean and dry.
- C. Replace or have Manufacturer refinish damaged or marred materials or equipment, including face plates of panels and switchboard sections.

3.5 Spare Parts

A. Refer to Section 01 78 43 for spare parts requirements:

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SECTION 26 05 19

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.1 Work Included

A. Materials, testing, and installation of building wire, power cable, control cable, instrumentation cable, wire connectors, insulating tape, and pulling lubricant for conductors and cables rated 600VAC and less.

1.2 Related Work

- A. Section 01 10 01: Summary of Work and Sequence of Construction
- B. Section 01 22 00: Unit Prices
- C. Section 01 33 00: Submittal Procedures
- D. Section 01 40 00: Quality Requirements
- E. Section 01 61 00: Common Product Requirements
- F. Section 01 65 00: Product Delivery Requirements
- G. Section 01 66 00: Product Storage and Handling Requirements
- H. Section 01 73 00: Execution
- I. Section 26 05 26: Grounding and Bonding for Electrical Systems
- J. Section 26 05 10: Common Work Results for Electrical
- K. Section 26 05 33: Raceway and Boxes for Electrical Systems
- L. Section 26 08 00: Commissioning of Electrical Systems
- M. Section 40 90 10: Common Work Results for Instrumentation and Control

1.3 Definitions

- A. The following definitions apply:
 - 1. <u>Building Wire</u>: Single conductor, insulated, with or without outer jacket depending on type.
 - 2. <u>Cable:</u> Multi-conductor, insulated assemblies with outer sheath containing either building wire or instrumentation wire.
 - 3. <u>Control Cable</u>: Multi-conductor, insulated, with outer sheath containing building wires #14AWG, #12AWG, or #10AWG.
 - 4. <u>Instrumentation Cable:</u> Multi-conductor insulated, twisted or untwisted, with outer sheath including:
 - a. Analog Signal Cable used to transmit low current (4-20mA DC) or low voltage (0-10VDC) signals using ≤ #14AWG conductors.
 - b. Common types include twisted shielded pairs (TSP) or twisted shielded triads (TST)
 - c. Digital Signal Cable: Used for transmission of digital signals between computers, PLC's, and RTU's.
 - 5. <u>Power Cable</u>: Multi-conductor, insulated, with outer sheath containing building wire ≥#8AWG.

1.4 System Description

- A. Furnish and install conductors and cables as shown on Plans and as required by NEC to power equipment furnished.
 - 1. Include appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable codes and standards.
- B. 600VAC power and control cable shall be suitable for installation indoors or outdoors in conduit and metal trays, and in wet or dry locations.

C. Cables from VFD's to motors shall be VFD-rated, braided and foil-shielded type cable.

1.5 Quality Assurance

- A. Use adequate number of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Conductors and cables shall be UL-listed and bear UL label.
- C. Where Manufacturer's, Electrical Utility or Contract Documents require larger conductor sizes than specified minimum sizes below, larger conductor size shall govern.
- D. For 600VAC cable sized ≥ #2AWG, furnish cable manufactured ≤1 year prior to installation.
- E. Wire diameters shall be ≥ 98% of specified AWG diameter.

1.6 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - ANSI C119.1 Electric Connectors-Sealed Insulated Underground Connector Systems Rated 600 Volts
 - 2. ANSI/TIA/EIA568B.2: Commercial Building Telecommunications Cabling Standards
 - 3. ASTM B1 Hard-Drawn Copper Wire
 - 4. ASTM B3 Soft or Annealed Copper Wire
 - 5. ASTM B8 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft
 - 6. ASTM B33 Tinned Soft or Annealed Copper Wire for Electrical Purposes
 - 7. ASTM B189 Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes
 - 8. ASTM D2219 Poly(Vinyl Chloride) Insulation for Wire and Cable, 60°C Operation
 - 9. ASTM D2220 Poly(Vinyl Chloride) Insulation for Wire and Cable, 75°C Operation
 - 10. ASTM D2301 Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
 - 11. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 12. California Building Code (CBC)
 - 13. California Electrical Code (CEC)
 - 14. California Fire Code (CFC)
 - 15. ICEA S19 Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
 - 16. ICEA S58-679 Standard for Control Cable Conductor Identification
 - 17. ICEA S61-402/NEMA WC5 Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
 - 18. IEEE 400 Field Testing and Evaluation of Insulation of Shielded Power Cable Systems
 - 19. IEEE 1202 Flame-Propagation Testing of Wire and Cable
 - 20. LAEC Los Angeles Electrical Code Article 725
 - 21. NEMA ICS4 Industrial Control and Systems: Terminal Blocks
 - 22. NEMA WC55 Instrumentation Cables and Thermocouple Wire
 - 23. NEMA WC57 Control Cables
 - 24. NEMA WC70 Non-Shielded Power Cables Rated 2000 Volts or Less for Distribution of Electrical Energy
 - 25. NETA ATS Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems
 - 26. NFPA 70 National Electric Code (NEC)
 - 27. NFPA 262 Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
 - 28. TIA/EIA/ANSI 568 Commercial Building Telecommunications Cabling Standard
 - 29. UL 44 Thermoset-Insulated Wires and Cables
 - 30. UL 62 Flexible Cords and Cables
 - 31. UL83 Thermoplastic-Insulated Wires and Cables
 - 32. UL444 Communications Cables
 - 33. UL 467 Grounding and Bonding Equipment
 - 34. UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors
 - 35. UL 486C Splicing Wire Connections
 - 36. UL 486D Sealed Wire Connector Systems
 - 37. UL 510 Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
 - 38. UL 1277 Electrical Power and Control Tray Cables with Optional Optical-Fiber Members
 - 39. UL1581 Electrical Wires, Cables, and Flexible Cords
 - 40. UL 2250 Instrumentation Tray Cable

1.7 Submittals

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A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
	MOBILIZATION SUBMITTALS	
Cable Splicer Qualifications	Submit documentation detailing qualifications of each cable splicer to be	
	working on job.	
D	RAWINGS AND PART SCHEDULES Refer to Section 26 05 10	
	MANUFACTURER'S LITERATURE	
Product Data	Submit the following for items of standard manufacture	
	Product Data for each type of conductor.	
	Product Data is not required for wire connectors, insulating tape, or cable lubricant.	
Material List	Submit material list for each conductor type.	
	Show insulation material, conductor material, voltage rating, Manufacturer, and other pertinent data such as type shielding, number of pairs, and applicable standards.	
Installation Instructions	Submit per Installation Instruction requirements.	
	Describe recommended splicing, testing, and installation procedures.	
	SAMPLES	
Material Samples	Submit for fireproofing tape materials.	
•	QUALITY ASSURANCE AND CONTROL SUBMITTALS	
Engineering Calculations	Submit cable pulling calculations for cables sized 4/0 and larger and for high-	
	voltage or medium-voltage cable per Engineering Calculations requirements to	
	ascertain cable will not overstrain.	
	If cable diameters exceed diameters shown, submit calculations verifying	
	larger cables fit within raceways shown in conformance to NEC requirements.	
Certificate of Compliance	Submit evidence of UL listing for products not bearing UL label.	
	Submit Certificate of Compliance for 5000VAC-rated series lighting conductors	
Test Record Transcripts	Submit for factory tests per Test Record Transcript requirements.	
	At least 30 days prior to system demonstration, submit transcript for field tests	
	using Owner-accepted test forms for cable tests, Hi-Pot, and Megger tests.	
	Field test data.	
	Show equipment used and time of test.	
	CLOSEOUT SUBMITTALS	
Warranty	Furnish 1-year warranty from date of final acceptance	

B. Refer to Section 01 33 00 for definition of requirements for Shop Drawings, Product Data, Installation Instructions, Certificates of Compliance, Engineering Calculations, and Test Record Transcripts.

1.8 <u>Delivery, Storage and Handling</u>

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Strictly follow Manufacturer's instructions and warranty requirements for delivery, storage and handling of conductors and cables.

1.9 **Project Site Conditions**

A. Refer to Section 01 10 01 for full list of project site conditions.

1.10 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for low-voltage electrical power conductors and cables.

PART 2 - PRODUCTS

2.1 <u>Acceptable Manufacturers</u>

A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION		
CONDUCTOR WIRES				
Insulated Conductor	Aetna Insulated Wire / Marmon / Berkshire Hathaway	Virginia Beach, VA (800) 423-6505		

ITEM	MANUFACTURER	MANUFACTURER LOCATION	
Wire	Alpha Wire	Elizabeth, NJ (800) 522-5742	
	Belden, Inc.	St Louis, MO (800) 235-3361	
	CerroWire SLiP-Wire® / Marmon / Berkshire Hathaway	Chicago, IL (800) 523-3869	
	Encore Wire Corporation	McKinney, TX (800) 962-9473	
	General Cable	Highland Heights, KY (859) 572-8000	
	Kris-Tech Wire	Norwalk, CA (315) 339-5268	
	The Okonite Company	Ramsey, NJ (201) 825-0300	
	Pro-Line Safety Products Company	West Chicago, IL (800) 554-3424	
	Rome Cable Corporation	Rome, NY (315) 337-3000	
	Southwire Company "SimPULL"	Carrollton, GA (770) 832-4000	
	USA Wire and Cable, Inc.	Austin, TX (800) 880-9473	
	Accepted equal		
	INSTRUMENTATION CABLES	1	
Control and Logic	Aetna Insulated Wire / Marmon / Berkshire Hathaway	Virginia Beach, VA (800) 423-6505	
Multiconductor Cable	Alpha Wire	Elizabeth, NJ (800) 522-5742	
	Belden, Inc.	St Louis, MO (800) 235-3361	
	Encore Wire Corporation	McKinney, TX (800) 962-9473	
	General Cable	Highland Heights, KY (859) 572-8000	
	The Okonite Company	Ramsey, NJ (201) 825-0300	
	Rome Cable Corporation	Rome, NY (315) 337-3000	
	Southwire Company	Carrollton, GA (770) 832-4000	
	Accepted equal		
Twisted, Shielded	Aetna Insulated Wire / Marmon / Berkshire Hathaway	Virginia Beach, VA (800) 423-6505	
Pair (TSP) and	Alpha Wire	Elizabeth, NJ (800) 522-5742	
Twisted, Shielded	Belden, Inc.	St Louis, MO (800) 235-3361	
Triad (TST	Encore Wire Corporation	McKinney, TX (800) 962-9473	
Instrumentation	General Cable	Highland Heights, KY (859) 572-8000	
Cable	The Okonite Company	Ramsey, NJ (201) 825-0300	
	Rome Cable Corporation	Rome, NY (315) 337-3000	
	Southwire Company	Carrollton, GA (770) 832-4000	
	Accepted equal		
Multi-Twisted	Alpha Wire	Elizabeth, NJ (800) 522-5742	
Shielded Pairs with	Belden, Inc.	St Louis, MO (800) 235-3361	
Common Overall	The Okonite Company	Ramsey, NJ (201) 825-0300	
Shield	Rome Cable Corporation	Rome, NY (315) 337-3000	
Instrumentation	Southwire Company	Carrollton, GA (770) 832-4000	
Cable Type TC	Accepted equal		
Ethernet Cable	Belden / Mohawk Cable M57561	St Louis, MO (978) 537-9961	
	Accepted equal		
	TERMINALS AND WIRE TERMINATING DEV	•	
600VAC Power	Hubbell Burndy Type YAV box	Manchester, NH (800) 346-4175	
Cable Terminations –	Thomas & Betts / ABB	Memphis, TN (800) 816-7809	
Wires ≤#8AWG	Accepted equal		
600VAC Power	Hubbell Burndy Type YA box	Manchester, NH (800) 346-4175	
Cable Terminations –	Thomas & Betts / ABB	Memphis, TN (800) 816-7809	
Wires ≥#6AWG	Accepted equal		
Wiring Termination	Hubbell Burndy Type TP	Manchester, NH (800) 346-4175	
Lugs for Control and	Thomas & Betts / ABB "Sta-Kon"	Memphis, TN (800) 816-7809	
Instrumentation Cable	Accepted equal		
Control Wiring	Refer to Section 26 27 26		
Terminal Blocks DIN	TAGIGI TO OGULIOTI ZO ZI ZO		
Rail-Mounted			
Control Circuit	Ideal Industries 30-400 Series	Sycamore, IL (800) 435-0705	
Splices and Taps	Accepted equal	Systemore, IE (000) 400-0100	
"Pigtail" Connections	/ recopiou oqual		
– Wires ≤#8AWG			
Taps in Wires	Thomas & Betts / ABB Type CT and CTC	Memphis, TN (800) 816-7809	
	, , , , , , , , , , , , , , , , , , , ,		

ITEM	MANUFACTURER	MANUFACTURER LOCATION	
≥#6AWG	Accepted equal		
Control Circuit	Hubbell Burndy Type YS	Manchester, NH (800) 346-4175	
Splices and Taps	Accepted equal		
Compression Sleeve			
Connections – Wires			
≥#6AWG			
Wire Splice	3M "Scotchlock	St Paul, MN (888) 364-3577	
Connectors – Solid	Ideal Industries Buchanan "B-Cap"	Sycamore, IL (800) 435-0705	
Conductors	Ideal Industries "Super Nut"	Sycamore, IL (800) 435-0705	
	Phoenix Contact	Middletown, PA (800) 888-7388	
	Accepted equal		
Wire Splice	Hubbell Burndy "Versitap"	Manchester, NH (800) 346-4175	
Connectors –	Ideal Industries "Super Nut"	Sycamore, IL (800) 435-0705	
Stranded Conductors	Ilsco Corporation	Cincinnati, OH (800) 776-5047	
	O-Z Gedney / Emerson solderless connectors	Rosemont, IL (800) 621-1506	
	Phoenix Contact	Middletown, PA (800) 888-7388	
	Teledyne Penn Union	Edinboro, PA (814) 734-1631	
	Thomas & Betts / ABB "Locktite"	Memphis, TN (800) 816-7809	
	Accepted equal		
	CABLE AND WIRE MARKERS		
Conductor Sleeve or	Grafoplast Wire Markers	Denver, CO (800) 864-3874	
Tag Markers	Floy Tag & Manufacturing, Inc Type FT200C	Seattle, WA (206) 524-2700	
	Floy Tag & Manufacturing, Inc Type FT200S	Seattle, WA (206) 524-2700	
	Phoenix Contact	Middletown, PA (800) 888-7388	
	Thomas & Betts / ABB TY-RAP TY54M Series	Memphis, TN (800) 816-7809	
	W H Brady Type B500	Milwaukee, WI (800) 940-0615	
	Accepted equal		
Conductor Tags	Floy Tag & Manufacturing, Inc Type FT205	Seattle, WA (206) 524-2700	
(Embossed Fiber	Accepted equal		
Floater Markers for			
Use in Small Junction			
Boxes	TE 0	D. DA (000) 500 0750	
Heat-Shrink Tubing	TE Connectivity / Tyco Electronics / Raychem RNR-100	Berwyn, PA (800) 522-6752	
	Accepted equal		
Insulating and Color-	3M "Scotch	St Paul, MN (888) 364-3577	
Coded Tape	Plymouth Bishop Tapes / Plymouth Rubber	Canton, MA (800) 458-0336	
	Red Seal Electric Company	Cleveland, OH (216) 941-3900	
	Accepted equal		
	OTHER OTHER	T. 4. T. 1. T. 1. (000) 0.10 = 000	
Cable Ties	Thomas & Betts / ABB	Memphis, TN (800) 816-7809	
	Accepted equal		
Cable Supports	Hubbell Kellems	Manchester, NH (800) 346-4175	
	Accepted equal		

2.2 <u>Materials</u>

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Conductors shall conform to NEC Article 200.
- C. Cables shall conform to NEC Article 340
- D. Materials for conductors and cables shall be:

ITEM	MATERIAL	SPECIFICATION				
BUILDING AND INDUSTRIAL CONDUCTOR WIRES						
Low-Voltage	Conductors except	Coated sift-drawn or annealed stranded copper				
Building Wire	#10AWG or	Conform to ASTM B33 and ASTM B189				
#8AWG and	#12AWG branch	Stranding shall conform to ASTM B8 Class B				
Smaller (600-	power or lighting					
VAC Rated)	circuits					

ITEM	MATERIAL		SPECIFICATION		
	Conductors - #10AWG or #12AWG designated for branch circuit power wiring to lighting and receptacle circuits	Coated sift-drawn or annealed solid copper or stranded copper Conform to ASTM B33 and ASTM B189 Stranding shall conform to ASTM B8 Class B			
	Size Minimum Size	Size as shown on Plans and as required per NEC			
	(where wire size not shown)	≥12AWG for power and lighting circuits			
	Insulation	Rated for 600VAC Conform to ASTM D2220 for 75°C PVC Rated for continuous operation at 90°C (194°F) in dry locations, 75°C (167°F) in wet locations			
		Loca		Permitted Insulation	Standard
		Architectural and Non- Architectural Finished Areas		Type XHHW-2,	Flame-retardant XLPE Conform to NEMA WC70 and UL 44
				THHN/THWN or THHN/THWN-2	Thermoplastic PVC with nylon jacket Conform to NEMA WC70 and UL 83
		Below Grade		Type XHHW-2	Flame-retardant XLPE Conform to NEMA WC70 and UL 44
		Wire Size	THWN Insulation Thickness	PVC Insulation Thickness	Clear Nylon Jacket Thickness
		#14AWG	≥12 mils	≥16 mils	≥4 mils
		#12 AWG	≥14 mils	≥19 mils	≥4 mils
		#10AWG ≥#8AWG	≥16 mils	≥22 mils	≥4 mils ≥4 mils
	Jacket	≥4-mil nylon jacket on THHW and THWN cables Moisture, sunlight, oil-and-heat-resistant, flame-retardant cross-linked polyolefin outer jacket on multi-conductor XHHW-2 cables No jacket required for single conductor XHHW-2 cables			
	Labeling	Permanently imprint along length of each conductor 1. Manufacturer Name or Trademark 2. Insulation Type Letter Designation 3. Voltage Rating 4. Wire Size 5. UL Label			
Low-Voltage Power Cable (600-VAC Rated)	Conductors	Conform to NFPA 70 (NEC) Type TC Coated sift-drawn or annealed stranded copper Conform to ASTM B33 and ASTM B189 Stranding shall conform to ASTM B8 Class B			
Type TC	Size	Size as shown on Plans and as required per NEC			
	Minimum Size (where wire size not shown)	≥#8AWG for power circuits			
	Number of Conductors	As required, including bare ground conductor			
	Insulation	Rated for 600VAC Conform to ASTM D2220 for 75°C PVC Flame-retardant cross-linked thermoplastic PVC with nylon jacket Rated for continuous operation at 90°C (194°F) in dry locations, 75°C (167°F) in wet locations			

ITEM	MATERIAL	SPECIFICATION			
		Location	Permitted Insulation	Standard	
		Architectural and Non- Architectural Finished Areas	Type XHHW-2,	Flame-retardant XLPE Conform to NEMA WC70 and UL 44	
			THHN/THWN or THHN/THWN-2	Thermoplastic PVC with nylon jacket Conform to NEMA WC70, UL 83, and UL 1277	
		Below Grade	Type XHHW-2	Flame-retardant XLPE Conform to NEMA WC70 and UL 44	
	Individual Conductor Color Coding	Conform to ICEA S58-679 Method 4 where not otherwise shown		otherwise shown	
	Jacket	≥4-mil nylon jacket on TH- Moisture, sunlight, oil-and- outer jacket on multi-condu No jacket required for singl	heat-resistant, flame ıctor XHHW-2 cables	-retardant cross-linked polyolefin	
	Labeling	Permanently imprint along 1. Manufacturer Name or 2. Insulation Type Letter I 3. Voltage Rating 4. Wire Size 5. UL Label	Trademark Designation	uctor	
Control Cable (600-VAC Rated) Type TC	Conductors	Conform to NFPA 70 (NEC) Type TC Coated sift-drawn or annealed stranded copper Conform to ASTM B33 and ASTM B189 Stranding shall conform to ASTM B8 Class B			
	Size	Size as shown on Plans ar		EC	
	Minimum Size (where wire size not shown)	≥#14AWG for control circuits.			
	Number of Conductors	As required, provided with or without bare ground conductor of same AWG size. When bare ground conductor is not provided, provide additional insulated conductor for ground conductor			
	Insulation	Rated for 600VAC Conform to ASTM D2220 f Flame-retardant cross-linke (THHN/THWN and THHN/ UL 1277 Type XHHW-2 for below-gi Type XHHW-2, THHN, or 1	or 75°C PVC ed thermoplastic PVC THWN-2) conforming rade runs THWN for above-grad	to NEMA WC57 and UL83 and	
		in wet locations	Down:ttod	Ctondovd	
		Location	Permitted Insulation	Standard	
		Architectural and Non- Architectural Finished Areas	Type XHHW-2,	Flame-retardant XLPE Conform to NEMA WC70 and UL 44	
			THHN/THWN or THHN/THWN-2	Thermoplastic PVC with nylon jacket Conform to NEMA WC57, UL 83, and UL 1277	
		Below Grade	Type XHHW-2	Flame-retardant XLPE Conform to NEMA WC70 and UL 44	
	Individual Conductor Color Coding	Conform to ICEA S58-679	Method 1, Table E2	where not otherwise shown	

ITEM	MATERIAL	SPECIFICATION
	Jacket	≥4-mil nylon jacket on THHW and THWN cables Moisture, sunlight, oil-and-heat-resistant, flame-retardant cross-linked polyolefin outer jacket on multi-conductor XHHW-2 cables No jacket required for single conductor XHHW-2 cables
	Labeling	Permanently imprint along length of each conductor 1. Manufacturer Name or Trademark 2. Insulation Type Letter Designation 3. Voltage Rating 4. Wire Size 5. UL Label
Grounding Conductors	Conductor	Stranded soft-drawn copper Required in multi-conductor power cables.
	Size – Alternating Current System Ground	As shown on Plans and sized per NEC Table 250.66
	Size – Equipment Ground	As shown on Plans and sized per NEC Table 250.122
	Minimum Size of Ground Conductors (Use where wire size not shown)	≥#12AWG
	Insulation	Insulation material shall match that used for phase conductors Color – Green or Green with yellow stripes per NEC 250.119
	Jacket	≥4-mil nylon jacket on THHW and THWN cables Moisture, sunlight, oil-and-heat-resistant, flame-retardant cross-linked polyolefin outer jacket on multi-conductor XHHW-2 cables No jacket required for single conductor XHHW-2 cables
	Labeling	Permanently imprint along length of each conductor 1. Manufacturer 2. Insulation Type Letter Designation 3. Voltage Rating 4. Conductor Size 5. UL Label
Direct-Buried Grounding	Conductors #10AWG or	Hard-drawn solid copper wire Conform to ASTM B1
Conductors	smaller	Soft or annealed copper wire Conform to ASTM B3
	Conductors - 8AWG – 500kcmil	Bare stranded soft-temper high-conductivity copper grounding cable Conform to ASTM B8 Class B Identify ground conductor with green electrical tape spiral-wound around conductor for exposed lengths in boxes, enclosures, or where emerging from protective raceways.
	Size – Alternating Current System Ground	As shown on Plans and as required per NEC Table 250.66
Switchboard, Panelboard, and Control Cabinet	Conductor	UL Type SIS or MTW flexible stranded copper control wire Conform to UL44 for Type SIS insulation Conform to UL 83 for Type MTW insulation
Control Wiring (within cabinet)	Minimum Size (where wire size not shown)	≥#16 AWG for instrument and communication circuits ≥#14 AWG for alarm circuits ≥#14 AWG for control circuits
	Labeling	Permanently imprint along length of each conductor 1. Manufacturer Name or Trademark 2. Insulation Type Letter Designation 3. Wire Size 4. UL Label
	Wiring	Factory-wired without splices and with uniform arrangement of circuits. Run wire bundles or single wires in straight lines with 90° corners, where change of direction is required.

ITEM	MATERIAL		SPECIFICAT	
		Where possible, run wirin Where not possible to o binding or bundle and sec Do not splice wires inside	contain wiring in ducure wire with nylon	uct, wrap wiring with plastic spiral ties.
	Hinge Crossings	Securely clamp wire bund	lles crossing hinges	to both door and panel.
Fixture Wires	Conductor	Run parallel to hinge for at least ½ door length to prevent chafing. Copper Conform to NEC Article 402 Type AVA		
	Minimum Size (where wire size not shown)	≥#14 AWG		
	Insulation	Rated for 600VAC		
Flexible Cords and Cables	Conductor	Copper Conform to NEC Article 4 Type SO	00	
	Insulation	Rated for 600VAC		
		INSTRUMENTATION		
Digital Control and Logic Cables (for Control Logic, PLC Outputs	Conductor	Conform to NFPA 70 (NE Copper UL-listed multi-conductor Conform to NFPA 262 As recommended by PLC	cable with ground	
and Inputs)	Ground	Include 1 full-size green e		
Type TC	Minimum Size (where wire size not shown)	≥14AWG 7-strand	,	
	Insulation	Rated for 600VAC Conform to ASTM D2220 15-mil PVC+4-mil nylon ja UL listed as Type THHN/ Color code to ICEA S61-4 Rated for continuous ope in wet locations Flame-retardant	acket insulated wire THWN 102 Appendix K, Me	
	Shield	Bind conductor groups wi	th spiral wrap of bar	rrier tape.
	Outer Jacket	PVC Flame-retardant, sunlight wet or dry locations	, abrasion, moistur	e and oil-resistant and suitable for
	Dimension	4-pair	OD ≤ 0.50"	45-mil nominal jacket thickness
		8-pair	OD ≤ 0.68"	60-mil nominal jacket thickness
		12-pair	OD ≤ 0.82"	60-mil nominal jacket thickness
		16-pair	OD ≤ 0.95"	80-mil nominal jacket thickness
		20-pair	OD ≤ 1.05"	80-mil nominal jacket thickness
		24-pair	OD ≤ 1.16"	80-mil nominal jacket thickness
		36-pair	OD ≤ 1.33"	80-mil nominal jacket thickness
		50-pair	OD ≤ 1.56"	80-mil nominal jacket thickness
	Labeling	Manufacturer Name or 2. Maximum Working Volt 3. Type of Cable 4. UL Label Verified performance le	age (Rating) for wh	ich cable was tested

ITEM	MATERIAL	SPECIFICATION
	Horizontal Voice and Data Cable	Category 6 per TIA/EIA/ANSI 568 Label-verified ≥#24AWG solid untinned copper conductors Rated CMP per NFPA 70 Use where recommended by PLC or RTU manufacturer
	Service	Multi-conductor control circuit interconnection cable with ground Suitable for installing in cable trays, conduit or other accepted raceways Passes vertical tray flame test
Instrument Analog Cable – Single Pair Type TC (UL 62 and UL 1277 or UL 1581)	Conductor	Conform to NFPA 70 (NEC) Article 336 Type TC Conform to UL2250 Conform to UL 1581 for cable tray use Conform to UL 1277 for direct burial or sunlight exposure Bare soft annealed stranded tinned copper Class B 7-strand ≥ 6 twists per foot Concentric conforming to ASTM B8
	Drain Wire	Pair drain wire #20AWG 7-strand tinned copper Increase wire size for runs >1000'
	Minimum Size (where wire size not shown)	Two or 3 ≥#18AWG for runs <1000' Two or 3 ≥#16AWG for runs >1000'
	Insulation	Rated for 300 or 600 VAC 15-mil PVC+4-mil nylon jacket-insulated twisted-pair wires Color code to ANSI/ICEA standards Rated for continuous operation at 90°C (194°F) in dry locations, 75°C (167°F) in wet locations Flame-retardant Pair conductors integrally pigmented black and red.
	Individual Conductor Color Coding	Conform to ICEA S58-679 Method 1, Table E2 where not otherwise shown
	Shield	Spiral-wound 1.35-mil aluminum/mylar metal-foil tape Overlap to provide 100% coverage
	Jacket	45-mil PVC Flame-retardant, sunlight, abrasion, moisture and oil-resistant and suitable for wet or dry locations
	Dimension	Nominal OD – 0.31"
	Service	Instrument cable designed for noise rejection for process control, computer, or data log applications Suitable for installing in cable trays, conduit or other accepted raceways
Instrument Analog Cable – Single Triad Type TC (UL 62 and UL 1277 or UL 1581)	Conductor	Conform to NFPA 70 (NEC) Article 336 Type TC Conform to UL2250 Conform to UL 1581 for cable tray use Conform to UL 1277 for direct burial or sunlight exposure Bare soft annealed stranded tinned copper Class B 7-strand ≥ 6 twists per foot Concentric conforming to ASTM B8
	Drain Wire	Triad drain wire #20AWG 7-strand tinned copper Increase wire size for runs >1000'
	Minimum Size (where wire size not shown)	Two or 3 ≥#18AWG for runs <1000' Two or 3 ≥#16AWG for runs >1000'
	Insulation	Rated for 300 or 600 VAC 15-mil PVC+4-mil nylon jacket-insulated twisted-triad wires Color code to ANSI/ICEA standards Rated for continuous operation at 90°C (194°F) in dry locations, 75°C (167°F) / in wet locations Flame-retardant Triad conductors integrally pigmented black, red, and blue

ITEM	MATERIAL		SPECIFICATION	DN .	
	Individual Conductor Color Coding	Conform to ICEA S58-679	Method 1, Table E2	where not otherwise shown	
	Shield	Spiral-wound 1.35-mil alu Overlap to provide 100%		oil tape	
	Jacket	45-mil PVC Flame-retardant, sunlight, wet or dry locations.	abrasion, moisture a	and oil-resistant and suitable for	
	Dimension	Nominal OD – 0.32"			
	Service	Instrument cable designed data log applications Suitable for installing in ca	·	or process control, computer, or other accepted raceways	
Instrument Analog Cable – #18AWG Multi- Twisted Shielded Pairs with Common Overall Shield	Conductor	Conform to NFPA 70 (NECOnform to UL2250 Conform to UL 1581 for cate Conform to UL 1277 for displaying the Conform to UL 1277 for displaying the Conform to UL 1277 for displaying to UL 1277 for displaying to UL 1581 for Conformit to UL 1581 for C	able tray use irect burial or sunligh led tinned copper		
Type TC (UL 62 and UL 1277 or UL 1581)	Drain Wire	Pair drain wire #20AWG to Group drain wire #18AWC Increase wire size for runs	inned copper 3 tinned copper		
	Minimum Size (where wire size not shown)	Two or 3 ≥#20AWG for runs >1000' Two or 3 ≥#20AWG for runs >1000' Two or 3 ≥#20AWG for runs >1000'			
	Insulation	in wet locations Flame-retardant	standards ration at 90°C (194°F ntegrally pigmented b	twisted together F) in dry locations, 75°C (167°F) black and red with red conductor	
	Individual Conductor Color Coding	Conform to ICEA S58-679 Method 1, Table E2 where not otherwise shown			
	Shield	Spiral-wound 1.35-mil aluminum/mylar metal-foil tape Group shield 2.35-mil aluminum/mylar metal-foil tape Overlap to provide 100% coverage			
	Jacket	wet or dry locations.		and oil-resistant and suitable for	
	Dimension	4-pair	OD ≤0.50"	45-mil nominal jacket thickness	
		8-pair	OD ≤0.68"	60-mil nominal jacket thickness	
		12-pair	OD ≤0.82"	60-mil nominal jacket thickness	
		16-pair	OD ≤0.95"	80-mil nominal jacket thickness	
		20-pair	OD ≤1.05"	80-mil nominal jacket thickness	
		24-pair	OD ≤1.16"	80-mil nominal jacket thickness	
		36-pair	OD ≤1.33"	80-mil nominal jacket thickness	
		50-pair	OD ≤1.56"	80-mil nominal jacket thickness	
	Service	Instrumentation, process	control, and compute	r cable suitable for installing in	

ITEM	MATERIAL	SPECIFICATION
		cable trays, conduit or other accepted raceways.
Network Cables	Cable	Conform to 4-connector channel performance requirements of
 Ethernet Cable 	Performance	ANSI/TIA/EIA568C.2
	Requirements	Test to 300MHz
	Construction	Industrial-grade CAT6-rated for outdoor-indoor use, sunlight-and oil-resistant
	Outside	4 twisted pairs of #24AWG polypropylene-insulated stranded conductors with
	Enclosures	ripcord surrounded by tight outer jacket.
	Construction	CAT6-rated patch cords, UL444 CM-listed
	Inside Enclosures	4 unshielded twisted pairs of #23AWG insulated solid conductors with ripcord surrounded by tight outer jacket.
		Provide 8-position modular plug with integrated strain-relief boot on each end.
		TERMINALS AND CONNECTIONS
Twist / Screw-on	Copper	600VAC-rated
Type Wire	''	For phase and neutral conductors, conform to UL 486C
Connectors		For ground conductors, conform to UL 486C and/or UL 467 as required by local
		codes.
Compression	Copper – Electro-	600VAC-rated
and Mechanical	Tin-Plated	For phase and neutral conductors conform to UL 486A
Screw Type		For ground conductors, conform to UL 467
Wire Connectors		
Terminal Block-	Copper – Electro-	High-density, screw-post barrier-type with white center marking strip
Type Wire	Tin-Plated	600VAC-rated for power circuits
Connectors		600VAC 20-Amp-rated for control circuits
		600VAC 15-Amp-rated for instrumentation circuits
		Conform to NEMA ICS4 and UL486A
Terminals - ≥#6AWG	Copper – Electro- Tin-Plated	UL-listed, solderless, compression type.
Terminals -	Copper – Electro-	UL-listed, solderless, compression type connectors, or mechanical seamless
≤#8AWG	Tin-Plated	tubular ring tongue terminals.
Terminals –	Copper - Electro-	Ring tongue terminals.
Control and	Tin-Plated	Terminal barrel shall be internally serrated and covered with color-coded PVC
Instrumentation		insulation sleeve.
Cable		
Terminals – For	Copper – Tin-	Ring-tongue, nylon- or vinyl-insulated copper crimp terminals and ferrules with
Terminations on	Plated	insulating sleeves for terminal blocks, except for light switches and receptacles.
Screw-Type		
Terminal Strips		
Supplied Integral		
to Devices		
Taps in Wires	Copper	Mechanical tap with preformed insulating cover.
#6AWG and		
Larger	0	NA_1 = 6-1-4-10 =
Taps - ≤#8AWG	Copper	Make "pigtail" or connections with compression connection with thermoplastic insulating cover.
	SDITO	CE INSULATION AND COLOR-CODING TAPE
Splice Insulation	Heat-Shrink	Conform to UL468D and ANSI C119.1 for extruded 600V insulated tubing.
Splice irisulation	Tubing	Medium- or heavy-wall thickness irradiated polyolefin tubing containing
	Tubing	adhesive mastic inner wall.
		When heated, inner wall shall melt and fill crevices and interstices of object
		covered while outer wall shrinks to form waterproof insulation.
		Ends of tubes or open ends of end caps of heat-shrink tubing shall, after
		contraction, overlap conductors ≥1½"
		Thickness ≥1/32" before contraction
		Shrinkage ratio ≤33% of supplied diameter when heated to 257°F and allowed
		to cool to 77°F.
		Dielectric strength 140kV per ¾"
		Resistivity ≥10 ¹³ Ω-mm
		Tensile Strength ≥2000 psi
		Operating Temperature -40°F-194°F (275°F Emergency)
		Water Absorption ≤0.5%
	1	

ITEM	MATERIAL	SPECIFICATION
Splice Insulation	All Insulation	Conform to ASTM D2301 type I and UL 510
Tape and Pads		UL- or ETL-Listed
	Color	Black for insulating tape
		Face-resistant color as shown for color-coding tape
	Synthetic Rubber	Self-fusing, oil and flame-resistant
	Polyvinyl-Chloride	Pressure-sensitive adhesive
		Thickness ≥150µm
		Premium grade
		Heat, cold, moisture, and sunlight resistant
		Use all-weather tape for cold-weather or outdoor locations
	Tape for Insulating	Designed for use on 5kV circuits
	Circuits >600VAC	Resistant to ozone, corrosion and water
	Insulating Pads	Composed of laminated 1/16" thickness of electrical grade PVC and 1/8"
		thickness of butyl splicing compound with removable liner
		CABLE AND WIRE MARKERS
Cable Markers	Nylon Identification Ties	Hot-stamp with black letters ≥5/32" high
Wire Markers	Hot-Stamped PVC	White with black lettering for uniform appearance
	Sleeves	Hold sleeve length to uniform length at each terminal board
		Where hot-stamped sleeve is unavailable, mark wire with clip sleeve covered
		with transparent heat-shrinkable tubing.
	Heat-shrink	White with black lettering for uniform appearance
	Polyolefin Sleeves	Hold sleeve length to uniform length at each terminal board
		OTHER
Wire and Cable		Baskets, grips, clamps, wedge assemblies and other devices designed for cable
Supports		support
		Heavy-duty split-lace
Pulling Lubricant		Cable Manufacturer's standard containing no petroleum or other products which
		deteriorate insulation.

E. The following product design criteria, options and accessories are required:

ITEM		DESCRIPTION
Wire Color	Phase Conductors #8AWG and smaller	Factory color coding with integrally pigmented solid color insulation along full length Do not use on-site coloring of conductor ends or apply colored plastic adhesives in lieu of factory color-coding.
	Phase Conductors #6AWG and larger	Factory color coding with solid color insulation or black insulation with onsite application of 3" length of colored plastic adhesives at conductor ends and at junctions and splice boxes.
	Ground Conductors	Factory color coding with integrally pigmented solid green color insulation along full length, or Stripping insulation from entire exposed length, or Covering entire exposed length with green tape.
	Purple-Colored Wiring	Use to identify wires connecting to PLC input/output circuits. Use white or purple with white stripe for PLC neutral throughout Work. This requirement is a worker safety precaution to identify foreign power sources in equipment and applies to internal wiring in PLC enclosure cabinet, interconnecting wiring to devices and equipment, and internal equipment wiring.

F. Color-code low-voltage building and power wire as follows:

PHASE	240/120 VOLTS	208/120 VOLTS	240 VOLTS	480/277 VOLTS
Phase A	Black	Black	Black	Brown
Phase B	Red	Red	Red	Orange
			(Orange for high leg	
			of Delta system)	
Phase C		Blue	Blue	Yellow
Neutral	White	White	White	Gray
Ground	Green	Green	Green	Green
		OTHER WIRING		

Control	Red (and see below)	
PLC (Field)	Purple	
PLC (Neutral)	White or Purple w/ White Stripe	
+24VDC	Blue	
-24VDC	Blue w/ White Stripe	
Instrument Signal Wiring	+White	
	-Black	
Wires energized by	Yellow	
sources external to control		
panels		

- 1. Phases A, B, and C denote direction of positive phase rotation.
- G. Control wires shall have colored insulation.
 - 1. Provide separate color codes for each wire in each conduit that has ≤ 7 wires.
 - 2. Conduits with >7 wires shall have ≥7 types of colored insulation.
- H. Refer to individual cable type specifications for color coding of multiconductor control and instrumentation cable.

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install conductors and cables before submitting shop drawings or ordering.
 - 1. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

3.2 Installation

- A. Refer to Section 01 73 00 for basic execution and installation requirements.
- B. Furnish and install conductors and cables at locations shown on Plans and Submittals.
- C. Conform to the following installation standards:
 - 1. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 2. Other applicable OSHA and Cal OSHA regulations
 - 3. California Electrical Code Article 300 "Wiring Methods"
 - 4. California Electrical Code Article 310 "Conductors for General Wiring"
 - 5. California Electrical Code Article 320 "Armored Cable: Type AC"
 - 6. California Electrical Code Article 322 "Flat Cable Assemblies: Type FC"
 - 7. California Electrical Code Article 324 "Flat Conductor Cable: Type FCC"
 - 8. California Electrical Code Article 326 "Integrated Gas Spacer Cable: Type IGS"
 - 9. California Electrical Code Article 330 "Metal-Clad Cable: Type IGS"
 - 10. California Electrical Code Article 332 "Mineral-Insulated Metal-Sheathed Cable: Type MI"
 - 11. California Electrical Code Article 334 "Nonmetallic Sheathed Cable: Types NM, NMC, and NMS"
 - 12. California Electrical Code Article 336 "Power and Control Tray Cable: Type TC"
 - 13. California Electrical Code Article 338 "Service-Entrance Cable: Types SE and USE"
 - 14. California Electrical Code Article 340 "Underground Feeder and Branch-Circuit Cable: Type UF"
 - 15. California Electrical Code Article 400 "Flexible Cords and Cables"
 - 16. California Electrical Code Article 402 "Fixture Wires"
 - 17. Other applicable building, fire and electrical code requirements
 - 18. NETA (National Electrical Testing Association) ATS standards
 - a. NETA ATS 7.3.2 for low-voltage cable inspections and tests.
 - 19. Manufacturer's installation and warranty requirements
- D. Refer variances between above docume8ts and Contract Documents to Owner's Representative.

- E. Tag control wires and instrument cables at terminations and visible and accessible locations in maintenance holes, hand-holes, panels, switchboards, pull boxes, terminal boxes, and at control device.
 - 1. Tag power wires in pull boxes or similar structures where there is more than 1 circuit.
- F. Tags shall conform to the following:
 - 1. Tag wires within ≤ 2" of termination at each device and terminal board.
 - 2. Tag both ends of wires ≥ 12" long.
 - 3. Do not use tags relying on adhesives or taped-on markers.
 - 4. Provide conductor tags for conductors ≤ #12AWG with legible permanent sleeve of yellow or white PVC with machine printed black marking.
 - 5. Provide tags for cables, and for conductors ≥ #10AWG, consisting of permanent nylon marker plates with legible designations hot stamped on plate.
 - a. Attach these marker plates to conductors and cables with nylon tie cord.
 - 6. Position wire markers to be readily visible for inspection.

G. Assign tag numbers as follows:

- 1. Identify power and control conductors at each termination and at all accessible locations including maintenance holes, handholes, panels, switchboards, pull boxes and terminal boxes.
- 2. Tag numbers for conductors shall follow 3-segment numbering scheme, defining origin of conductor, function of conductor, and destination of conductor.
 - a. For example: MCCA-P-MCCB shows MCCA is origin, P is function identification (P=power, L=lighting or receptacle, C=control, S=signal, etc.), and MCCB is destination.
- 3. Where Plans, Shop Drawings, or interconnection diagrams show circuit numbers or where conductors have multiple destinations, append circuit numbers or identifiers to letters showing function of conductor, eq PA, PB.
- 4. Make origin and destination identification the specific names of equipment or instruments used on Plans
- H. Install Conductor Arc and Fireproofing Tapes as Follows:
 - 1. Wrap together single conductors and cables, except those rated TC, in maintenance holes, handholes, vaults, cable trays, and other indicated locations using arc and fireproofing tapes.
 - a. Wrap all conductors entering from each conduit together as 1 cable.
 - 2. Follow tape Manufacturer's Installation Instructions.
 - 3. Throughout their exposed length, bundle and secure arc and fireproofing tape at intervals ≤18" on centers with nylon, self-locking, releasable, cable ties or bands of specified glass cloth electrical tape.
 - a. Make each band of ≥2 wraps of tape directly over each other.
 - 4. Wrap together as far as possible, conductors carrying phases A, B, and C of same feeder.
 - a. Do not wrap together conductors carrying only 2 of 3 phases.
 - 5. Train cables as closely as possible to their final positions.
 - 6. Clean cables of oil, grease, and cable pulling compounds, using suitable solvents and cleaners non-injurious to cable, and then wipe dry.
 - 7. Cover projecting surfaces such as fittings, ground connectors or bonding connections with insulating compound to present smooth continuous surface for taping.
 - 8. Fireproofing tape shall be 3" width half-lapped and extend ≥6" into raceway.
 - a. Use 3/4" glass tape at 3' intervals to hold tape in place.
- I. Install wiring within raceways unless otherwise shown.
 - 1. Do not combine feeder, branch, control, and instrumentation circuits in same raceway, cable tray, junction or pull box, except:
 - a. Where shown in Contract Documents
 - b. Where field conditions dictate and where written acceptance is obtained from Owner's Representative.

- 2. Isolate control circuits from feeder and branch power circuits and from instrumentation circuits
 - a. 12VDC, 24VDC, and 48VDC control circuits may be combined.
 - b. Isolate AC control circuits from DC control circuits.
 - c. Isolate 125 VDC control circuits from all other AC and DC circuits.
- Isolate instrumentation circuits from feeder and branch power circuits and from control circuits.
 - a. Isolate analog and digital instrumentation circuits.
 - b. Analog instrumentation signal circuits may be combined.
 - c. Digital instrumentation signal circuits may be combined.
- 4. Multiple branch circuits for lighting, receptacle, and other 120VAC circuits may be combined into a common raceway.
 - a. If circuits are combined, upsize raceway as required by NEC for size and quantity of conductors.
 - b. If circuits are combined, upsize conductor sizes as required by NEC for ampacity deratings for number of conductors in raceway.
 - c. Neutral conductors may not be shared.
- J. Pull cables and conductors into place as follows:
 - 1. Do not install conductors or cables in conduits, ducts or trays until raceway system is completed.
 - 2. Size raceways to accommodate number and size of cables shown in accordance with NEC Article 300.
 - Immediately prior to placement of each cable or cable group, inspect raceway route to be followed and verify installation is complete and free of materials detrimental to cable or its placement.
 - a. Brush, scrape, or swab embedded or buried conduits and ducts before pulling in conductors.
 - 4. Do not damage conductors or insulation.
 - a. Handle conductors carefully to avoid kinks or insulation damage.
 - b. Do not pull cables tight against bushings nor press cables heavily against enclosures.
 - 5. If during Work progress, raceways appear inadequate to accommodate assigned cable, notify Owner's Representative and discontinue further Work within questionable raceway until advised by Owner's Representative on how to proceed.
 - 6. Group cables assigned to each conduit and pull in simultaneously, using cable grips and UL-accepted lubricants compatible with insulation.
 - 7. Check size and length of cables before pulling into conduits.
 - 8. Install shielded instrumentation wire from terminal to terminal with no splicing at intermediate points.
 - a. Remove cable pulled into wrong conduit or cut too short and replace at no additional cost to Owner.
 - b. Do not reuse cable removed from 1 conduit or duct without permission from Owner's Representative.
 - 9. Where pulling compound is used, use UL-listed compound acceptable to cable Manufacturer and compatible with cable outer jacket or insulation and with raceway involved.
 - 10. Accomplish fishing and pulling with flexible round metal or non-metallic tape, carbon dioxide or forced air propelled polyethylene cord, nylon rope, or manila rope.
 - a. Use woven wire cable grips to pull single conductor cable, #2/0AWG and larger, and multiconductor cable.
 - b. Use pulling loops to pull single conductor cable smaller than #2/0AWG.
 - c. Use only those pulling mechanisms of both manual and power types with rated capacity in tons clearly marked on mechanism.
 - d. Do not exceed cable Manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
 - e. Do not use vehicles to pull conductors.

- f. If pulling mechanism capacity exceeds recommended pulling tension of cable as given by cable Manufacturer, provide dynamometer to monitor cable tension, and observe indicator throughout pulling.
- g. If excessive strain develops, stop pulling operation, determine difficulty, and make corrections.
- h. When cable grip is used for pulling, cut off area of cable covered by grip plus 6" and discard.
- 11. Leave spare conductors at their maximum length for possible use as replacements.
 - a. Coil each spare conductor neatly and then tape to conductors being used.
- K. Install low-voltage (600VAC) building wire and power wire as follows:
 - 1. Install wiring and cable in conduit and terminate unless otherwise noted.
 - 2. To reduce pulling tension in long runs, coat wires and cables with pulling compound recommended by wire or cable Manufacturer before pulling into conduits.
 - 3. Remove debris and moisture from conduits, boxes, and cabinets prior to wire or cable installation.
 - 4. Install wires and cables in each voltage classification in separate raceways and completely isolate at cable and wire terminations.
 - 5. Group conductors #1/0 AWG and smaller in panelboards, cabinets, pull boxes, and switchboard wireways.
 - a. Tie with plastic ties, and fan out to terminals.
 - b. Lace conductors #2/0 AWG and larger with marline.
 - 6. Do not insulate soldered mechanical joints with tape.
 - 7. Vinyl plastic insulating tape for wire and cable splices and terminations and for color coding shall be flame retardant, rated for ≥ 90°C, conforming to UL510.
 - a. Use tape ≥ 7-mil thick for ≤ #8AWG size wire.
 - b. Use tape ≥ 8.5-mil thick for outdoor or cold-weather applications for ≤ #8AWG size wire
 - c. Use tape \geq 10-mil thick for \geq #6AWG size wire.
 - 8. Arrange wiring in cabinets, panels, and motor control centers neatly, cut to proper length, remove surplus wire, and bridle and secure in acceptable manner.
 - a. Identify circuits entering motor control centers or other control cabinets in accordance with conductor identification system specified.
 - 9. Cap spare conductors and conductors not terminated with UL-listed end caps.
 - 10. Where conductors pass through holes or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect conductors.
 - 11. For conductors to be connected by others, provide ≥6' spare conductor in freestanding panels and ≥2' spare in other assemblies.
 - a. Provide more spare conductor in assemblies where it is obvious more conductor will be needed to reach termination point.
- L. Splice low-voltage (600VAC) cable and building wire as follows:
 - 1. Splices shall be as follows using connectors listed under Acceptable Manufacturers.

FEEDER AND POWER BRANCH CIRCUITS				
Location	Wire Size	Type of Splice or Termination		
Device Outlet Boxes	≤#10AWG	Use twist/screw-on-type connectors or crimp connectors with tools by same		
		Manufacturer or UL listed for connector		
	≤#8AWG	Use twist/screw-on-type connectors		
Junction and Pull Boxes	≤#10AWG	Use twist/screw-on-type connectors or crimp connectors with tools by same		
and Wireways		Manufacturer or UL listed for connector		
	≤#8AWG	Use twist/screw-on-type connectors		
	≥#6AWG	Use compression sleeve, mechanical screw or terminal block, or terminal strip-type connectors. Stagger sleeves to minimize completed splice diameter Cover sleeves with Thermofit insulation sleeve, extending ≥3 wire diameters beyond each end of compression sleeve after shrinking.		

		Heat source and shrinking techniques shall conform to Manufacturer's			
		Installation instructions.			
Motor Terminal Boxes	Motor Terminal Boxes ≤#10AWG Use twist/screw-on-type connectors or crimp connectors with tools by				
		Manufacturer or UL listed for connector			
	≥#8AWG	Use insulated mechanical screw-type connectors			
Manholes or Handholes	≤#8AWG	Use twist/screw-on-type connectors pre-filled with epoxy			
	≥#6AWG	Use watertight compression sleeve or mechanical screw-type connectors			
	CONTROL CIRCUITS				
Junction and Pull Boxes	≤#8AWG	Use terminal-block-type connector			
Manholes or Handholes	≤#8AWG	Use twist/screw-on-type connectors pre-filled with epoxy			
Control Panels or Motor	≤#8AWG	Use terminal block or strips provided within equipment or field-installed			
Control Centers within equipment by Contractor.					
	INSTRUMENTATION CIRCUITS				
May be spliced where	May be spliced where field conditions dictate and written permission is obtained from Owner's Representative.				
Maintair	Maintain electrical continuity of shields when splicing twisted shielded conductors.				
Junction and Pull Boxes	≤#10AWG	Use terminal-block-type connector			
Control Panels or Motor	≤#10AWG	Use terminal block or strips provided within equipment or field-installed			
Control Centers within equipment by Contractor.					

- 2. Retighten bolt-type connectors 24-48 hours after initial installation and before taping.
 - a. Tape connections made with non-insulated-type connectors with rubber-type tape, 1½ times thickness of conductor insulation, then cover with Scotch 33 tape.
- 3. Do not splice wires in underground handholes or pull boxes unless shown on Plans.
 - a. Seal splices in underground handholes and pull boxes and in light poles with individual sealing packs of Scotchcast Brand 400 Resin or equal.
- 4. Submersible splices below grade shall be cast-resin type.
- M. Terminate low-voltage (600VAC) wires as follows:
 - 1. Terminate wires and cables at each end.
 - 2. Do not splice feeders without written acceptance from Owner's Representative.
 - 3. Provide terminals and connectors acceptable for material type used.
 - 4. Terminate control and instrumentation wiring with methods consistent with terminals provided, and in accordance with terminal Manufacturer's Installation Instructions.
 - a. Where terminals provided will accept such lugs, terminate control and instrumentation wiring (except solid thermocouple leads) with insulated, locking-fork compression lugs
 - 5. Install compression-type lugs or connectors with specially-designed hydraulic or mechanical tool conforming to Manufacturer's Installation Instructions to ensure permanent, secure, high-conductivity joint.
 - a. Tooling shall provide complete, controlled crimp where tool will not release until crimp is complete.
 - b. Do not use plier-type crimpers.
 - 6. Provide color-coded system on terminal and die sets to provide correct number and location of crimps.
 - a. Permanent die index number shall be embossed on completed crimp for inspection purposes.
 - 7. For terminals designed to accept only bare wire compression terminations, use only stranded wire.
 - a. Terminate only 1 wire per terminal.
 - b. Tighten terminal screws with torque screwdriver to recommended torque values.
 - 8. For solid conductors of 120VAC and 277VAC lighting and 120VAC receptacle circuits only, wire nuts may be used.
 - a. Place no more than 1 conductor in single-barrel pressure connections.
 - b. Use crimp connectors with tools by same Manufacturer and/or UL-listed for connectors of stranded conductors.
 - 9. Tighten screws and terminal bolts using torque-type wrenches and/or drivers to tighten to inch-pound requirements of Manufacturer, NEC, and UL.
 - 10. Lace control leads between conduit ends and terminal blocks located in control panels, cabinets and similar locations neatly together with nonreleasing nylon ties.

- N. Install instrument cables as follows:
 - 1. Do not splice instrument cables without permission of Owner's Representative.
 - a. Cables shall be continuous from device to RTU unless shown otherwise on Plans.
 - 2. Cable splices shall be made by qualified cable splicers following Manufacturer's recommendations.
 - 3. Locate splices, when permitted, only in readily accessible cabinets or junction boxes using terminal strips.
 - a. Splices will only be permitted where proven necessary by accepted pulling tension calculations.
 - 4. Where connections of cables are to be made for instrumentation and control cables, leave pigtails of adequate length for neat bundled type connections.
 - 5. Maintain integrity of shielding of instrumentation cables.
 - a. Ensure grounds do not occur because of damage to jacket over shield.
 - 6. Seal cables entering maintenance holes, hand-holes or vaults using accepted expanding foam product.
 - 7. Ground drain wire of shielded instrumentation cables at source terminal strip end only.
 - a. Preferred grounding location is at load (eg control panel), not at source (eg field-mounted instrument).

3.3 Field Quality Control

A. Refer to Section 26 08 00 for field testing requirements.

END OF SECTION

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 Work Included

 A. Materials, testing, and installation of grounding and bonding conforming to CEC and NEC Article 250.

1.2 Related Work

- A. Section 01 10 01: Summary of Work and Sequence of Construction
- B. Section 01 22 00: Unit Prices
- C. Section 01 33 00: Submittal Procedures
- D. Section 01 40 00: Quality Requirements
- E. Section 01 61 00: Common Product Requirements
- F. Section 01 65 00: Product Delivery Requirements
- G. Section 01 66 00: Product Storage and Handling Requirements
- H. Section 01 73 00: Execution
- I. Section 26 05 10: Common Work Results for Electrical
- J. Section 26 05 19: Low-Voltage Electrical Power Conductors and Cables
- K. Section 26 05 33: Raceway and Boxes for Electrical Systems
- L. Section 26 08 00: Commissioning of Electrical Systems
- M. Section 31 23 33: Trenching and Backfilling

1.3 System Description

- A. Furnish and install complete operating grounding and bonding including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.
- B. System shall bond and ground exposed non-energized metal surfaces containing energized devices, parts, or conductors, building steel, other metals, metallic electrical raceways, and neutrals of transformers and generators.
 - 1. Assure ground continuity is continuous throughout Work.

1.4 Quality Assurance

- A. Use adequate number of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Furnished equipment shall be UL listed and labeled.
- C. Work shall conform to applicable requirements of NEC and Cal OSHA Title 8.

1.5 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - 1. ASTM B3 Soft or Annealed Copper Wire
 - 2. ASTM B8 Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft
 - 3. ASTM B33 Tinned Soft or Annealed Copper Wire for Electrical Purposes
 - California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 5. California Building Code (CBC)
 - 6. California Electrical Code (CEC)
 - 7. California Plumbing Code (CPC)
 - 8. IEEE 81 Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of Ground System
 - 9. IEEE 142 Grounding of Industrial and Commercial Power Systems
 - 10. IEEE 837 Qualifying Permanent Connections Used in Substation Grounding

- 11. NETA ATS Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems
- 12. NFPA 70 National Electric Code (NEC)
- 13. UL 467 Safety Standard for Grounding and Bonding Equipment

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION			
DRAWINGS AND PART SCHEDULES				
Shop Drawings	Shop Drawings Submit per equipment Shop Drawing requirements			
Material List	Submit list of grounding materials and equipment.			
	Show size, material and manufacturer.			
	MANUFACTURER'S LITERATURE			
Product Data	Submit for the following per Product Data requirements:			
	Exothermic welding materials			
Terminal lugs and clamps Copper grounding cable				
4. Ground rods				
	5. Ground connection hardware			
Installation Instructions	Submit per Installation Instruction requirements.			
	QUALITY ASSURANCE AND CONTROL SUBMITTALS			
Field Test Procedures	Include list of test equipment to be used.			
CLOSEOUT SUBMITTALS				
Field Test Record	Indicate overall resistance to ground, resistance of each electrode, and plot of			
Transcripts	resistance vs distance from grid.			
Warranty	Furnish 1-year warranty from date of final acceptance			

B. Refer to Section 01 33 00 for definition of requirements for Shop Drawings, Product Data, Installation Instructions, and Test Record Transcripts.

1.7 <u>Delivery, Storage, and Handling</u>

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Strictly follow Manufacturer's instructions and warranty requirements for delivery, storage, and handling of grounding and bonding equipment.

1.8 **Project Site Conditions**

A. Refer to Section 01 10 01 for full list of project site conditions.

1.9 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for grounding and bonding for electrical systems.

PART 2 - PRODUCTS

2.1 <u>Acceptable Manufacturers</u>

A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Concrete Grounding	Brooks Products	Ontario, CA (909) 947-7470
Wire Boxes and Cover	J&R Concrete Products #10-R	Perris, CA (951) 943-5855
	Accepted equal	
Polymer-Concrete	Applied Engineering Products	Chino, CA (909) 393-9800
Utility Vaults	Armorcast Products Company	Ontario, CA (909) 390-1365
	J &.R Concrete Products	Perris, CA (951) 943-5855
	Accepted Equal	
Grounding Rods	Burndy Corporation	Manchester, NH (800) 346-4175
	Erico International Corp "Eritech"	Solon, OH (440) 349-2630
	Harger Lightning Protection	Grayslake, IL (847) 548-8700
	Henry Brothers	Springville, NY (716) 941-6141
	Jocelyn Forge, Inc.	Bulacan, PHI (632) 984-8582

ITEM	MANUFACTURER	MANUFACTURER LOCATION
	Lyncole Grounding Solutions/ VFC XIT®	Torrance, CA (310) 214-4000
	Robbins Lightning Protection	Maryville, MO (800) 426-3792
	Thomas & Betts (Blackburn)	Memphis, TN (800) 888-0211
	Thompson Lightning Protection, Inc.	Saint Paul, MN (800) 777-1230
	Accepted equal	
Electrolytically-	Lyncole Grounding Solutions/ VFC XIT®	Torrance, CA (310) 214-4000
Enhanced Grounding	Accepted equal	
Rods and Backfill		
Exothermic Weld	Erico / Pentair Cadweld Electrical Products	Solon, OH (440) 349-2630
Equipment	Furseweld	Torrance, CA (310) 214-4000
	Harger Lightning Protection	Grayslake, IL (847) 548-8700
	ThermOweld / Continental Industries	Tulsa, OK (800) 558-1373
	Accepted equal	
Prefabricated	Armorcast Products Company	Ontario, CA (909) 390-1365
Composite Test	Quasite Composolite / Hubbell Lenoir City	Lenoir City, TN (865) 986-9726
Stations	Accepted equal	

B. Molds, cartridges, powder, and accessories for exothermic welds shall be furnished by same Manufacturer.

2.2 Materials

A. Refer to Section 01 61 00 for basic requirements for products and materials.

B. Materials for grounding and bonding shall be:

ITEM	MATERIAL	SPECIFICATION
Grounding Conductors	Insulated Copper	Refer to Section 26 05 19.
		Color-coded to code requirements or bare.
Conduit		Refer to Section 26 05 33.
Bonding Jumpers	Multiple-Circuit	#6AWG
	Lighting Systems	Cross-sectional areas of jumper shall match cross-sectional
		area of conductors in circuit
	Series and Other	#8AWG or larger
	Lighting Systems	Cross-sectional areas of jumper shall match cross-sectional
		area of conductors in circuit
Main Ground Conductor Loop	Copper	Minimum 1/4" x 1" rectangular bar ground bus supported with
when Exposed within Buildings		suitale spacers at ½"-1" from structure
Grounding System Bond to	Copper	Connect to 1st pipe flange inside structure on either suction or
Piping		discharge pipe using copper bar or strap and drilling and
		tapping flange to provide bolted connection
Ground Connection Hardware,	High-Strength High-	
Bolts, and Nuts	Conductivity Copper	
	Alloy	
Ground Rods	Copper-Clad Steel	UL listed
		≥³¾" diameter
		≥10' long
		With hardened steel points Provide heavy uniform coating of electrolytic copper
		molecularly bonded to rigid steel core.
		Hard drawn for scar-resistant surface.
	Galvanized Steel	UL listed
	Galvariizeu Steel	≥1" diameter
		≥10' long
		With hardened steel points
Ground Bars	Solid Copper	UL listed
Cround Baro	Cona Coppor	1/4" thick
		4" wide
		≥ 24" long in main service entrance electrical rooms;
		≥12" long elsewhere.
		Provide predrilled grounding lug mounting holes
		Provide stainless steel or galvanized steel mounting brackets
	•	

ITEM	MATERIAL	SPECIFICATION
		Provide insulated standoffs
Electrolytically-Enhanced Grounding Rods	Copper Tube	UL listed Shall hygroscopically extract moisture from air to activate electrolytic process. ≥0.079" wall thickness ≥2" diameter ≥10' long 100% self-activating, sealed, and maintenance-free Factory-fill ground rods with nonhazardous earth salts, Calsolyte™ or equal. Permanently cap copper tube on top and bottom with air breather holes at top and drainage holes at bottom. Weld #4/0AWG copper ground wire to side of weld for connection to grounding electrode conductor
Electrolytically-Enhanced	Non-corrosive	pH of 8-10
Grounding Rod Backfill	bentonite clay	Maximum resistivity of 3Ω-m at 30% solids density
Connections – Ground Clamps or Lugs, Connectors and Terminals – Mechanical Type	Copper	Conform to UL 467
Connections – Ground Clamps, Connectors and Terminals – Compression Type Suitable for Direct Burial in Earth or Concrete	Bronze	High Copper Alloy Content Conform to UL 467 Conform to IEEE 837 Non-Reversible
Connections – Ground Clamps, Connectors and Terminals – Compression Type for Interior Locations	Bronze	High Copper Alloy Content Conform to UL 467 Non-Reversible Provide 2 bolt holes for terminals for connection to bus bars
Connections – Ground Clamps, Connectors and Terminals – Compression Type Suitable for Direct Burial in Earth or Concrete	Bronze	High Copper Alloy Content Conform to UL 467 Conform to IEEE 837 Non-Reversible
Exothermic Weld Connections	Copper oxide reduction by aluminum process	Properly size molds for application.
Above-Grade Outdoor Connectors	Exothermic Weld, Compression, or Brazed Type	Of proper size for conductors and ground rods specified
Below-Grade Connectors	Exothermic Weld Type	Of proper size for conductors and ground rods specified.
Bare Copper Conductor and Bus	Heat-Shrink Tape or	
Splice Protection	Sleeve	
Grounding Wire Boxes	Precast Concrete	H25-rated
Grounding Wire Box Cover	Cast Iron	7# minimum Embossed "GROUND" Provide breather holes when used with electrolytically-enhanced grounding rods.

C. The following product design criteria, options and accessories are required:

ITEM		DESCRIPTION
Grounding System Resistance	Transformer Grounding Electrodes	5Ω
	Separately Derived Sources Grounding Electrode	5Ω
	Noncurrent-Carrying Metal Parts	25Ω
	All other Grounds	25Ω

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install grounding and bonding before submitting shop drawings or ordering.
 - 1. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Examine areas and conditions under which Work of this section will be performed.
 - 1. Correct conditions detrimental to timely and proper completion of Work.
- C. Coordinate installation of embedded ground cables with concrete Work.
- D. Remove paint, rust, or other nonconducting material from contact surfaces before making ground connections.

3.2 Installation

- A. Refer to Section 01 73 00 for basic execution and installation requirements.
- B. Refer to Section 31 23 33 for open trench requirements.
- C. Furnish and install grounding and bonding at locations shown on Plans and Submittals.
- D. Install grounds in presence of Owner's Representative.
- E. Conform to the following installation standards:
 - 1. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders.
 - 2. Other applicable OSHA and Cal OSHA regulations.
 - 3. California Electrical Code Article 250 "Grounding and Bonding".
 - 4. NFPA 70 National Electric Code (NEC)
 - 5. Other applicable building, fire, plumbing, mechanical and electrical code requirements.
 - 6. NETA (National Electrical Testing Association) ATS standards
 - a. NETA ATS 7.13 for grounding inspections and tests.
 - b. NETA ATS 7.14 for ground fault protection inspections and tests.
 - 7. Manufacturer's installation and warranty requirements.
- F. Refer variances between above documents and Contract Documents to Owner's Representative.
- G. The following shall be grounded:
 - 1. Antenna masts
 - 2. Steel tanks
 - 3. Metal ladders
 - 4. Door frames
 - 5. Handhole and maintenance hole exposed metal covers
 - 6. Hand rails
 - 7. Air conditioners
 - 8. Motors
 - 9. Pumps
 - 10. Casings
 - 11. Compressors
 - 12. Magnetic flow meters
 - 13. Exposed pump suction and discharge piping
 - 14. Process equipment with exposed metal parts
 - 15. Exposed non-current-carrying metallic parts of electrical equipment.
 - 16. Raceways and neutral of wiring systems.
 - 17. Neutrals of transformers.
 - 18. Metal sheathing and exposed metal vertical structural elements of buildings.
 - 19. Metal fences enclosing electrical equipment.
 - 20. Metal equipment platforms supporting electrical equipment. (Bond platform to equipment.)
 - 21. Bond metal frames and railings supporting pushbutton stations, receptacles, instrument cabinets to raceways carrying circuits to these devices.
 - 22. Exposed metallic equipment that may contact electrical equipment due to close proximity.

- 23. Bond electrical enclosures, including metallic raceways, panels, switchboards and other similar metallic panels, cases, and devices associated with power, instrumentation, and control systems to grounding electrode system.
- H. Ground both ends of conduit where possible.
- I. Install ground electrode as follows:
 - 1. Construct grounding system at each structure where switchgear, motor control centers, switchboards, panelboards, panels, or other electrical equipment are installed.
 - 2. Install ground rods and grounding conductors in undisturbed, firm soil.
 - a. Provide excavation required for installation of ground rods and ground conductors.
 - 3. Drive ground rods and install grounding conductors prior to constructing concrete slabs and duct banks.
 - a. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.
- J. Install active electrolytically-enhanced grounding rods as follows:
 - 1. Bore ground rod holes as recommended by Manufacturer.
 - 2. Lower grounding rod tube into hole.
 - 3. Mix and place bentonite backfill around installed rod per Manufacturer's Installation Instructions.
 - 4. Install protective box over top of grounding rod and flush with ground surface.
 - 5. Ensure box breathing holes are clear of debris.
 - 6. Connect ground rod pigtail to grounding electrode with exothermic weld.
- K. Construct ground ring grounding systems around structures as follows:
 - 1. Ground ring consists of ground rods and grounding conductor looped around structure.
 - 2. Place ground rings ≥10' from structure foundations and ≥30" below grade.
 - 3. Provide ≥4 ground rods placed at corners of structure and additional rods so distance between ground rods ≤ 50'.
 - 4. Bond building structure metal support columns to ground ring at all corners of structure.
- L. Connect conductors to grounding rod as follows:
 - 1. Do not splice grounding conductors except at ground rods.
 - 2. Provide exothermic welds between grounding cable installed for building ground grid and each ground electrode in ground grid system.
 - 3. Install grounding cable near base of structures in undisturbed, firm earth and as far from structure as excavation permits and ≥18".
 - 4. Provide sufficient slack in grounding conductor to prevent conductor breakage during backfill or due to ground movement.
 - 5. Extend pigtail conductors at structures or risers 6' above finished grade.
 - 6. Protect pigtail conductors from damage by coiling, tying, and bagging in 10-mil polyethylene.
 - 7. Backfill excavation completely, tamping to provide contact between backfill materials and ground rods and conductors.
 - 8. Extend grounding conductors through concrete foundations or building walls within 3' below finish grade
 - a. Where ground conductors penetrate floor slabs or building walls provide non-metallic water-stop sleeves.
 - 9. Extend grounding conductors within structures to accessible points for grounding equipment and electrical enclosures.
 - 10. For buildings, construct concrete-encased bare copper ground loop in bottom of concrete footing for buildings as shown.
 - 11. For isolated well sites, construct bare copper ground wire from MCC ground bus to well casing as shown.
 - 12. Construct concrete-encased bare ground conductor in each duct bank.
 - a. Run grounding electrode system conductors continuously in duct banks, through maintenance holes, handholes, raceway boxes and cable tray exteriors.
 - b. Connect conductors to structure ground ring or grounding system to provide continuous grounding electrode system.

- c. Bond to metal lid or cover.
- 13. Bond electrical enclosures, pedestals, and support racks, including metallic raceways, panels, switchboards and other similar metallic panels, cases, and devices associated with power, instrumentation, and control systems to grounding electrode system.
 - a. Connect using ≥#6AWG bare copper conductor to ground
 - b. Connect metal light or utility poles to ground rod using ≥#6AWG bare copper conductor.
- 14. Extend both ends of loop to ground bus within main service switchboard or motor control centers as appropriate.
- 15. Buried or concealed joints or terminations are not permitted.
- 16. Protect wires with rigid steel conduit where exposed wires stub up through slab at switchboard or motor control centers.
- M. For buildings, construct concrete-encased bare copper ground loop in bottom of concrete footing for buildings as shown on Plans.
 - 1. Ground cable penetrations through building exterior walls shall enter within 3' below finish grade and shall be prepared with a water stop.
 - a. Unless otherwise shown, water stop shall include filling space between strands with solder and soldering 12" copper disc over cable.
 - 2. Ground cables near bases of structures shall be in earth and as far from structure as excavation permits but not closer than 6".
 - 3. Extend both ends of loop to ground bus within main service switchboard or motor control centers as appropriate.
- N. For isolated well sites, construct bare copper ground wire from MCC ground bus to well casing as shown on Plans.
- O. Bond and ground raceways as follows:
 - 1. Install metallic conduit so it is electrically continuous.
 - 2. Conduits shall contain grounding conductor with insulation identical to phase conductors, unless otherwise shown.
 - 3. NEC-required grounding bushings shall be of insulating type.
 - 4. Provide double locknuts at panels.
 - 5. Bond conduit, at entrance and exit of equipment, to equipment ground bus or lug.
 - 6. Provide bonding jumpers if conduits are installed in concentric knockouts.
 - 7. Make metallic raceway fittings and ground clamps tight to ensure equipment grounding system operates continuously at ground potential to provide low impedance current path for proper operation of overcurrent devices during possible ground fault conditions.
 - 8. Ground raceways and non-current carrying parts of electrical equipment in accordance with NEC Article 250.
- P. Connect to ground bars as follows:
 - 1. Connect ground rod pigtail conductors to ground rods with compression type connectors or exothermic weld.
 - a. Do not use exothermic welding if it will damage structure grounding conductor is being welded to.
 - 2. For ground bars mounted on wall, use compression type terminal and bolt to ground bar with 2 bolts.
 - 3. For ground bars in electrical equipment, use compression type terminal and bolt to ground bar.
 - 4. For grounding to piping systems, use mechanical type connections.
 - 5. For grounding to building steel below grade and encased in concrete, use compression type connector or exothermic weld.
 - 6. Label conductors at above-grade terminations.
- Q. Where grounding conductors are shown, bond wires to metallic enclosures at each end and to intermediate metallic enclosures.
 - 1. Provide ground rod and ground bar, when shown or when needed in each electrical maintenance hole and handhole with exposed metal parts.

- a. Expose ≥4" of rod above floor for field connections to rod.
- b. Connect exposed metal parts including conduits and cable racks to ground rod.
- 2. Bond ground cables in underground circuits with main ground cables in each electrical maintenance hole and handhole.
- 3. Ground maintenance hole hardware and cover.
- 4. Connect grounding conductors to all grounding bushings on raceways.
- 5. Run ground conductors inside conduits enclosing power conductors.
- 6. Buried or concealed joints or terminations are not permitted.
- 7. Protect wires with rigid steel conduit where wires stub up through slab at switchboard or motor control centers.
- 8. Protect exposed splices and connections for bare copper conductors and buses by wrapping with heat-shrink tape or covering.
- R. Make connections to enclosures not provided with ground buses or ground terminals using clamp type lugs added under permanent assembly bolts or under new bolts drilled and added through enclosures other than explosion proof, or by grounding locknuts or bushings.
 - 1. Ground explosion-proof enclosures not provided with grounding means above by adding adjacent junction box with ground lug.
 - 2. Do not connect ground cables to anchor bolts, against gaskets, paint, or varnish, or to bolts holding removable access covers.
- S. Ground shields of shielded power cable at each splice or termination in accordance with recommendations of splice or termination Manufacturer.
- T. Ground shields of control cables in accordance with details shown.
- U. Bond neutrals of transformers within buildings to system ground network or to additional grounding electrodes shown.
- V. Ground separately mounted step-down transformers XO terminals to either:
 - 1. Closest building steel using mechanical-type terminal bolted to steel, compression type connection, or exothermic weld.
 - 2. Closest water pipe using mechanical-type connection.
- W. Ground step-down transformers mounted in MCC's to motor control center ground bus.
- X. Ground equipment as follows:
 - 1. Connect ground buses of lighting panels, distribution panels, switchboards, motor control centers and switchgear to common ground bus with grounding conductor.
 - 2. Use metallic conduit system for equipment and enclosure grounding.
 - a. Grounding through conduit system shall be in excess of ground conductors shown in Plans.
 - 3. Provide liquid-tight flexible conduits with separate equipment grounding conductors sized per NEC.
 - 4. Circuits in nonmetallic conduit shall carry 1 ground conductor for equipment grounding.
 - 5. Where equipment contains ground bus, extend and connect grounding conductors to that bus.
 - 6. Form equipment ground conductors to contour of equipment and firmly support.
 - 7. Run ground conductors to equipment neatly along face of concrete surfaces or structural steel.
 - a. Support and secure ground conductors with cable fasteners at ≤5' intervals.
 - 8. Bond equipment grounding conductor to approved grounding bushing and terminal lug. a. Install grounding conductor outside conduit if required size is >#10.
 - 9. Connect equipment enclosure containing ground bus to that bus.
 - 10. Construct grounding bushings at both ends of rigid conduit runs.
 - a. Bond grounding bushings to grounding system.
 - 11. Run conductors to equipment neatly along face of concrete surfaces or structural steel.
 - 12. Support and secure conductors with cable fasteners at ≤5' intervals.
- Y. Install ground test well as follows:

- 1. Provide handhole and ground rod as detailed on Plans to aid in performing ground testing and connecting additional ground rods if required by test results.
- 2. Connect ground wire from ground rod to main service switchboard or motor control center ground bus as shown on Plans.
- Z. Obtain Owner's written approval of each below-grade connection before backfilling.
 - 1. After installation and inspection, backfill trench with earth and other low resistivity materials.
 - 2. Exclude stones, gravel, or crushed rock.

3.3 Field Quality Control

- A. Notify Owner ≥48 hours before ground testing to allow witness for all ground resistance testing.
- B. Ground resistance tester shall be instrument specifically designed for ground resistance testing.

C. Field testing shall include:

		TEST STANDARD		FIRST TEST PAID	RETESTS PAID FOR
ITEM	TEST FOR	(ASTM OR OTHER TEST STANDARD)	FREQUENCY	FOR BY	BY
Grounding and Bonding	Installation	Visual inspection and testing of finished grounding installation per NETA ATS 7.13 Notify Owner's Representative 24 hours before below-grade connections are ready for inspection.	1 inspection	Contractor	Contractor
	Exothermic Weld Connections	Welds shall encompass 100% of ends of materials being welded. Strike weld with moderate hammer blow. Remake connections failing test or which exhibit porous or deformed welds.	1 test each weld	Contractor	Contractor
	Resistance of Electrodes to Ground	Refer to testing requirements below.	1 test each ground electrode	Contractor	Contractor
	Grounding System Continuity	Test building ground loops, major equipment grounds, ground rods, motor, wire and cable grounds, directly referenced to an extremely low resistance (approximately 1Ω) reference ground bench mark located ≥20' from ground test point.	1 test	Contractor	Contractor
	Ground Fault Protection	Visual inspection and testing of finished ground fault protection system per NETA ATS 7.14	1 inspection	Contractor	Contractor
		Primary current injection into switchgear bus with test set configured to simulate transformer source and high-current jumper used to simulate unbalanced load and ground fault conditions	1 inspection	Contractor	Contractor
		Verify no tripping for unbalanced load on each feeder and each main breaker	1 inspection	Contractor	Contractor
		Verify no tripping for unbalanced load across tie breaker for dual-source schemes	1 inspection	Contractor	Contractor
		Verify tripping for ground fault on load side of feeder for each feeder and on each main bus	1 inspection	Contractor	Contractor
		Verify tripping for ground fault on single feeder and each main bus through breaker(s) for multiple-source schemes	1 inspection	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

- D. Test resistance of electrodes to ground as follows:
 - 1. Refer to Paragraph 2.2C for allowable resistances to ground.
 - 2. Complete tests before energizing electrical distribution system.
 - 3. Services at power company interface points shall conform to power company ground resistance requirements.
 - 4. Measure resistance of separate grounding electrode systems before systems are bonded together below grade.
 - 5. Combined resistance of separate systems may be used to meet required resistance, but specified number of electrodes shall still be provided.
 - 6. Measure resistance of grounding electrode system using 3-point or 4-terminal "fall-of-potential" method per IEEE 81.
 - 7. Before connecting to ground electrode, measure resistance of electrode to ground using JB Biddle Company low-resistance, null-balance ground testing Bulletin 25-2 ohmmeter.
 - 8. Test per test instrument Manufacturer's recommendations.
 - 9. Do not test until 3 days after most recent rainfall.
 - 10. Test in afternoon after ground condensation (dew) has evaporated.
 - 11. Take ground resistance readings with current reference rod driven ≥200' from ground grid connection point.
 - 12. Take measurements at 20' intervals starting at grid or rod connection and ending at current reference electrode.
 - 13. Submit plot of resistance vs distance from grid to Owner's Representative.
 - 14. If tests show resistance less than specified requirements, provide ground rod driven 6" below grade spaced 10' away from ground well and connect to ground test well with #4 AWG bare copper wire and repeat test.
 - 15. If performance requirements are still not obtained, inform Owner for resolution.

END OF SECTION

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SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of conduit, raceway, boxes and fittings to contain conductors for electrical power, communications, control circuits and feeders for Work outside public right-of-way.
- B. Refer to the following sections for Work not covered herein.
 - 1. Section 01 73 33 for identification procedures for above-ground raceways.
 - 2. Section 03 30 00 for procedures for concrete encasement.
 - 3. Section 26 05 43 for offsite electrical Work.
 - 4. Section 31 23 33 for trenching procedures.
 - 5. Section 33 05 26 for identification procedures for buried raceways.
 - 6. Section 33 05 38 for requirements for hangers and supports.

1.2 Related Work

- A. Section 01 10 01: Summary of Work and Sequence of Construction
- B. Section 01 22 00: Unit Prices
- C. Section 01 33 00: Submittal Procedures
- D. Section 01 40 00: Quality Requirements
- E. Section 01 61 00: Common Product Requirements
- F. Section 01 65 00: Product Delivery Requirements
- G. Section 01 66 00: Product Storage and Handling Requirements
- H. Section 01 73 00: Execution
- I. Section 01 73 33: Mechanical Identification
- J. Section 03 30 00: Cast-in-Place Concrete
- K. Section 09 90 00: Painting and Coating
- L. Section 26 05 10: Common Work Results for Electrical
- M. Section 26 05 19: Low-Voltage Electrical Power Conductors and Cables
- N. Section 26 05 26: Grounding and Bonding for Electrical Systems
- O. Section 26 08 00: Commissioning of Electrical Systems
- P. Section 31 23 33: Trenching and Backfilling
- Q. Section 33 05 26: Utility Identification
- R. Section 33 05 38: Hangers and Supports

1.3 System Description

- A. Furnish and install raceway and boxes as shown on Plans and as required by CEC to deliver power to equipment furnished.
 - 1. Include appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable codes and standards.

1.4 **Quality Assurance**

- A. Use adequate number of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Factory testing shall include:

		TEST STANDARD		FIRST	RETESTS
		(ASTM OR OTHER TEST		TEST PAID	PAID FOR
ITEM	TEST FOR	STANDARD)	FREQUENCY	FOR BY	BY
Raceway,	NEMA	NEMA Standards	All products furnished	Contractor	Contractor
Conduit,	Compliance				

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Fittings and	UL Compliance	Products shall be UL listed and	All products furnished	Contractor	Contractor
Boxes	'	UL labeled	•		

1.5 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - 1. AASHTO Standard Specifications for Highway Bridges
 - 2. ANSI C33.84 Safety Standards for Outlet Boxes and Fittings
 - 3. ANSI 61
 - 4. ANSI C80.1/UL6 Electrical Rigid Steel Conduit (ERSC)
 - 5. ASME/ANSI B16.5 Steel Pipe Flanges and Flanged Fittings (Including ratings for Class 150, 300, 400, 600, 900, 1500, and 2500)
 - 6. ASTM A123 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - 7. ASTM A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 8. ASTM A536 Ductile Iron Castings
 - 9. ASTM A1008 Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
 - 10. ASTM A1011 Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength ASTM B63 Electrodeposited Coatings of Zinc on Iron and Steel
 - 11. ASTM D1785 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
 - 12. ASTM D2564 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping
 - 13. ASTM D2855 Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
 - 14. ASTM F512 Smooth-Wall Poly(Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation
 - AWWA C209 Cold-Applied Tape Coatings for Exterior of Special Sections, Connections and Fittings for Steel Water Pipelines.
 - 16. AWWA C214 Tape Coating Systems for Exterior of Steel Water Pipelines
 - 17. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 18. California Building Code (CBC)
 - 19. California Electrical Code (CEC)
 - 20. California Fire Code (CFC)
 - 21. California Plumbing Code (CPC)
 - 22. Federal Specification WW-C-581E Conduit, Metal, Rigid, and Intermediate; and Coupling, Elbow, and Nipple,
 - 23. IEEE C2 National Electric Safety Code (NESC)
 - 24. NEMA 5-19-1986
 - 25. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)
 - 26. NEMA FB1 Conduit Fitting, Cables Fittings and Accessories
 - 27. NEMA/ANSI OS1 Sheet-Steel Outlet Boxes, Devices, Covers, and Box Supports
 - 28. NEMA RN1 Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
 - NEMA RN2 Packaging of Master Bundles for Steel Rigid Conduit, Intermediate Metal Conduit (IMC), and Electrical Metallic Tubing
 - 30. NEMA TC2 Electrical Polyvinyl Chloride (PVC) Conduit
 - 31. NEMA TC3 Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
 - 32. NEMA TC6 and TC8 Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations
 - 33. NFPA 70 National Electric Code (NEC)
 - 34. Society of Cable Telecommunications Engineers SCTE 77 Underground Enclosure Integrity
 - 35. UL1 Flexible Metal Conduit
 - 36. UL 6/ANSI C80.1 Electrical Rigid Metal Conduit Steel (ERSC)
 - 37. UL 35-L4
 - 38. UL 50 Enclosures for Electrical Equipment, Non-Environmental Considerations
 - 39. UL 360 Liquid-Tight Flexible Steel Conduit
 - 40. UL 467 Grounding and Bonding Equipment
 - 41. UL 514A Metallic Outlet Boxes
 - 42. UL 514B Conduit, Tubing, and Cable Fittings
 - 43. UL 514C Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
 - 44. UL 651 Schedule 40 and 80 Rigid PVC Conduit
 - 45. UL 870 Wireways, Auxiliary Gutters, and Associated Fittings

- 46. UL 886 Outlet Boxes and Fittings for use in Hazardous (Classified Locations)
- 47. UL1242 Electrical Intermediate Metal Conduit Steel

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	ITTAL DESCRIPTION		
	DRAWINGS AND PART SCHEDULES		
Shop Drawings	Submit conduit layout and installation drawings		
	Show individual conduit numbers, proposed routing, conduit sizes, circuit numbers contained in each conduit, and size of wires in each conduit.		
	Show dimensional size of pull and junction boxes to be used.		
	Verify conduit sizes meet NEC requirements.		
	Owner's review of layout drawings will be solely for aesthetics and Operator access.		
	MANUFACTURER'S LITERATURE		
Product Data	Submit the following for items of standard manufacture:		
	Product Data for each type of conduit, fittings and boxes.		
	List of conduits, fittings, boxes, conduit boxes, mounting hardware, and accessories.		
	Product data is not required for conduit fittings or support systems		
QUALITY ASSURANCE AND CONTROL SUBMITTALS Refer to Section 26 05 10			
CLOSEOUT SUBMITTALS			
Warranty	Furnish 1-year warranty from date of final acceptance		

B. Refer to Section 01 33 00 for definition of requirements for Shop Drawings, and Product Data.

1.7 <u>Delivery, Storage, and Handling</u>

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Strictly follow Manufacturer's instructions and warranty requirements for delivery, storage, and handling of raceway and boxes.
- C. Ship conduit with thread protectors.

1.8 **Project Site Conditions**

A. Refer to Section 01 10 01 for full list of project site conditions.

1.9 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for raceways and boxes for electrical systems.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Acceptable Manufacturers for conduit and raceways include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION			
	CONDUIT FITTINGS				
Conduit Bodies	Appleton / Emerson	Rosemont, IL (800) 621-1506			
	Crouse Hinds / Eaton Form 8	Syracuse, NY (866) 764-5454			
	Killark / Hubbell	Saint Louis, MO (314) 531-0460			
	O-Z Gedney / Emerson	Rosemont, IL (800) 621-1506			
	Thomas & Betts / ABB "Ocal"	Memphis, TN (800) 816-7809			
	Accepted equal				
Conduit Fittings (Metal)	Appleton / Emerson	Rosemont, IL (800) 621-1506			
	Crouse Hinds / Eaton	Syracuse, NY (866) 764-5454			
	Hubbell-Raco	South Bend, IN (800) 992-7030			
	Killark / Hubbell	Saint Louis, MO (314) 531-0460			
	Osburn Associates, Inc.	Saint Petersburg, FL (888) 672-8767			
	O-Z Gedney / Emerson	Rosemont, IL (800) 621-1506			

ITEM	MANUFACTURER	MANUFACTURER LOCATION
	Robroy Industries	Gilmer, TX (903) 843-6562
	Steel City / ABB	Memphis, TN (800) 816-7809
	Thomas & Betts / ABB "Ocal"	Memphis, TN (800) 816-7809
	Accepted equal	
Conduit Fittings (PVC)	Carlon / Lamson & Session Co "PV-Duit"	Cleveland, OH (800) 346-2646
	Cantex Inc.	Fort Worth, TX (817) 215-7000
	Accepted equal	
Conduit Hubs	Appleton / Emerson	Rosemont, IL (800) 621-1506
	Myers Power Products	Ontario, CA (909) 923-1800
	Hubbell-Raco	South Bend, IN (800) 992-7030
	Killark / Hubbell	Saint Louis, MO (314) 531-0460
	Thomas & Betts / ABB "Ocal" Bullet Type	Memphis, TN (800) 816-7809
	Accepted equal	
Conduit Unions	Appleton / Emerson	Rosemont, IL (800) 621-1506
	Crouse Hinds / Eaton	Syracuse, NY (866) 764-5454
	Thomas & Betts / ABB "Ocal" Erickson Type	Memphis, TN (800) 816-7809
	Accepted equal	
Conduit Expansion-	Crouse Hinds / Eaton Type XD	Syracuse, NY (866) 764-5454
Deflection Couplings	Accepted equal	, , ,
Service Entrance	Killark / Hubbell	Saint Louis, MO (314) 531-0460
Heads	Accepted equal	, ,
	CONDUIT ACCESSORIES	
Conduit Automatic	Crouse Hinds / Eaton ECD	Syracuse, NY (866) 764-5454
Drains	Accepted equal	
Conduit Clamps	O-Z Gedney / Emerson	Rosemont, IL (800) 621-1506
	Accepted equal	
Conduit Seals for	Appleton / Emerson	Rosemont, IL (800) 621-1506
Sealing Around Pipe or	Crouse Hinds / Eaton "EYS" and "EYD"	Syracuse, NY (866) 764-5454
Conduit	O-Z Gedney / Emerson CSM Type	Rosemont, IL (800) 621-1506
	Accepted equal	
Conduit Seals for	Appleton / Emerson	Rosemont, IL (800) 621-1506
Sealing Around Cables	Crouse Hinds / Eaton	Syracuse, NY (866) 764-5454
in Conduit	O-Z Gedney / Emerson CSB Type factory-	Rosemont, IL (800) 621-1506
	prepared for each cable application	
	Accepted equal	
Conduit Fire-Stop	Nelson / Emerson FSP™ firestop putty	Rosemont, IL (800) 621-1506
Sealing	Accepted equal	
Locknuts	O-Z Gedney / Emerson	Rosemont, IL (800) 621-1506
	Accepted equal	
Bushings	O-Z Gedney / Emerson Type B	Rosemont, IL (800) 621-1506
-	Accepted equal	
Grounding Bushings	O-Z Gedney / Emerson Type BLG	Rosemont, IL (800) 621-1506
	Accepted equal	
Phenolic Bushings for	O-Z Gedney / Emerson Type ABB	Rosemont, IL (800) 621-1506
Protecting Cables	Accepted equal	·
Penetrating Metal	· ·	
Partitions or Barriers		
E	NEC TYPE RMC RIGID METAL COND	
Electrical Rigid Steel Conduit (ERSC) ½"-6"	Atkore International (Allied Tube and Conduit) "Rigid"	Harvey, IL (708) 339-1610
	Galvite® / Republic Conduit	Louisville, KY (502) 995-5900
	LTV Steel Tubular Products Company	Youngstown, OH
	Thomas & Betts / ABB "Ocal" (Occidental)	Memphis, TN (800) 816-7809
	Triangle Industries	Minneapolis, MN (612) 638-1330
	Accepted equal	
Electrical Rigid Steel	O-Z Gedney / Emerson Type "AX" with jumper	Rosemont, IL (800) 621-1506
Conduit (ERSC)	Accepted equal	. , ,
Expansion Fittings for		

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Exposed Locations		
Electrical Rigid Steel Conduit (ERSC)	Spring City Electrical Manufacturing Company Type "D"	Spring City, PA (610) 948-4000
Expansion Fittings at	Accepted equal	
Structural Expansion		
Joints	0 11 1 15 1 (071)	0 10/(000) 704 5454
Electrical Rigid Steel	Crouse Hinds / Eaton "STL"	Syracuse, NY (866) 764-5454
Conduit (ERSC) Threaded Joint Pre-	Thomas & Betts / ABB "Aluma-Shield"	Memphis, TN (800) 816-7809
Coating Anti-Corrosion	Thomas & Betts / ABB "Kopr-Shield"	Memphis, TN (800) 816-7809
Pastes	Accepted equal	
Galvanizing Repair	Enterprise Galvanizing Company "Galvabra®"	
Stick	Accepted equal	
PVC-Coated Electrical	Robroy Industries "KorKap"	Gilmer, TX (903) 843-6562
Rigid Steel Conduit	Robroy Industries "Perma-Cote"	Gilmer, TX (903) 843-4388
(PVC-ERSC) and Fittings	Thomas & Betts / ABB "Ocal" (Occidental Coating Company)	Memphis, TN (800) 816-7809
	Accepted equal	
PVC-Coated Electrical	Robroy Industries "Plastibond"	Gilmer, TX (903) 843-6562
Rigid Steel Conduit	Accepted equal	
(PVC-ERSC) and		
Fitting Coating Repair		
Material		
	NEC TYPE IMC INTERMEDIATE METAL C	
Intermediate Metal	Atkore International (Allied Tube and Conduit)	Harvey, IL (708) 339-1610
Conduit (IMC) ½"-4"	Republic Conduit	Louisville, KY (502) 995-5900
	Accepted equal	
	NEC TYPE PVC RIGID NONMETALLIC CO	
NEC Type PVC	Carlon / Lamson & Session Co "PV-Duit"	Cleveland, OH (800) 346-2646
Rigid Nonmetallic	Cantex Inc	Fort Worth, TX (817) 215-7000
Conduit (RNC) (PVC)	Condux International	Rancho Cucamonga, CA (909) 989-4377
and Fittings	JM Eagle Inc	Los Angeles, CA (310) 693-8200
	Osburn Associates, Inc	Saint Petersburg, FL (888) 672-8767
	Queen City Plastics	Fort Mill, SC (803) 548-0685
	Triangle Industries	Minneapolis, MN (612) 638-1330
	Accepted equal	EVIDLE CONDUIT
	EC TYPE LFMC AND TYPE LFNC LIQUIDTIGHT FL	
NEC Type LFMC Liquid-Tight Flexible	AFC Cable Systems® / Atkore International (Allied Tube and Conduit)	Harvey, IL (708) 339-1610
Metal Conduit	Anamet Electrical Sealtite® / Anaconda	Mattoon, IL (800) 230-3718
	Electri-Flex Company Type LA	Roselle, IL (800) 323-6174
	Flexible Metal Inc (FMI) / Hyspan	Tucker, GA (770) 493-1100
	General Electric Company	Fairfield, CT (203) 373-2211
	International Metal Hose Company	Bellevue, OH (419) 483-7690
	LTV Steel Company	Cleveland, OH (216) 622-5000
	Triangle Industries PWC Line	Minneapolis, MN (612) 638-1330
	Accepted equal	
Liquid-Tight Flexible	Thomas & Betts / ABB sealing rings	Memphis, TN (800) 816-7809
Metal Conduit Fittings	(5262 = ½" 5263 = ¾" 5264 =1" or "Jake"	
1	Accepted equal	D ((000) 004 4500
Liquid-Tight Flexible Metallic Conduit	Appleton / Emerson "Series ST" or Jake Type "BC"	Rosemont, IL (800) 621-1506
Connectors	Pyle-National / Hillcrest Enterprises Series "CT"	Ashland, VA (800) 848-3106
	Accepted equal	(100) 210 2100
NEC Type LFNC	Ultratite® / Southwire Company	Carrollton, GA (770) 832-4000
Liquid-Tight Flexible	Accepted equal	, (),
Non-Metallic Conduit		
	CONDUIT AND RACEWAY ACCESSO	RIES

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Plastic Wire Duct and	Hoffman-Panduit / Pentair	Anoka, MN (763) 545-1730
Spiral Binding	Accepted equal	
Wireway	Hoffman-Panduit / Pentair	Anoka, MN (763) 545-1730
	Accepted equal	
Conduit Hangers and Supports	Refer to Section 33 05 38.	
Duct Spacers and	Carlon / Lamson & Session Co	Cleveland, OH (800) 346-2646
Supports	George Fischer Sloane, Inc.	Little Rock, AR (501) 490-7777
	Queen City Plastics	Fort Mill, SC (803) 548-0685
	Accepted equal	
Conduit Through-Wall	O-Z Gedney / Emerson Type "WDK"	Rosemont, IL (800) 621-1506
Seals	Accepted equal	
Cable-Lubricating	CRC Industries Powerlube with Teflon	Horsham, PA (800) 556-5074
Compounds	Accepted equal	
Corrosion Protective	Carboline Carbo-Mastic	St Louis, MO (888) 227-2654
Coatings for Metal	Koppers Company Bitumastic 505	Pittsburgh, PA (412) 227-2001
Conduit	Porter Paint Company Super Tar Set	Louisville, KY (502) 541-5155
	Accepted equal	

B. Acceptable Manufacturers for boxes include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION	
OUTLET AND DEVICE BOXES			
Cast Steel (CS) Outlet	Appleton / Emerson Type FD	Rosemont, IL (800) 621-1506	
and Device Boxes	Bell Outdoor / Hubbell	South Bend, IN (574) 234-7151	
	Crouse Hinds / Eaton / B-Line	Syracuse, NY (866) 764-5454	
	Eaton / B-Line Circle AW	Highland, IL (800) 851-7415	
	Hoffman-Panduit / Pentair	Anoka, MN (763) 545-1730	
	Hubbell Wiegmann	Santa Fe Springs, CA (714) 620-6300	
	Killark / Hubbell	Saint Louis, MO (314) 531-0460	
	Thomas & Betts / ABB	Memphis, TN (800) 816-7809	
	Accepted equal		
Nonmetallic (NM) Outlet	Carlon / Lamson & Session Co	Cleveland, OH (800) 346-2646	
and Device Boxes	George Fischer Sloane, Inc.	Little Rock, AR (501) 490-7777	
	Accepted equal		
	JUNCTION AND PULL BOXES	·	
Cast Steel Embedded	Crouse Hinds / Eaton Series W	Syracuse, NY (866) 764-5454	
Pull Boxes Above	O-Z Gedney / Emerson Series Y	Rosemont, IL (800) 621-1506	
Grade	Accepted equal		
Cast Steel Embedded	Crouse Hinds / Eaton Type WJBF	Syracuse, NY (866) 764-5454	
Pull Boxes Below	O-Z Gedney / Emerson Series YR	Rosemont, IL (800) 621-1506	
Grade	Accepted equal		
Nonmetallic Pull Boxes	Crouse Hinds / Eaton Type NJB	Syracuse, NY (866) 764-5454	
	Accepted equal		
Fasteners	Hoffman-Panduit / Pentair	Anoka, MN (763) 545-1730	
	Accepted equal		
Fiberglass and	Armorcast Products Company	Ontario, CA (909) 390-1365	
Composite Polymer-	Carson Industries H Series	Glendora, CA (909) 592-6272	
Concrete Hand-Holes	J &.R Concrete Products	Perris, CA (951) 943-5855	
	Accepted Equal		
Precast Concrete Hand-	Brooks Products 3½T	Ontario, CA (909) 947-7470	
Holes	Eisel Enterprises, Inc.	Placentia, CA (714) 993-1706	
	Ford Meter Box Co.	Wabash, IN (260) 563-3171	
	Jensen Precast	Sparks, NV (775) 352-2700	
	J &.R Concrete Products	Perris, CA (951) 943-5855	
	Oldcastle Precast (formerly Utility Vault Company)	Fontana, CA (800) 626-3860	
	Accepted Equal		

2.2 <u>Materials</u>

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Do not use aluminum conduits, fittings, elbows, supports or boxes.
- C. Mark raceway products to show:
 - 1. Nominal trade size.
 - 2. Name or trademark of Manufacturer.

D. Materials for NEC Type RMC electrical rigid steel conduit (ERSC) and fittings shall be:

ITEM	MATERIAL	SPECIFICATION
I I CIVI		
NEO T. DMO EL 1111		STEEL CONDUIT (ERSC)
NEC Type RMC Electrical	Hot-Dipped	Conform to UL6/ANSI C80.1 and NEMA RN2.
Rigid Steel Conduit (ERSC),	Galvanized Steel	Conform to CEC Article 344
Connectors, and Fittings ½"-6"		Smooth, clean, and free of burrs and rough spots to enhance
Finish	Hot Dinned	wire pulling
Finish	Hot-Dipped	≥2.0 oz/sf conforming to ASTM A123 or A153
	Galvanizing Inside and Outside	Galvanized after threading with solid unbroken zinc layer on interior and exterior.
	Bi-chromate	
	Treatment	Coat surface finish inside and outside, threads included, with
	Treatment	secondary bi-chromate treatment over galvanizing to extend
	CONDII	surface protection and prevent oxidation. IT FITTINGS
Conduit Dadies (File and Toos)		
Conduit Bodies (Ells and Tees)	Hot-Dipped Galvanized Steel or	Provide types, shapes, and sizes to suit individual
		applications.
	Galvanized Malleable Iron	Oblong Provide threaded hubs.
	IIOII	
		Standard and Mogul type
		When fittings are used with #2AWG or larger multi-conductor cables, fittings shall be Mogul type
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
Conduit Body Covers (Ells and	Same Material as	Form 8 secured with ≥2 captive stainless steel screws
Tees)	Conduit Bodies	With tongue-in-groove (V-seal) gasket to seal out corrosive
1663)	Conduit Dodles	elements.
Conduit Bodies (Round)	Hot-Dipped	Provide types, shapes, and sizes to suit individual
Conduit Bodies (Nound)	Galvanized Steel or	applications.
	Galvanized Malleable	Oblong
	Iron	Provide threaded hubs.
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
Conduit Body Covers (Round)	Same Material as	Form 8 secured with ≥2 captive stainless steel screws
conduct Body covers (realid)	Conduit Bodies	With tongue-in-groove (V-seal) gasket to seal out corrosive
	Conduit Bodioo	elements.
Conduit Fittings and Elbows –	Hot-Dipped	Conform to UL 514B and NEMA FB1
Indoor Dry Non-Corrosive	Galvanized Steel or	Standard threaded
Locations	Galvanized Malleable	
	Iron	
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
Conduit Fittings and Elbows –	Hot-Dipped	Provide wedge nut covers (Form 8) weathertight
Outdoor, or Wet or Corrosive	Galvanized Steel or	
Locations shown on Plans	Galvanized Malleable	
	Iron	
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
Service Entrance Heads	Hot-Dipped	Provide insulated knockout cover for use with variety of sizes
	Galvanized Steel or	and number of conductors
	Galvanized Malleable	
	Iron	
Sealing Fittings	Hot-Dipped	Provide threaded hubs.
-	Galvanized Malleable	Standard and mogul size
	Iron	With or without drain and breather
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
	Fiber and Sealing	UL listed for use with sealing fitting.
	Compound	
Long Radius Elbows (PVC	3/4"-11/4"	≥12" radius

ITEM	MATERIAL	SPECIFICATION
Coated)	1½"-2½"	≥15" radius
Conduit Hubs	Hot-Dipped	Threaded type
	Galvanized Steel or	Insulated and gasketed for raintight connection
	Galvanized Malleable	
	Iron Galvanizing	>2.0 oz/of conforming to ACTM A122 or A152
Box Connectors for Damp and	Galvariizirig	≥2.0 oz/sf conforming to ASTM A123 or A153 Provide watertight threaded hub on enclosure consisting of
Wet Locations		sealing fitting with tapered conduit thread, neoprene O-ring,
		and 105°C rated insulating throat with grounding and bonding
		lug.
		Sealing locknuts are allowed but not as substitute for
		threaded watertight hubs or sealing fittings.
Chase Nipples	Hot-Dipped	Use for connection between contiguous enclosures.
	Galvanized Steel or Galvanized Malleable	Provide with locknut and insulating bushing.
	Iron with Nylon	
	Insulator	
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
Conduit Unions	Threaded Hot-Dipped	Do not use running threads.
	Galvanized Steel or	Required for connections
	Galvanized Malleable	
	Iron	> 0.0 / f
Countings	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
Couplings	Hot-Dipped Galvanized Steel or	IPS-threaded straight type Hot-dipped after fabrication.
	Galvanized Malleable	Threadless type
	Iron	Gland compression or self-threading tyope, concrete-tight
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
Expansion Couplings	Hot-Dipped	Allow ≥2" expansion or contraction
	Galvanized Steel with	
	Insulating Bushing	
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
	Gasketing Grounding	Gasketed for wet locations Internally or externally grounded
Expansion-Deflection	Hot-Dipped	Allow up to 3/4" expansion and 30° deflection from relaxed
Couplings	Galvanized Steel	position.
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
	Outer Jacket	Neoprene
	Jacket Clamps	Stainless Steel
	Gasketing	Watertight, raintight and concrete-tight
End Caps		Protect threads using color-coded end caps to provide quick
	ACCI	trade size identification.
Fasteners	Stainless Steel, Hot-	Do not use cadmium-plated hardware.
i asteriers	Dipped Galvanized	Do not use caumum-plateu naruware.
	Steel or Galvanized	
	Malleable Iron	
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
Clamps	Hot-Dipped	2-hole type with spacers (clamp-backs) and nest backs
	Galvanized Malleable	
	Iron	>2.0 oz/of conforming to ACTM A122 or A152
Screws, Bolts, Nuts and	Galvanizing Stainless Steel	≥2.0 oz/sf conforming to ASTM A123 or A153 SAE Type 316
Hardware	Olainioss Oleci	ONE Type of to
Locknuts	Hot-Dipped	Threaded type
	Galvanized Steel or	Bonding type with sharp edges for digging into metal
	Galvanized Malleable	enclosure walls
	Iron	Gasketed
D. deleter	LL.(B)	Grounding or non-grounding type
Bushings	Hot-Dipped	Threaded type

ITEM	MATERIAL	SPECIFICATION
	Galvanized Steel or Galvanized Malleable Iron with Insulating Molded Phenolic or Nylon Dielectric Collar Insert	Provide 105°C-rated plastic insulated throat and grounding and bonding lug Do not use all-metal or all-plastic bushings. Plastic bushings with 105°C temperature rating may be used for conduits ≤1" where hubs are not required and circuit conductors are supplying <480V Grounding or non-grounding type
Grounding Bushings	Hot-Dipped Galvanized Steel or Galvanized Malleable Iron with Insulating Molded Phenolic or Nylon Dielectric Collar Insert	Threaded type Provide 105°C-rated plastic insulated throat and grounding and bonding lug Do not use all-metal or all-plastic bushings. Plastic bushings with 105°C temperature rating may be used for conduits ≤1" where hubs are not required and circuit conductors are supplying <480V Grounding type Conform to UL467
Conduit Mounting Strut	Hot-Dipped Galvanized Steel	
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
	PVC Coating	≥20-mil

E. Materials for NEC Type RMC PVC-coated Electrical Rigid Steel Conduit (ERSC) and fittings shall be:

ITEM	MATERIAL	SPECIFICATION
PVC-0	COATED ELECTRICAL R	IGID STEEL CONDUIT (PVC-ERSC)
PVC-Coated Electrical Rigid	Hot-Dipped	Conform to UL6/ANSI C80.1
Steel Conduit (PVC-ERSC)	Galvanized Steel	Conform to NEMA RN1
and Fittings		Conform to CEC Article 344
Finish	Zinc with Epoxy	Conduit shall be bendable without coating damage.
	Primer and PVC	See below for PVC final coating and urethane final lining
	Coating	
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
		Conduits shall be hot-dipped galvanized after threading
		Treat zinc surface to enhance metal-plastic bond
	Epoxy-Acrylic Primer	Provide 0.5-mil thick coating over steel surface to ensure
		bond between steel exterior and PVC coating
		Apply exterior coat by dipping in liquid plastisol or equal
<u> </u>	D) (0	method producing finished product conforming to NEMA 5-19
Exterior Coating	PVC	40-mil thick for full conduit length except threads.
		Bond between PVC and conduit surface shall exceed tensile
		strength of plastic.
Interior Lining	Llucthono	Provide 2-mil clear urethane coating to threads.
Interior Lining	Urethane	≥2-mil thick on conduit and fittings Sufficiently flexible to permit conduit bending without coating
		cracking or flaking.
	PVC Sleeve on	40-mil PVC coat extending 1 conduit diameter or 2" beyond
	Female Opening	opening, whichever is less.
	T emale Opening	Sleeve interior diameter shall be same as conduit OD before
		coating.
	CONDU	IT FITTINGS
Conduit Bodies (Ells and Tees)	Hot-Dipped	Provide types, shapes, and sizes to suit individual
(2.13 4.13 1.33)	Galvanized Steel or	applications.
	Galvanized Malleable	Oblong
	Iron	Provide threaded hubs.
		Standard and Mogul type
		When fittings are used with #2AWG or larger multi-conductor
		cables, fittings shall be Mogul type
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
Conduit Body Covers (Ells and	Same Material as	Form 8 secured with ≥2 captive stainless steel screws
Tees)	Conduit Bodies	With tongue-in-groove (V-seal) gasket to seal out corrosive

ITEM	MATERIAL	SPECIFICATION
		elements.
Conduit Bodies (Round)	Hot-Dipped	Provide types, shapes, and sizes to suit individual
	Galvanized Steel or	applications.
	Galvanized Malleable	Oblong
	Iron	Provide threaded hubs.
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
Conduit Body Covers (Round)	Same Material as	Form 8 secured with ≥2 captive stainless steel screws
	Conduit Bodies	With tongue-in-groove (V-seal) gasket to seal out corrosive elements.
Conduit Fittings and Elbows –	Hot-Dipped	Conform to UL 514B and NEMA FB1
Indoor Dry Non-Corrosive	Galvanized Steel or	Standard threaded
Locations	Galvanized Malleable	
	Iron	
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
Conduit Fittings and Elbows –	Hot-Dipped	Provide wedge nut covers (Form 8) weathertight
Outdoor, or Wet or Corrosive	Galvanized Steel or	
Locations shown on Plans	Galvanized Malleable	
	Iron	
	Galvanizing	2.0 oz/sf conforming to ASTM A123 or A153
Conduit Fittings and Elbows –	Hot-Dipped	Provide wedge nut covers (Form 8) weathertight
Outdoor, or Wet or Corrosive	Galvanized Steel or	Listed for use in Class I Groups C and D locations
Locations shown on Plans	Galvanized Malleable	Conform to UL886
	Iron	
EW ED D	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
Fittings, FD Boxes, Condulets		Conform to UL 514A
and Accessories		≥40-mil PVC coat similar to conduits.
		≥2-mil urethane liner similar to conduit
		Otherwise same as specified for Electrical Rigid Steel
		Conduit (ERSC)
		Screws on Form 8 fittings shall be stainless steel with encapsulated plastic heads
		Encapsulate screw heads on condulets with corrosion-
		resistant material recommended by Manufacturer.
Service Entrance Heads	Hot-Dipped	Provide insulated knockout cover for use with variety of sizes
Corvide Entrance Floads	Galvanized Steel or	and number of conductors
	Galvanized Malleable	
	Iron	
Sealing Fittings	Hot-Dipped	Provide threaded hubs with PVC oversize sleeve
	Galvanized Malleable	Standard and mogul size
	Iron	With or without drain and breather
	Fiber and Sealing	UL listed for use with sealing fitting.
	Compound	
Expansion Couplings	Hot-Dipped	Allow ≥2" expansion or contraction
	Galvanized Steel with	
	Insulating Bushing	
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
	Gasketing	Gasketed for wet locations
E	Grounding	Internally or externally grounded
Expansion-Deflection	Hot-Dipped	Allow ≥3/4" expansion and ≥30° deflection from relaxed
Couplings	Galvanized Steel	position. ≥2.0 oz/sf conforming to ASTM A123 or A153
	Galvanizing Outer Jacket	Neoprene
	Jacket Clamps	Stainless Steel
	Gasketing	Watertight, raintight and concrete-tight
	Grounding	Internally or externally grounded
End Caps	Grounding	Protect threads using color-coded end caps to provide quick
Life Caps		trade size identification.
Long Radius Elbows	3/"-11/"	≥12" radius
Long radido Libowo	1½"-2½"	≥15" radius
Conduit Hubs	Plated Steel or	Threaded type
Conduit Habs	T TOLOG OLGGI OI	Throadod typo

ITEM	MATERIAL	SPECIFICATION
	Malleable Iron	Insulated and gasketed for raintight connection
		Shall have PVC sleeves equal to those on couplings.
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
Box Connectors for Damp and		Provide watertight threaded hub on enclosure consisting of
Wet Locations		sealing fitting with tapered conduit thread, neoprene O-ring,
		and 105°C rated insulating throat with grounding and bonding
		lug.
		Sealing locknuts are allowed but are not a substitute for
Conduit Unions	Throadad Hat Dinnad	threaded watertight hubs or sealing fittings.
Conduit Onions	Threaded Hot-Dipped Galvanized Steel or	Do not use running threads. Required for connections
	Galvanized Malleable	Nequired for confine-ctions
	Iron	
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
Couplings	Hot-Dipped	IPS-threaded, Hot-dipped after fabrication.
o o a pinigo	Galvanized Steel	Provide ribbed loose coupling with each conduit length
		Bond PVC coating to coupling outer surface.
		PVC sleeve equal to OD of uncoated conduit shall extend 1
		pipe diameter or 2" (whichever is smaller) beyond both ends
		of coupling.
		Sleeve's wall thickness shall be same as plastic coating on
		pipe.
		PVC coating on coupling shall be ribbed to enhance
		installation.
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
-		ESSORIES
Fasteners	Stainless Steel or PVC-Coated Steel	
Screws, Bolts, Nuts and	Stainless Steel	SAE Type 316
Hardware		S. I. Type one
Locknuts	Hot-Dipped	Threaded, gasketed, insulated
	Galvanized Steel or	Bonding type with sharp edges for digging into metal
	Galvanized Malleable	enclosure wall
	Iron	Grounding or non-grounding type
Bushings	Hot-Dipped	Threaded type with 105°C-rated plastic insulated throat and
	Galvanized Steel or	grounding and bonding lug
	Galvanized Malleable	Plastic bushings with 105°C temperature rating may be used
	Iron	for conduits 1" and smaller where hubs are not required and
		circuit conductors are supplying less than 480V
Cravadina Dvahinas	Distant Ctanting	Grounding or non-grounding type
Grounding Bushings	Plated Steel or Malleable Iron with	Threaded type
		Provide 105°C-rated plastic insulated throat and grounding
	Insulating Molded Phenolic or Nylon	and bonding lug Do not use all-metal or all-plastic bushings.
	Dielectric Collar Insert	Plastic bushings with 105°C temperature rating may be used
	Piologino Colidi Iliacit	for conduits ≤1" where hubs are not required and circuit
		conductors are supplying <480V
		Grounding type
		Conform to UL467
U-bolts and RA Clamps		Size to fit conduit
		Encapsulate nuts in plastic.
Conduit Mounting Strut	Stainless Steel	SAE Type 316

F. Materials for NEC Type IMC intermediate metal conduit and fittings shall be:

ITEM	MATERIAL	SPECIFICATION
INTERMEDIATE METAL CONDUIT (IMC)		
NEC Type IMC Intermediate	Hot-Dipped	Conform to UL1242 and NEMA RN1
Metal Conduit, Connectors,	Galvanized Steel	Conform to CEC Article 342
and Fittings 1/2"-4"	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
CONDUIT FITTINGS		

ITEM	MATERIAL	SPECIFICATION
Conduit Fittings and Elbows –	Hot-Dipped	Provide wedge nut covers (Form 7) weathertight for outdoor,
Indoor Dry Non-Corrosive	Galvanized Steel	wet or corrosive locations shown on Plans
Locations	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
Conduit Fittings and Elbows – Outdoor, or Wet or Corrosive	Hot-Dipped Galvanized Steel	Provide wedge nut covers (Form 7) weathertight
Locations shown on Plans	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
Couplings	Hot-Dipped Galvanized Steel	IPS-threaded
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153Hot-dipped after fabrication
Conduit Unions	Hot-Dipped Galvanized Steel	Do not use running threads.
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
	ACC	ESSORIES
Fasteners	Hot-Dipped Galvanized Steel	
Screws, Bolts, Nuts and Hardware	Stainless Steel	SAE Type 316
Locknuts	Hot-Dipped Galvanized Steel or Galvanized Malleable Iron	
Bushings	Hot-Dipped Galvanized Steel or Galvanized Malleable Iron	Threaded type with 105°C-rated plastic insulated throat and grounding and bonding lug Plastic bushings with 105°C temperature rating may be used for conduits 1" and smaller where hubs are not required and circuit conductors are supplying less than 480V
Box Connectors for Damp and Wet Locations		Provide watertight threaded hub on enclosure consisting of sealing fitting with tapered conduit thread, neoprene O-ring, and 105°C rated insulating throat with grounding and bonding lug. Sealing locknuts are allowed but shall not substitute for threaded watertight hubs or sealing fittings.
Conduit Mounting Strut	Hot-Dipped Galvanized Steel	
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
	PVC Coating	≥20-mil

G. Materials for NEC Type PVC rigid nonmetallic conduit (PVC) and fittings shall be:

ITEM	MATERIAL	SPECIFICATION
	PVC RIGID NONME	TALLIC CONDUIT (PVC)
NEC Type PVC	PVC	Conform to ASTM D1785, NEMA TC2 Type EC40 and UL651
Rigid Nonmetallic Conduit		Conform to CEC Article 352
(PVC)		Schedule 40
		Type EB for concrete encased conduit ≥2"
		UL labeled for above-ground and underground use
		Rated for direct sunlight exposure
		Fire retardant and low smoke emission
		90°C rise rating – marked "maximum 90 Deg C"
		Type 1 (normal impact) Grade 1 (high chemical resistance)
		Add inert modifiers to improve weatherability and heat
Davis d Divid Names tallis	DVO	distribution
Buried Rigid Nonmetallic	PVC	Conform to ASTM F512, NEMA TC6 and TC8 and UL651A
Conduit (PVC)		UL labeled for above-ground and underground use
		Schedule 40
	CONDIT	90°C rise rating IT FITTINGS
Digid Naggaratallia Canduit		
Rigid Nonmetallic Conduit	PVC	Conform to UL 514C and NEMA TC3 Schedule 40
(PVC), Connectors, and		
Fittings		Same thickness and construction as adjacent conduit

ITEM	MATERIAL	SPECIFICATION	
		Homogeneous plastic free from cracks, nicks, holes, blisters,	1
		foreign inclusions or imperfections which could damage	
		conductors	
		As recommended by conduit Manufacturer.	
Elbows (90°)	PVC	Schedule 80	1
		Same dimension as specified for Electrical Rigid Steel Conduit (ERSC)	
Couplings, Adapters,	PVC	Factory-made	1
Expansion Couplings, Elbows and 30° turns		Conform to NEMA TC2 and TC3	
Couplings	PVC	Socket-type for use with solvent weld cement	1
		Provide bell-end fitting upon termination in maintenance	1
		holes, hand holes, or pull boxes.	
	ACCF	ESSORIES	PVC to ERS
Joint Cement		As recommended and furnished by conduit Manufacturer for climate	
		Furnished with instructions to achieve watertight joints.	
		Conform to ASTM D2564.	
Fasteners	PVC-Coated Steel or]
	Nonmetallic		
Conduit Mounting Strut	Stainless Steel	SAE Type 316]

H. Materials for NEC Type LFMC liquid-tight flexible metal conduit and fittings shall be:

ITEM	MATERIAL	SPECIFICATION		
	LIQUID-TIGHT FLEXIBLE CONDUIT (LFMC)			
NEC Type LFMC Liquid-Tight Flexible Metal Conduit and	Hot-Dipped Galvanized Steel	Conform to UL1 Conform to CEC Article 350		
Fittings (FLEX)	Galvariizeu Steel	Size ≥3/4".		
Fittings (FLEA)	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153		
	Galvariizirig	Hot-dip galvanized on all 4 sides before conduit fabrication		
NEC Type LFMC Liquid-Tight	Hot-Dipped	Conform to UL360		
Flexible Metal Conduit and	Galvanized Steel	Conform to CEC Article 350		
Fittings (FLEX-LT)	Odivanized Steel	Core of continuous, spiral wound, steel strip with interlocking		
Tittings (TEEX-ET)		convolutions.		
		Liquid- and vapor-tight		
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153		
	Carvariizing	Hot-dip galvanized on all 4 sides before conduit fabrication		
	Jacketing	Extruded PVC positively locked to steel core		
NEC Type LFMC Liquid-Tight	Bronze (Use in dry,	Conform to CEC Article 350		
Flexible Metal Conduit and	damp, or wet areas)	Liquid-tight and arc-resistant		
Fittings (HAZ-FLEX)	,	Electrically conductive so no bonding jumper is required		
		Provide bronze braided covering over flexible brass core,		
		bronze end fittings, and hot-dipped galvanized steel or		
		malleable iron unions and nipples		
	Stainless Steel (Use in	Conform to CEC Article 350		
	corrosive areas)	Liquid-tight and arc-resistant		
		Electrically conductive so no bonding jumper is required		
		Provide stainless steel braided covering over flexible		
		stainless steel core, stainless steel end fittings, unions and		
		nipples.		
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153		
	CONDIL	Hot-dip galvanized on all 4 sides before conduit fabrication		
Fittings NEC Tyras LEMO		IT FITTINGS Conform to III 514D and NEMA ED4		
Fittings NEC Type LFMC Liquid-Tight Flexible Metal	Hot-Dipped Galvanized Steel or	Conform to UL 514B and NEMA FB1 Conform to ANSI C33.84		
Conduit and Fittings (FLEX)	Zinc-Plated Malleable	UL listed for use with conduit		
Conduit and Fittings (FLEX)	Iron Insulated Type	Provide Steel or plastic compression rings and glands for		
	iron insulated Type	tightening.		
		Provide 105°C rated insulated throats.		
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153		
	Jaivanizing	1 =2.0 023 Contolling to ACTIVI ATZO OF ATOO		

ITEM	MATERIAL	SPECIFICATION
	Grounding	Provide threaded grounding cones or grounding and bonding
		lugs.
		For sizes ≤1¼", UL listed for grounding
		For fittings ≥1½" trade size, provide external grounding lugs.
Fittings NEC Type LFMC	Hot-Dipped	UL 514B and NEMA FB1
Liquid-Tight Flexible Metal	Galvanized Steel or	Conform to ANSI C33.84
Conduit and Fittings (FLEX-LT)	Zinc-Plated Malleable	UL listed for use with conduit
	Iron Insulated Type	Straight or angle type
		Liquid-tight
		Provide steel construction, insulated and gasketed with
		locknut, grounding ferrule, and gland compression nut
		Provide 105°C rated insulated throats.
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
	Grounding	Conform to UL 467
		Provide threaded grounding cones or grounding and bonding
		lugs.
		For sizes ≤1¼", UL listed for grounding
		For fittings ≥1½" trade size, provide external grounding lugs.
Conduit Fittings and Elbows –	Hot-Dipped	Provide wedge nut covers (Form 7) weathertight
Outdoor, or Wet or Corrosive	Galvanized Steel	Do not use setscrew connectors
Locations shown on Plans	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
		SSORIES
Bushings	Hot-Dipped Galvanized Steel	Compression type
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
Integral Copper Bonding	Copper	Required on conduit 11/4" and smaller
Conductor		Wind spirally in space between each convolution on conduit
		interior
		Conform to UL360
Jacket	Gray PVC Vinyl	Extend around and into helical grooves of core.
Conduit Mounting Strut	Hot-Dipped	
	Galvanized Steel	
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
	PVC Coating	≥20-mil

I. Materials for conduit identification tags shall be:

ITEM	MATERIAL	SPECIFICATION
ACCESSORIES		
Conduit Identification Tags	Stainless Steel	19-gauge
		With ½" stamped letters and numbers as shown on Plans

J. Materials for duct spacers and supports shall be:

ITEM	MATERIAL	SPECIFICATION
Duct Spacers and Supports	High-Density	Interlocking
	Polyethylene (HDPE)	Provide ≥3" spacing between parallel conduits
	or High-Impact	Provide 1" clearance between perpendicular conduits or
	Polystyrene	conduits and pipes.
Spacers for Wall-Mount Boxes	Hot-Dipped	If spacers are cut from galvanized stock, coat cut surfaces
and Cabinets	Galvanized Steel	with 2 coats cold galvanizing compound
	Galvanizing	≥2.0 oz/sf conforming to ASTM A123 or A153
Accessories		Provide hold down bars
		Provide duct-bank strapping

K. Materials for wireways shall be:

ITEM	MATERIAL	SPECIFICATION
Bodies and Covers	Stainless Steel	SAE Type 316
		≥14-gauge without knockouts
		≥10-gauge SS flanges
		Conform to CEC Article 376
		Gasketed cover held in place with captive clamp type latches
	Cast Rustproof Metal	Gasketed with bolted flanges

ITEM	MATERIAL	SPECIFICATION
	where required by	Provide hinged covers, except where removable covers are
	NEC or Plans	shown.

L. Materials for outlet, junction and pull-boxes shall be:

ITEM	MATERIAL	SPECIFICATION	
OUTLET AND DEVICE BOXES			
Cast Outlet Boxes	Cast Steel (CS) Outlet and Device Boxes	May be used in exterior or interior wet or dry locations with the following raceway systems 1. Electric rigid steel conduit (ERSC) 2. PVC-coated electric rigid steel conduit (ERSC) 3. Intermediate metal conduit (IMC) 4. Liquid-tight flexible steel conduit 5. PVC rigid nonmetallic conduit (RNC) 6. Concealed raceway systems 7. Concrete-encased raceways Use where required by NEC or Plans	
		Conform to UL 50, UL 514A, and NEMA/ANSI OS1 Hot-dipped galvanized cast steel box Provide cast mounting lugs where required Zinc-plated cast steel cover, watertight and gasketed Fabricate without knockouts Provide threaded cast hubs for connections Provide removable screw-cover in accessible location. Use stainless steel fasteners.	
Sheet Steel Outlet Boxes	Sheet Steel (SS) Outlet and Device Boxes	May be used in interior dry locations with the following raceway systems 1. Electric rigid steel conduit (ERSC) 2. PVC-coated electric rigid steel conduit (ERSC) 3. Liquid-tight flexible steel conduit 4. PVC rigid nonmetallic conduit (RNC) 5. Exposed or concealed raceways >4' above floor 6. Ceiling portion of lighting circuits Use where required by NEC or Plans Hot-dipped galvanized of 1-piece drawn carbon steel sheet ≥14-gauge thick Conform to UL 50 and UL 514A Shop fabricate when nonstandard size boxes are shown Provide removable screw-cover in accessible location. Use stainless steel fasteners.	
	Stainless Steel (SS) Outlet and Device Boxes	May be used in exterior or interior wet or dry locations with the following raceway systems 1. Electric rigid steel conduit (ERSC) 2. PVC-coated electric rigid steel conduit (ERSC) 3. Liquid-tight flexible steel conduit 4. PVC rigid nonmetallic conduit (RNC) 5. Exposed or concealed raceways >4' above floor 6. Ceiling portion of lighting circuits Use for NEMA 4X enclosures Use where required by NEC or Plans Hot-dipped galvanized of 1-piece drawn carbon steel sheet ≥14-gauge thick Conform to UL 50 and UL 514A Shop fabricate when nonstandard size boxes are shown Provide removable screw-cover in accessible location. Use stainless steel fasteners.	
Nonmetallic Outlet Boxes	Nonmetallic (NM) Oullet and Device Boxes	May be used in exposed, concealed, or concrete-encased exterior or interior locations with the following raceway systems 1. PVC Rigid Nonmetallic Conduit (RNC) Use where required by NEC or Plans Conform to UL 50 and UL 514A	

ITEM	MATERIAL	SPECIFICATION
		PVC box
		Provide mounting lugs where required
		PVC cover, watertight and gasketed
		Fabricate without knockouts
		Provide threaded hubs for connections
0.11.4		Use stainless steel fasteners.
Outlet and Device Box		Factory-made standard sizes ≥2" deep
Dimensions		Use ≥4"x4"x2" boxes for switches and receptacles.
		Use ≥4" octagonal boxes for ceiling outlets.
		For hollow masonry construction, provide boxes of depth to allow hubs to be in masonry void space.
		Where field conditions or fixture requirements mandate use of
		smaller box dimensions than specified, obtain acceptance
		from Owner's Representative before ordering boxes.
Outlet Box Extensions	Prohibited	Do not use box extensions to provide NEC-required wiring
Outlet Box Extensions	1 Tornibited	space.
Concealed and Flush-Mounted	Galvanized Steel	Gang sizes as required by code
Boxes (Use with concealed		Do not use sectional boxes for multi-gang applications.
conduits)		Use square cornered tile-type rings for exposed masonry wall
		construction
		Use square corner tile-type covers with ribs or extensions for
		casting in concrete
	_	Use stainless steel fasteners.
	Туре	Use only deep boxes, Type FD
	Grounding Screw	Required
	Coating	≥40-mil PVC exterior coating
	0 (1 '''	≥2-mil urethane interior coating
Exposed and Surface-Mounted	Cast Iron with	Provide boxes with mounting flanges
Outlet Boxes (Use with	Threaded Hubs	Conduit bodies may be used instead of boxes except where boxes contain devices.
exposed conduits)		Outlet boxes connecting to PVC-coated rigid conduit shall be
		of same material and coating as conduit, with metal threaded
		hubs.
		Provide gasketed covers secured with ≥2 stainless steel
		capture screws.
	Grounding Screw	Required
	Coating	≥40-mil PVC exterior coating
	Ĭ	≥2-mil urethane interior coating
	PVC-Coated Steel	≥40-mil PVC exterior coating
		≥2-mil urethane interior coating
	Type	Use only deep boxes, Type FD
Outlet Boxes Encased in	Cast or Sheet Metal as	Moisture-proof and concrete-tight boxes designed for
Concrete	required by NEC or	concrete encasement
	Plans	ND DUIL BOYES
Outlet and Davise Payer		ND PULL BOXES
Outlet and Device Boxes	See above	Use outlet boxes as junction boxes and pull boxes where
Cast Steel Boxes	Cast Steel	possible and allowed by applicable codes May be used for above-grade or below-grade conduit
Casi Oleei Duxes	<u> </u>	Hot-dipped galvanized cast steel box
		Neoprene gasketed watertight
		Hinged cast steel full access screw-mounted covers.
		Drilled and tapped conduit entrances.
		Use stainless steel fasteners and hinges
		Size ≥8"x8"x6"
Sheet Steel Boxes	Galvanized Steel	
		Code gauge with gasketed full-access screw covers
		Use stainless steel fasteners
Stainless Steel Boxes	Stainless Steel	May be used for above-grade or below-grade conduit
		Use for NEMA 4X enclosures
		Code gauge with gasketed full-access screw covers

ITEM	MATERIAL	SPECIFICATION
		Use stainless steel fasteners
Nonmetallic Boxes	Fiberglass-Reinforced	May be used for above-grade or below-grade conduit
	Polyester	Corrosion resistant FRP with stability to high heat
		Gasketed watertight
		Hinged full-access screw-mounted FRP cover
		Provide mounting lugs where required
		Provide threaded hubs for connections
		Use stainless steel fasteners and hinges
Comprete Days	Dainfarand Coat	Size ≥7"x10"x6½"
Concrete Boxes	Reinforced Cast Concrete	May be used for below-grade conduit Interior Size ≥10"x17"
	Concrete	Cast Iron Cover
		Mark" ELECTRICAL" or "TELEPHONE" as shown on Plans
	NEMA-RATED JUNC	TION AND PULL BOXES
NEMA 1 General Purpose	Hot-Dip Galvanized	≥14 gauge wall thickness
Boxes (Use for indoor pull and	Sheet Steel or Hot-Dip	= 14 gaage wan anomicos
junction boxes in dry areas.)	Galvanized Malleable	
,	Iron	
	Knockouts	With or without concentric knockouts on 4 sides
	Cover	Flat cover fastened with screws
	Finish	Hot-dipped galvanized after fabrication or
		1 coat rust-inhibiting primer + 1 coat primer seal inside and
		out
		Factory paint with ANSI 61 gray exterior finish and white
		interior finish
NEMA 2 Drip-Tight Boxes	Hot-Dip Galvanized	≥14 gauge wall thickness
	Sheet Steel or Hot-Dip	
	Galvanized Malleable	
	Iron	
	Knockouts Cover	
	Gaskets	Provide gaskets
	Finish	Hot-dipped galvanized after fabrication or
	1 1111311	1 coat rust-inhibiting primer + 1 coat primer seal inside and
		out
		Factory paint with ANSI 61 gray exterior finish and white
		interior finish
NEMA 3R Rainproof, Sleet-	Hot-Dip Galvanized	≥14 gauge wall thickness
Resistant Boxes	Sheet Steel or Hot-Dip	
	Galvanized Malleable	
	Iron	
	Knockouts	Prohibited
	Cover	Hinged or non-hinged door secured with stainless steel
	0 1 1	screws and clamps
	Gaskets	Provide oil-resistant gaskets
	Finish	Hot-dipped galvanized after fabrication or
		1 coat rust-inhibiting primer + 1 coat primer seal inside and out
		Factory paint with ANSI 61 gray exterior finish and white
		interior finish
NEMA 4 Watertight Boxes (Use	Hot-Dip Galvanized	≥14 gauge wall thickness
for pull and junction boxes in	Code Gauge Steel	
outdoor, wet, or damp areas.)	Seams	Continuously welded and ground smooth
' ' '	Mounting Flanges	External
	Knockouts	Prohibited
	Cover	Hinged or non-hinged door secured with stainless steel
		screws and clamps
	Gaskets	Provide oil-resistant gaskets
	Finish	1 coat rust-inhibiting primer + 1 coat primer seal inside and
		out

ITEM	MATERIAL	SPECIFICATION
		Factory paint with ANSI 61 gray exterior finish and white
		interior finish
		Finishes shall be corrosion-resistant
NEMA 4X Watertight Metallic	Stainless Steel	≥14 gauge wall thickness
Corrosion-Resistant Boxes		SAE Type 316
(Use for pull and junction boxes	Seams	Continuously welded and ground smooth
in outdoor, wet, damp, or	Mounting Flanges	External
corrosive areas)	Knockouts	Prohibited
	Cover	Hinged cover secured with stainless steel screws and clamps
	Gaskets	Provide oil-resistant gaskets
NEMA 4X Watertight	Fiberglass	Ultraviolet light-protected fiberglass-reinforced polyester
Nonhmetallic Corrosion-	Mounting Flanges	External
Resistant Boxes (Use for pull	Knockouts	Prohibited
and junction boxes in outdoor,	Cover	Hinged door with quick-release latches and padlocking hasp
wet, damp, or corrosive areas)	Gaskets	Provide oil-resistant gaskets on door
NEMA 12 Industrial Use Boxes	Hot-Dip Galvanized	≥14 gauge wall thickness
(Use for indoor pull and	Code Gauge Steel	Hot-dipped galvanized after fabrication
junction boxes in dry areas)	Seams	Continuously welded and ground smooth
	Mounting Flanges	External
	Knockouts	Prohibited
	Cover	Flat
		Continuous hinged cover with 3-point latch or stainless steel
		bolts and clamps
	Gaskets	Provide oil-resistant gaskets on door
	Finish	1 coat rust-inhibiting primer + 1 coat primer seal inside and
		out
		Factory paint with ANSI 61 gray exterior finish and white
		interior finish
Accessories	Handles	Provide rigid handles for covers ≥9 sf or ≥25 lbm.
		Provide split covers when >25 lbm.
	Weldnuts	Provide weldnuts for mounting optional panels and terminal
		kits.
	Terminal Blocks	Provide screw-post barrier-type terminal blocks
		rated ≥600VAC and ≥20A

M. Materials for conduit sealant shall be:

Materiale for corrulat coalant chair bo.			
ITEM	MATERIAL	SPECIFICATION	
Moisture Barrier Types	Water-Tight Material	Nontoxic, nonshrink, nonhardening, putty-type, hand-applied material providing effective barrier under submerged conditions	
Fire-Retardant Types	Fire-Stop Material	Reusable, nontoxic, asbestos-free, expanding, putty-type material with 3-hour rating in accordance with UL35L4.	

N. Materials for tape coating system shall be:

ITEM	MATERIAL	SPECIFICATION
Tape Coating System	Water-Tight PVC Tape	Conform to AWWA / ANSI C209 and C214
		Provide protection against moisture, acids, alkalis, salts and
		sewage.
		Suitable for direct burial.
	Primer	Hot Dip Galvanized
		≥2.0 oz/sf conforming to ASTM A123 or A153
	Inner Layer Tape	≥30 mils thickness
	(Corrosion Protection)	
	Outer Layer Tape	≥30 mils thickness
	(Mechanical	
	Protection)	
	Complete System	≥60 mils thickness

O. Materials for pull cord shall be:

materials for pair cord criain bo.				
ITEM	MATERIAL	SPECIFICATION		

ITEM	MATERIAL	SPECIFICATION
Cord, Pull Tape, or Rope	Polypropylene or	1/4" diameter 1800-lbf-rated
·	Nylon	
	Polyester Tape	Flat, woven, lubricated, soft-fiber polyester
		1800-lbf-rated
		With painted sequential measurement markings each 3'

P. Materials for concrete hand-holes shall be:

ITEM	MATERIAL	SPECIFICATION
Hand-Holes	Steel-Reinforced	Weatherproof concrete with pull-in irons
	Concrete	
	Fiberglass-Reinforced	
	Polymer-Concrete	
Cable Racks	Galvanized Steel with	≥2.0 oz/sf conforming to ASTM A123 or A153
	Porcelain Blocks	-
Cover and Frame	Ductile Iron	Traffic-rated 20-lb Lid and Lid Ring
		ELECT shall be cast into lid in 1" letters

7. The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION	
Pre-Cast Concrete Hand-Hole Sections	Base	Solid bottom with 12"x12" or 12" diameter opening to French drain beneath hand-hole.
	Sections	Mating edges shall be tongue-and-groove-type
	Top Slab	Gasketed removable top slab with lifting eyes and cast-in iron frame and cover. Provide cover extension rings as required.
	Design Surcharge and Lateral Earth Pressure	AASHTO H25 Loading
	28-day Compressive Strength f'c	≥4500 psi
	Steel Reinforcing Yield Strength f _y	60 ksi
	Size	As shown on Plans or as required for number and size of entering conduits.
Openings	Knockouts	Full round openings with thin walls Diameter = pipe penetration OD + 4"

- 8. Install the following types of conduits and fittings in locations listed, unless otherwise shown on Plans.
 - 1. Definitions and requirements of NEC apply unless modified below.

2. Installation of buried or concealed conduit Work shall be witnessed and accepted by Owner's Representative or inspector.

EXPOSURE	ALLOWABLE SIZE	ALLOWABLE MATERIALS	
	RANGE		
Indoor Exposed Dry, Wet and	3/4" – 3"	Electrical Rigid Steel Conduit (ERSC)	
Damp Noncorrosive Locations	≥3"	IMC	
		In wet locations provide watertight joints.	
Indoor, Concealed, Dry or Damp	³ / ₄ " – 1 ¹ / ₂ "	Electrical Rigid Steel Conduit (ERSC)	
Locations	2" – 3"	Electrical Rigid Steel Conduit (ERSC)	
	≥3"	IMC	
Outdoor Exposed Dry Locations	3/4" – 3"	Electrical Rigid Steel Conduit (ERSC)	
	≥3"	IMC	
Underground Vault Interiors	≥3/4"	Rigid Non-Metallic Conduit (Schedule 40 PVC) or PVC-Coated	
		Electrical Rigid Steel Conduit (ERSC)	
Corrosive Locations Indoor and	≥3/4"	Rigid Non-Metallic Conduit (Schedule 80 PVC)	
Outdoor			
Embedded in Concrete Slabs	≥1"	Rigid Non-Metallic Conduit (Schedule 40 PVC)	
and Masonry Walls			
Embedded in Concrete Slabs	≥1"	Rigid Non-Metallic Conduit (Schedule 80 PVC)	
and Masonry Walls Emerging			

into Wet, Corrosive, or Highly		
Corrosive Areas		
Underground Below Concrete	≥1"	Rigid Non-Metallic Conduit (Schedule 40 PVC)
Slabs		Extend exposed stub-ups ≥6" above grade or finish floor.
	Stub-ups into Equipment Pads or Floor	Provide PVC Schedule 80 long-radius elbows and stub-ups
	Stub-ups into Exposed Areas	PVC-Coated Electrical Rigid Steel Conduit (ERSC) Conduit Connect underground Non-Metallic Conduit to PVC-Coated Electrical Rigid Steel Conduit (ERSC) Conduit with 90° PVC- Coated Rigid Steel long-radius elbows before emergence. Extend ≥6" above grade or finish floor. Apply corrosion-resistant coating consisting of heavy coat of coal-tar paint or 3 wraps of 10-mil pipe wrap tape extending 1" on each side of turn-out point.
	Stub-ups to be Embedded in Walls	Rigid Non-Metallic Conduit (Schedule 40 PVC)
Underground Outside Concrete Slabs or Under Roadways and Parking Areas	≥1"	Rigid Non-Metallic Conduit (Schedule 40 PVC) ≥30" cover Provide red-colored concrete encasement Watertight
	Long sweeping bends >15° and ≥2"	Electrical Rigid Steel Conduit (ERSC)
Final Connections to Lighting	≥1/2"	Liquid-Tight Flexible Steel Conduit
Fixtures and Appliances		16-20" long unless otherwise accepted by Owner
Final Connections to Motors,	3/4"-21/2"	Liquid-Tight Flexible Steel Conduit with polyvinyl sheathing
Solenoids, Transformers, Vibrating Equipment,		and insulated stranded ground conductor. Connect ground conductor to enclosure or raceway at each
Appliances, or Instruments		end. 16"-20" long with 50% slack unless otherwise accepted by Owner
	≥3"	Liquid-Tight Flexible Steel Conduit
Divid Data Local Life	> 0"	≤ 3' long unless otherwise authorized by Owner
Direct-Buried Conduit for Telemetry Cable	≥2"	Rigid Non-Metallic Conduit (Schedule 80 PVC) Watertight
Underground Duct Banks	≥2"	Rigid Non-Metallic Conduit (Schedule 40 PVC) or PVC-Coated Electrical Rigid Steel Conduit (ERSC) Provide red-colored concrete encasement.
		Watertight

9. The following electrical design criteria are required for equipment specified in this section:

ITEM	DESCRIPTION		
Electrical Work	NEC Article 505	Conform to NFPA 820	
	Classification	Nonhazardous	
Enclosures – Indoor Dry	NEMA 250	NEMA 12 – Industrial Use	
Locations	Enclosure Rating		
Enclosures – Indoor Corrosive	NEMA 250	NEMA 12 – Industrial Use	
Locations	Enclosure Rating		
Enclosures – Indoor Damp	NEMA 250	NEMA 12 – Industrial Use	
Locations	Enclosure Rating		
Enclosures – Outdoor or Wet	NEMA 250	NEMA 4X – Watertight, Corrosion-Resistant, Stainless steel	
Locations	Enclosure Rating		
All Enclosures	Construction	Lockable	
		With powdercoat epoxy finish on steel surfaces	
	IEC 60529	IP 65 water jet	
	Enclosure Rating for		
	Underground		
	Equipment		

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install raceway and boxes before submitting Shop Drawings or ordering.
 - 1. Locations shown are approximate.
 - 2. Study Plans in relation to spaces and equipment around outlets and devices.
 - 3. Make minor changes in dimensions and alignments as needed to avoid utilities or mechanical or structural conflicts.
- B. Determine conduit routing conforming to installation requirements set forth in Contract Documents and Raceway and Cable Schedules.
 - 1. Not all conduit routing is shown on Contract Documents.
 - 2. Route conduit to Owner's satisfaction, including those shown on:
 - a. Single-line diagrams
 - b. Control block diagrams
 - c. Home runs shown on Plans
 - d. Manufacturer's equipment installation instructions.
 - 3. Install conduit runs for lighting and receptacle circuits whether or not shown on Plans for circuits and circuit numbers shown.
 - 4. Conduit routings and stub-up locations shown are approximate.
 - a. Coordinate stub-up locations with conduit entries of furnished equipment.
 - Modify stub-up locations as required to accommodate equipment furnished and field conditions.
 - 5. Where circuits are indicated as "home-runs," provide necessary fittings and boxes for complete raceway installation.
 - 6. Use conduit and conductor sizes shown for entire branch circuit.
 - 7. Supports, pull-boxes, junction boxes, and other ancillary equipment are not usually shown.
 - a. Provide pull-boxes and junction boxes where shown.
 - b. Provide pull-boxes and junction boxes as required by NEC.
 - 8. Provide additional pull boxes and junction boxes required to permit pulling wires without damage to conductors or insulation.
 - a. Bends shall total ≤270° total deflection between pull points.
 - b. Conduit runs shall total ≤100' between pull points.
 - c. Provide boxes where necessary to terminate, tap-off, or redirect multiple conduit runs
 - 9. Coordinate motor terminal box locations with motor branch circuit conduit and wiring.
- C. Verify with Owner's Representative exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.
- D. Set and mount outlet and device box locations as follows:

DEVICE	TYPE	HEIGHT TO CENTERLINE
Wall Switches	All	48" above floor
Thermostats	All	48" above floor
Receptacles	Near Floor	12" above floor

- 1. Where above heights are inappropriate for construction or finish, locate boxes as directed by Owner's Representative.
- 2. Locate light switches on lock side of doors.
- 3. Locate light fixture and utility outlets in symmetrical pattern according to room or vault layout.
- E. Support surface mounted panel boxes, junction boxes, and conduit with spacers to provide clearance between walls, equipment, and parallel or perpendicular pipe or conduit crossings.
- F. Provide and place sleeves for conduits penetrating floors, walls, and partitions.
 - 1. Locate necessary slots for electrical Work and form before concrete is poured.
- G. Seal openings, sleeves, penetration, and slots.

3.2 Installation

9-19-dp

- A. Refer to Sections 01 73 00, 01 73 24, and 01 73 33 for basic execution and installation requirements.
- B. Refer to Section 33 05 26 for identification procedures for buried raceways.
- C. Refer to Section 33 05 38 for installation procedures for hangers and supports.
- D. Furnish and install raceway and boxes at locations shown on Plans and Submittals.
- E. Conform to the following installation standards:
 - 1. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 2. Other applicable OSHA and Cal OSHA regulations
 - 3. California Electrical Code Article 312 "Cabinets, Cutout Boxes, and Meter Socket Enclosures"
 - 4. California Electrical Code Article 314 "Outlet, Device, Pull, and Junction Boxes; Conduit Bodies; Fittings; and Handhole Enclosures"
 - 5. California Electrical Code Article 342 "Intermediate Metal Conduit: Type IMC"
 - 6. California Electrical Code Article 344 "Rigid Metal Conduit: Type RMC"
 - 7. California Electrical Code Article 348 "Flexible Metal Conduit: Type FMC"
 - 8. California Electrical Code Article 350 "Liquidtight Flexible Metal Conduit: Type LFMC"
 - 9. California Electrical Code Article 352 "Rigid Polyvinyl Chloride Conduit: Type PVC"
 - 10. California Electrical Code Article 362 "Electrical Nonmetallic Tubing Type ENT"
 - 11. California Electrical Code Article 366 "Auxiliary Gutters"
 - 12. California Electrical Code Article 368 "Busways"
 - 13. California Electrical Code Article 370 "Cablebus"
 - 14. California Electrical Code Article 372 "Cellular Concrete Floor Raceways"
 - 15. California Electrical Code Article 374 "Cellular Metal Floor Raceways"
 - 16. California Electrical Code Article 376 "Metal Wireways"
 - 17. California Electrical Code Article 378 "Nonmetallic Wireways"
 - 18. California Electrical Code Article 380 "Multi-Outlet Assembly"
 - 19. California Electrical Code Article 382 "Nonmetallic Extensions"
 - 20. California Electrical Code Article 384 "Strut-Type Channel Raceway"
 - 21. California Electrical Code Article 386 "Surface Metal Raceways"
 - 22. California Electrical Code Article 388 "Surface Nonmetallic Raceways"
 - 23. California Electrical Code Article 390 "Underfloor Raceways"
 - 24. California Electrical Code Article 392 "Cable Trays"
 - 25. Other applicable building, fire, and electrical code requirements
 - 26. Manufacturer's installation and warranty requirements
- F. Refer variances between above documents and Contract Documents to Owner's Representative.
- G. Size raceways as follows:
 - 1. Raceway sizes are shown on Plans.
 - 2. If not shown on Drawings, size in accordance with NFPA 70.
 - 3. For runs not sized on drawings, compute maximum conduit fill using NEC (NFPA 70) requirements for Type THW conductors (larger if applicable), although actual wiring may be with conductor types having smaller cross sections.
 - 4. For multi-conductor cables, size conduit to ≤40% fill considering overall outside diameter of multi-conductor cable.
 - 5. Unless shown otherwise, conduit size shall be ≥¾" for exposed conduit and ≥1" for buried conduit.
 - a. Use 1", 2", 4" and 5" conduit only.
 - 6. Wireway size shall be ≥4" x 4"
- H. Construct raceway system to provide firm mechanical assemblies with electrical conductivity throughout.
- I. Install raceway and boxes to tolerances recommended by Manufacturer.

- 1. Unless otherwise shown, install raceway and boxes true, plumb, and level using precision gauges and levels.
- 2. Do not use diagonal runs except when expressly shown on Plans.
- J. Install outlet and device boxes as follows:
 - 1. Metallic outlet boxes may be used for:
 - a. Housing wiring devices.
 - b. Pull or junction boxes above gypsum board or acoustical tile ceilings.
 - c. Pull or junction box ≥10' above floor in architecturally finished area with no ceiling.
 - 2. Recess metallic outlet and device boxes:
 - a. In stud-framed walls and ceilings using appropriate stud wall support brackets or adjustable bar hangers to mount boxes flush with wall face.
 - b. In poured concrete walls of architectural finished areas and exterior building walls.
 - c. In ungrouted cells of concrete block in architectural finished areas and exterior building walls, with bottom box edge flush with bottom edge of block.
 - 3. Cast outlet boxes may be used for:
 - a. Housing wiring devices surface-mounted in non-architecturally finished areas.
 - b. Pull or junction boxes surface-mounted in architecturally finished area with no ceiling.
 - 4. Mount outlet and device boxes at locations and elevations shown on Plans.
 - a. Set outlet and device boxes plumb and vertical to floor.
 - 5. Mount box edges flush with finished surface.
 - a. Provide proper type extension rings or plaster covers for this purpose.
 - b. For flush-mounted boxes, make holes in surrounding surface no larger than required to receive box.
 - 6. Mount boxes in secure, substantial manner supported independently of conduit by attachment to building structure or structural member.
 - a. Fasten boxes with bolts and expansion shields on concrete toggle bolts on hollow masonry units, and machine screws or welded, threaded studs on steelwork.
 - b. Boxes embedded in concrete or masonry need not be additionally supported.
 - 7. Provide flush or recessed lighting fixtures with separate junction boxes when required by fixture terminal temperature.
 - a. Where boxes support fixtures, provide proper means of attachment with adequate strength.
 - 8. Place barriers between switches in boxes with 277VAC switches on opposite phases.
 - a. Back-to-back installations are prohibited.
 - 9. Outlet boxes connected to PVC-coated conduit shall also be PVC-coated.
 - 10. Open no more knockouts in sheet steel boxes than are required.
 - a. Seal used openings in boxes with insert plugs.
- K. Install junction and pull boxes as follows:
 - 1. Make boxes and covers accessible.
 - 2. Do not install boxes in finished areas until surfaces receiving boxes are accepted by Owner's Representative.
 - 3. Mount boxes plumb and level.
 - 4. Use flush mounted boxes with concealed conduits.
 - a. Make edges of boxes flush with final surface.
 - 5. Mount boxes in secure, substantial manner, supported independently of conduit by attachment to building structure or structural member.
 - a. Fasten boxes with bolts and expansion shields on concrete toggle bolts on hollow masonry units, and machine screws or welded threaded studs on steelwork.
 - b. Boxes embedded in concrete or masonry need not be additionally supported.
 - 6. Install boxes for conduits under grade flush with finished grade in locations outside paved areas, roadways, or walkways.
 - 7. If adjacent structure is available, box may be mounted on structure surface just above finished grade in accessible but unobtrusive location.
 - a. If it is found desirable to locate boxes in paved areas, roadways, or walkways, obtain Owner's Representative's written acceptance.

- Use boxes and covers suitable for traffic loadings to which they may be subjected.
- 8. Support pull boxes independently of raceways, walls, and partitions.
 - a. Securely mount surface boxes, cabinets and apparatus.
 - b. Unless otherwise specified, space wall-mounted boxes, cabinets and apparatus enclosures out from walls ≥½".
 - c. Equip NEMA 4 and NEMA 4X boxes and boxes located in wet locations with automatic drain.
 - d. Install flush-mounted wall or ceiling boxes with raised covers so front face of raised cover is flush with surface.
 - e. Install surface-mounted wall or ceiling boxes with surface-style flat or raised covers.

L. Route conduits and raceways as follows:

- 1. Construct conduit and fittings as required to provide complete system with neat appearance conforming to applicable codes.
- 2. Run raceways concealed except where otherwise shown.
 - a. Install conduit in walls or slabs which have reinforcement in both faces between reinforcing steel mats.
 - b. In slabs, with only 1 layer of reinforcing steel, install conduit under reinforcement.
 - c. Install PVC conduits not embedded in slabs ≥6" thick under bottom of concrete slab floors.
- 3. Run conduits parallel and perpendicular to building lines, walls, surfaces or exposed structural members.
 - a. Follow surface contours as much as practicable to provide neat appearance.
 - b. Unless otherwise shown, keep legs of bends in same plane and straight legs of offsets parallel.
- 4. Do not route conduits:
 - a. Through areas of high ambient temperature or radiant heat.
- 5. Install rigid conduits exposed with the following exceptions:
 - a. Where shown on Plans.
 - b. Concealed above gypsum wall board or acoustical tile suspended ceilings.
 - c. Concealed within stud frame, poured concrete, or concrete masonry block walls of architecturally finished areas.
 - d. Embedded in ground-level floor slabs or buried under floor where accepted by Owner's Representative.
- 6. Conduit shall not interfere with or prevent access to piping, valves, ductwork, or equipment for operation, maintenance, or repair.
- 7. Maintain spacing between parallel conduit and piping runs for runs >30' as follows:

ITEMS	REQUIRED SEPARATION	
SEPARATION FROM FLUES, HOT WATER PIPES, STEAM PIPES, HEATING APPLIAN	NCES AND HEAT SOURCES	
All conduit	≥12" wall-to-wall	
SEPARATION FROM PROCESS, GAS, AIR, AND WATER PIPES AN	ID DUCTS	
All conduit	≥6" wall-to-wall	
SEPARATION FROM AC POWER CONDUCTORS, ≤600VAC		
Instrumentation or Telecommunication	≥6" wall-to-wall	
DC Power Conductors ≤125VAC	≥2" wall-to-wall	
SEPARATION FROM DC POWER CONDUCTORS ≤125VDC		
Instrumentation or Telecommunication	≥2" wall-to-wall	
SEPARATION FROM INSTRUMENTATION CABLE OR CONDUIT		
Telecommunication	≥1" wall-to-wall	

- 8. Provide ≥1" wall-to-wall separation at crossings.
- 9. Slope horizontal outdoor and indoor runs exposed to moisture to low point or to downturned elbow to drain internal moisture.
 - a. Equip low points with automatic drains.
- 10. Where space exists within housing of roof- or floor-mounted equipment, stub up conduit within housings.
- 11. Route exposed conduit to preserve headroom, access space, and work space.

- 12. Construct conduit runs to avoid interference with both proper and safe equipment operation, and ingress or egress including equipment removal hatches.
- 13. Install exposed, parallel, or banked conduits together.
 - a. Make bends in parallel or banked runs from same centerline so bends are parallel.
 - b. Factory elbows may be used in banked runs only where they can be installed parallel.
- 14. Buried conduits shall penetrate surfaces at 90°

M. Install conduits as follows:

- 1. Conduits shall be continuous from outlets to cabinets, pull or junction boxes and secured to boxes with locknuts and insulated bushings such that each system is electrically continuous throughout.
- 2. Cut conduit joints square so ends butt together for full circumference of cut.
 - a. Ream ends of conduit smooth, interior and exterior, whether shop-cut or field-cut, to remove burrs and rough edges.
 - b. Degrease threads after threading.
 - c. Thread, and draw up tight.
- Before installing fittings, paint male threads of field-threaded galvanized rigid-steel conduit with:
 - a. Zinc-rich paint or
 - b. Homogenized blend of colloidal copper and rust corrosion inhibitor joint pre-treating pipe compound from acceptable Manufacturer.
- 4. For PVC-coated rigid conduits, use Manufacturer's recommended style threading and installation tools.
- 5. Before installing fittings, coat male threads of conduit with electrically conductive antisieze compound.
- 6. Make threaded connections wrench-tight.
- 7. Anchor conduits in place at ≤10' intervals, at elbows, and within 24" of outlet boxes or cabinets.
 - a. Provide hangers, supports, channel strut systems, fastenings, or clamps at elbows and at ends of straight runs terminating at boxes or cabinets.
 - b. Do not use perforated metal or "plumber's tape."
 - c. Provide anti-rattle conduit supports when conduits are routed through metal studs.
- 8. Space out raceways and conduits run on building surfaces from surface ≥½" using clamp backs and nest backs.
 - a. Do not use offset bends at boxes or cabinets except where accepted by Owner's Representative.
- 9. Install duct-bank raceway to external conduit size transitions at pull-boxes and manholes.
- 10. Make connections from metallic to non-metallic conduits with accepted fittings.
 - a. Limit use of threadless couplings to applications joining new conduit to existing conduit when existing conduit is not threaded and it is not possible to cut threads on existing conduit with pipe threader.

N. Bend conduits as follows:

- 1. Make offsets and right-angle bends in conduit runs with hub-type conduit fittings, or standard or long-radius elbows.
- 2. To make field bends and cuts, use tools, equipment, benders or hickeys recommended by conduit Manufacturer and designed for bending or cutting conduit material.
 - a. Use Electrical Rigid Steel Conduit (ERSC) for bends
 - b. Make bends and offsets so inside diameter of conduit is not reduced.
 - c. Prepare tools and equipment to prevent damage to PVC coatings.
 - d. Make bends to radii not less than those specified for standard or long-radius elbows depending on wire pull conditions.
- 3. Number of bends shall not exceed NEC limitations.
- O. Install PVC-coated Electrical Rigid Steel Conduit (ERSC) as follows:
 - 1. Use Manufacturer's recommended installation tools and recommendations.

- 2. Manufacturer shall certify installer before installation proceeds.
- 3. Provide expansion fittings where conduit crosses expansion joint in structure
 - a. Provide expansion fittings with #8AWG copper bonding jumper.
- 4. Bend rigid metallic conduit without crimping or flattening with radius of ≥6 x conduit inside diameter.
- 5. Fittings shall be galvanized steel.
- 6. Securely tighten couplings to provide electrical and mechanical connection throughout conduit run length.
- 7. When standard coupling cannot be used, use UL or ETL listed threaded union coupling accepted by Owner's Representative.
- 8. Where rigid metallic conduit is capped and caps are removed, provide ends of conduit with conduit bushings.

P. Install Rigid Nonmetallic (PVC) Conduit as follows:

- 1. Conform to installation provisions of NEMA TC2, except as modified below.
- 2. Install rigid PVC for underground portions of conduit for power, control, communication and instrumentation cables.
- 3. Provide rigid PVC conduit for underground portions of telephone conduit unless otherwise required by telephone utility.
 - a. Conduits shall have end bells where terminated at walls.
- 4. Provide specified cover and concrete encasement for buried conduit.
- 5. Conduits shall have end bells where terminated at walls, or adapters for steel conduit continuations where required.
 - a. Solvent weld PVC conduit joints per Manufacturer's recommendations.
 - b. Immediately after installing PVC conduit and fitting, rotate fitting or conduit 90° to provide uniform contact while drawing joint up tight to shoulder.
 - c. Cementing and joining operation take ≤20 seconds.
 - d. Do not disturb joint for 5 minutes, longer (up to 10 minutes) at lower temperatures.
 - e. Make joints watertight.
 - f. Joining procedure shall conform to ASTM D2855.
- 6. Provide ground wire with power wiring and increase conduit size as required.
- 7. Make cuts with fine tooth handsaw.
 - a. For sizes 2" and larger, use miter box or similar saw guide to assure square cut.
- 8. Use factory-made couplings for joining conduit.
- 9. Ream square-cut ends smooth, and wipe clean.
- 10. Provide expansion fittings as follows:
 - a. Provide expansion fittings when conduit is left exposed in trenches for time period during which conduit's temperature may vary by >2°F.
 - b. Provide near fixed end of runs and 100' on center.
 - c. Provide where shown on Plans.
- 11. Install expansion/deflection fittings as follows:
 - a. Provide where conduits enter structures other than electrical manholes and handholes except where ductbank is tied to structure with rebar.
 - b. Provide where conduits span structural expansion joints.
 - c. Provide where shown on Plans.
- 12. Convert to steel conduit through adaptors when entering buildings and for risers.
- 13. For direct buried conduit transition from PVC to ERSC, provide half-lapped 5-mil plastic protective tape-coating over ERSC.
- Q. Install flexible metallic conduit as follows:
 - 1. Provide separate insulated stranded copper equipment ground conductor in areas exposed to weather, damp locations, and connections to transformer enclosures regardless of location.
 - 2. Connect ground conductor to enclosure or raceway at each end.
- R. Seal conduit entries with silicone conduit sealant when conduit:
 - 1. Exits areas identified as corrosive.
 - 2. Exits underground structures.

- S. Provide grounding in accordance with Section 26 05 26.
 - 1. Use grounding bushings for conduits carrying grounding conductor or not installed into threaded hubs.
 - 2. Maintain grounding continuity of interrupted metallic raceways with ground conductor, and in flexible conduit for feeders and motor terminal connections.
 - 3. In exposed, damp, or wet locations, provide equipment grounding conductor with raceway or in liquid-tight flexible conduit.
 - 4. Size grounding conductors according to NEC §250.
- T. Install raceway embedded in concrete and below slabs as follows:
 - 1. Perform trenching and backfill in accordance with Section 31 23 33.
 - 2. Perform cutting and patching of curbs and pavements required for proper installation of electrical Work.
 - a. Use patching of same material, workmanship and finish as existing surface and matching surrounding work to Owner's satisfaction.
 - 3. Use ERSC for bends.
 - 4. Install half-lapped 5-mil plastic protective tape-coating system on buried ERSC conduits.
 - 5. Install conduits and sleeves passing through slabs, walls, or beams so as not to impair strength of construction.
 - a. Secure conduit to prevent sagging or shifting during concrete placement.
 - 6. Provide ≥1" concrete cover over embedded conduit.
 - 7. Conduits >1½" diameter may be embedded in concrete only after submittal and review of location and reinforcement details.
 - a. Conduits and sleeves may be installed without specific permission, provided they are ≤1½" in diameter and are spaced ≥3 diameters on centers.
 - 8. Install conduits in slabs other than slabs-on-grade as close to slab center as practical without disturbing steel reinforcement.
 - a. Conduit outside diameters shall not exceed \(\frac{1}{3} \) x slab thickness.
 - 9. Do not space parallel runs of conduit ≤3 diameters on centers, except at cabinet and outlet box locations.
 - 10. Install conduit deep enough for elbows to penetrate perpendicular to slab.
 - 11. Concrete encasement of conduits installed below concrete slabs shall be continuous with concrete floor or slab where practical.
 - a. Otherwise, install below floor slab, under curing or damp-proofing membranes, and under sand blankets.
 - 12. Locate conduit stub-ups below cabinets and boxes within conduit entry area identified in equipment Manufacturer's shop drawings.
 - a. Brace conduits prior to concrete placement to prevent shifting of conduits during placement.
 - 13. Keep raceways clear of motor and equipment foundations.
 - 14. Transition from PVC to steel underground 5' prior to riser.
- U. Install underground raceway as follows:
 - 1. For high-voltage and service entrance conduits, provide burial depth, bedding, and backfill per Electrical Utility service requirements, and provide concrete encasement.
 - 2. Provide cover as follows:
 - a. Provide ≥30" cover for direct-burial cable.
 - b. Provide ≥30" cover where PVC or PVC-coated rigid steel conduit is installed underground in locations other than under concrete slab.
 - c. Unless otherwise shown, provide other underground conduits and conduit banks with ≥24" earth cover.
 - 3. Underground conduit bend radius shall be ≥24" at vertical risers and ≥36" elsewhere.
 - 4. Maintain separations as follows.
 - a. Maintain ≥12" vertical separation between buried raceways and other systems at crossings.
 - b. Maintain ≥12" horizontal separation between buried raceways and other utility piping systems in parallel runs.

- 5. Pitch and slope conduit to drain away from buildings to manholes or pull-boxes.
- 6. Isolate telephone and communication cables, raceways, conduits, boxes, manholes, and hand-holes from those of other circuits.
- 7. Isolate communication and instrument cables from power wiring raceways, conduits, boxes, manholes, and hand-holes.
 - a. Route these cables through manholes and hand-holes in liquid-tight flexible metal conduit.
- 8. Where other utility piping systems are encountered or being installed along raceway route, refer conflicts to Owner's Representative before proceeding.
 - a. Do not place raceways over buried valves, couplings or appurtenances.
- 9. Provide concrete encasement for underground conduit duct banks unless shown otherwise on Plans.
 - a. Where conduits are concrete- or slurry-encased, provide ≥ 2" wall-to-wall separation between conduits, ≥ 1" wall to edge separation between conduit and reinforcing, and ≥ 3" cover over reinforcing or conduit
 - b. Provide ≥3" sand-cement slurry with red color additive on all sides of buried conduits.
 - c. Continue concrete encasement on exposed outdoor conduit risers to 3" above grade, with top crowned and edges chamfered.
- 10. Where conduit and concrete encasement terminate underground, terminate steel conduit flush at bulkhead with coupling and screw plug.
 - a. Protect threads with screw-in plastic cap.
 - b. Form ≥1¾"x¾" deep horizontal shear key in concrete encasement above and below embedded conduits.
 - c. After concrete placement, clean conduit and bar connector ends and coat with 2 coats of thixotropic coal tar.
- 11. Refer to Section 33 05 26 for installation of detectable warning tape above conduits, or, if under slabs, directly beneath concrete subgrade.
- 12. Isolate low-voltage cable raceways from raceways, conduits, boxes, manholes and hand-holes for other circuits.
- 13. Separate communication and instrumentation cables from power wiring in raceways, boxes, manholes, and hand-holes.
- 14. Transitions from PVC to steel conduit shall occur underground.
- V. Construct building wall or foundation penetrations as follows:
 - 1. Underground conduit banks through building walls or footings shall be cast in place or concreted into box-outs with water stops on all sides of box-out.
 - 2. Conduits not encased in concrete and passing through walls which have 1 side in contact with earth shall be sealed watertight with special rubber-gasketed sleeve-and-joint assemblies or with sleeves and modular rubber sealing elements.
 - 3. Maintain integrity of damp-proofing and waterproofing membranes penetrated by conduits and boxes.
 - 4. Buried conduit shall penetrate surface at 90°.
 - 5. Seal between raceway and building where raceway passes through exterior wall or rated firewall as follows:
 - a. Concrete Construction: Cast conduit in wall or core drill wall and pack around conduit with, dry-pack, fire stop putty or equivalent method accepted by Owner's Representative.
 - b. Frame Construction: Seal with fire-stop rated material compatible with building material through which raceway passes, as accepted by Owner's Representative.
 - c. Provide flashing for conduits installed through roofs or metal walls and seal watertight.
 - Fill openings in walls, floors, and ceilings and finish flush with surface.
- W. Construct conduit terminations into enclosures as follows:

ENCLOSURE TYPE	CONNECTING CONDUIT	TERMINATION
Metallic Outlet Boxes	ERSC	Provide conduit hub and locknut.

		Provide insulated bushing and 2 locknuts.
		Use grounding type locknut or bushing when required by NEC.
Stubups Through Floors		Provide insulated grounding bushing on metallic conduits.
into Floor-Mount Equipment		Provide end bells on nonmetallic conduits.
NEMA 1 Enclosures	ERSC	Provide conduit hub and locknut.
		Provide insulated bushing and 2 locknuts.
		Use grounding type locknut or bushing when required by NEC.
NEMA 4 and 4X Enclosures		Provide watertight, insulated, and gasketed hub and locknut.
NEMA 12 Enclosures		Provide watertight, insulated, and gasketed hub and locknut.
		Use grounding type locknut or bushing when required by NEC.

- 1. Terminate conduits in manner ensuring each system is electrically continuous throughout.
- 2. Terminate conduits entering enclosures using fittings ensuring NEMA rating of enclosure is not compromised.
- 3. Terminate conduits with locknuts and bushings except where threaded hubs are specified.
- 4. Terminate rigid steel conduits with Meyers-type hubs with bushings.
- 5. Install conduits squarely to box and provide 1 locknut outside box and 1 locknut and bushing inside box.
- 6. Install locknuts with dished side against box.
- 7. When terminating in threaded conduit hubs, screw conduit or fitting tight into hub so end bears against fire protection shoulder.
- 8. When chase nipples are used, install conduits and coupling square to box.
 - a. Tighten chase nipple leaving no exposed threads.
- 9. Cap conduits during construction to prevent entrance of dirt, trash, and water.
- 10. Ream and taper thread termination and connections of rigid steel conduit.
- 11. Terminate all sizes with conduit bushings.
- 12. Terminate concealed conduits for future use within equipment or by galvanized couplings plugged flush with structural surfaces or installed ≥6" from surface if so directed.
- 13. Terminate exposed conduit stubs for future use with galvanized pipe caps.
- 14. Space rigid steel conduit stubouts ≥6" apart.
- 15. Connect underground nonmetallic conduit which turns out of concrete, masonry, or earth to metallic conduit before emergence, with 90° elbows of electrical rigid steel conduit (ERSC).
 - a. Ensure conduit risers are vertically plumb.
- 16. Apply corrosion-resistant coating to conduits that turn out of concrete, masonry, or earth.
 - a. Provide coating which consists of heavy coat of thixotropic coal tar paint extending 1" on each side of point of turn-out.
- X. Clean and protect constructed conduit as follows:
 - 1. Maintain protective coating integrity of conduits, fittings, outlet, pull and junction boxes and accessories.
 - 2. Install conduit systems complete with insulated, grounding bushing before pulling in conductors.
 - 3. Cap or plug open ends of conduit with tapered wood plugs or plastic inserts immediately after installation to prevent entrance of foreign matter until wire is pulled.
 - 4. Clean and ensure conduit runs are not crushed or creased.
 - a. After concrete (if any) has set, pull mandrel with diameter nominally ¼" smaller than raceway interior through raceway to remove obstructions.
 - b. Then pull bristle brush through raceways to remove debris.
 - c. Swab conduit by pulling clean, tight-fitting rag through conduit.
 - d. Verify no foreign objects or obstructions are present in conduit prior to installing conductors.
 - e. Remove moisture and debris from conduit before pulling wire into place.
 - 5. After completing installation of ≥2" conduit runs, snake conduits with conduit cleaner equipped with cylindrical mandrel of diameter ≥85% of nominal diameter of conduit.

- a. Remove and replace conduits through which mandrel will not pass.
- 6. Where portions of raceways are subject to different temperatures and where condensation is known to be a problem, as where passing from interior to exterior of buildings, seal raceway to prevent circulation of warm air to colder section of raceway.
- Y. Install general purpose sheet steel pull-boxes in dry interior locations only.
 - 1. Install cast metal or concrete pull-boxes in exterior locations where boxes are subject to mechanical injury.
- Z. Repair damaged conduit as follows:
 - 1. Replace conduit damaged during or after installation.
 - Replace crushed or clogged conduit or any conduit whose inner surface is damaged or not smooth.
 - 3. Prior to installation, repair surfaces which will be inaccessible after installation.
 - 4. Repair cuts, nicks, or abrasions in zinc coating of galvanized conduit with:
 - a. Galvanizing repair stick or
 - b. Zinc-rich paint.
 - 5. Repair painted components using touch up paint provided by or approved by Manufacturer.
 - 6. Repair cuts, nicks, or abrasions in PVC coatings with PVC material.
 - a. Manufacturer's furnished or recommended PVC patching compound of same thickness, and color as coating, or
 - b. Self-adhesive, conformable, cross-linked silicone composition strip, followed by protective coating of vinyl tape.

AA.Install empty conduit as follows:

- 1. Provide ≥200-lbf strength pull cord, tape, or rope in empty conduits, with ≥4' knotted and coiled at each end.
- 2. Provide waterproof label on each end of pull-cords to indicate destination of other end.
- 3. Show coordinate dimensions of stub-outs on record drawings.
 - a. Place 1"x12"x12" concrete marker over stub-outs, and engrave with words "Electrical Conduit."
- 4. Cap spare conduits and provide #10 THHN green wire below threaded cap.
- 5. Provide bonded bushing and bond wire.

BB.Install outlets for general wiring as follows:

- 1. Use multi-gang boxes and device plates where several devices are located in same general area.
 - a. Do not use sectional boxes.
 - b. Obtain back box requirements for systems provided under other sections and provide them per those requirements.
- 2. Mount outlets for different conduit systems shown in same wall area not more than 6" on center.
- 3. Locate switch boxes 4" from doorjamb.
- 4. Rigidly support boxes for wall and ceiling outlets and finish flush and straight.
 - a. Front edge shall be within ½ of finished surface and plumb within ½"
- 5. Install outlets in exposed masonry walls, with square corner boxes or standard boxes with square corner extensions sufficiently deep that conduit offsets are not required.
 - a. Saw cut openings in exposed masonry and tile walls with opening tolerance of 1/8" on all sides, placing bottom of box at nearest masonry joint to specified mounting height.
 - b. For other wall finishes, install with plaster or other rings.
 - c. Do not activate outlets until these installation requirements are met.
- 6. Install outlets and boxes securely and support them substantially.
 - a. Anchor boxes into masonry construction with 1 or more integral flanges.

CC. Seal conduits as follows:

1. Upon completion of installation of conduits and boxes, inspect interiors of conduits and boxes; clear blockages; and remove burrs, dirt, and construction debris.

- 2. After cable has been installed and connected, seal conduit ends by non-hardening duct sealing compound forced into conduits to depth ≥ conduit diameter.
 - a. This shall apply for conduits at hand-holes, manholes, and building entrance junction boxes, and for 1" and larger conduit connections to equipment.

DD. Provide conduit identification as follows:

- 1. Provide conduit identification tags in manholes, hand-holes, building entrance pull boxes, junction boxes, and equipment.
- 2. Attach identification tags shall be attached to conduits with nylon tie wraps.
- 3. Position tags to be visible for inspection.
- 4. Labels shall designate conduit destination.

3.3 Field Quality Control

- A. Install conduit exposed unless specifically noted otherwise.
 - 1. Concealed and underground conduits shall be inspected by Owner's Representative prior to concealment.
- B. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Raceway and	Installation, & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
Boxes	Cleanliness	Snake conduits with conduit cleaner equipped with cylindrical mandrel of diameter ≥85% of nominal diameter of conduit.	1 each conduit ≥2"	Contractor	Contractor
	Continuity	Test resistance of feeder conduits from service to point of final distribution using 1 conductor return. Resistance shall be ≤25Ω	1 each conduit	Contractor	Contractor
	11-month Warranty Inspection	Confirm Work conforms to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

END OF SECTION

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SECTION 26 05 43

OFFSITE UNDERGROUND ELECTRICAL WORK

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of conduit, raceway, boxes and fittings for underground electrical Work typically within public right-of-way or offsite.
- B. Refer to Section 26 05 33 for requirements for raceway and boxes on-site.
- C. Refer to Section 31 23 33 for trenching procedures.
- D. Refer to Section 33 05 16 for requirements for precast concrete utility structures.
- E. Refer to Section 33 05 26 for identification procedures for buried raceways.
- F. Refer to Section 33 05 38 for requirements for hangers and supports.

1.2 Related Work

- A. Section 01 10 01: Summary of Work and Sequence of Construction
- B. Section 01 22 00: Unit Prices
- C. Section 01 33 00: Submittal Procedures
- D. Section 01 40 00: Quality Requirements
- E. Section 01 61 00: Common Product Requirements
- F. Section 01 65 00: Product Delivery Requirements
- G. Section 01 66 00: Product Storage and Handling Requirements
- H. Section 01 73 00: Execution
- I. Section 01 73 33: Mechanical Identification
- J. Section 03 30 00: Cast-in-Place Concrete
- K. Section 26 05 10: Common Work Results for Electrical
- L. Section 26 05 19: Low-Voltage Electrical Power Conductors and Cables
- M. Section 26 05 26: Grounding and Bonding for Electrical Systems
- N. Section 26 05 33: Raceway and Boxes for Electrical Systems
- O. Section 26 08 00: Commissioning of Electrical Systems
- P. Section 33 05 16: Precast Concrete Utility Structures
- Q. Section 31 23 33: Trenching and Backfilling
- R. Section 33 05 26: Utility Identification
- S. Section 33 05 38: Hangers and Supports

1.3 System Description

- A. Furnish and install raceway and boxes as shown on Plans and as required by NEC to deliver power to equipment furnished.
 - 1. Include appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable codes and standards.
- B. The following definitions shall apply:
 - 1. Direct-buried conduit: Individual (single) underground conduit.
 - 2. Multiple underground conduit: Conduit arranged in 1 or more planes, in a common trench.
 - 3. Concrete-encased ductbank: Individual (single) or multiple conduits, arranged in 1 or more planes, encased in common concrete envelope.

1.4 Quality Assurance

A. Use adequate number of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section. B. Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Raceway, Conduit, Fittings and Boxes	UL Compliance	Products shall be UL listed and UL labeled	All products furnished	Contractor	Contractor

1.5 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - 1. AASHTO Standard Specifications for Highway Bridges
 - 2. ASTM A536 Ductile Iron Castings
 - 3. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 4. California Electrical Code (CEC)
 - 5. NEMA/ANSI 250 Enclosures for Electrical Equipment
 - 6. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)
 - 7. NFPA 70 National Electric Code (NEC)
 - 8. Society of Cable Telecommunications Engineers SCTE 77 Underground Enclosure Integrity

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL DESCRIPTION		
	DRAWINGS	
Shop Drawings Submit dimensional drawings oh hand-holes. Show accessories and conduit entry locations. Submit installation drawings, showing individual conduit numbers, routing, conduit sizes, circuit numbers contained in each conduit, and size of wires in each conduit.		
	MANUFACTURER'S LITERATURE	
Product Data Required for each type of conduit, fittings, hand-holes and boxes per Product Data requirements. Include list of all conduits, fittings, hand-holes, boxes, mounting hardware, and related accessories.		
CLOSEOUT SUBMITTALS		
Warranty	Furnish 1-year warranty from date of final acceptance	

B. Refer to Section 01 33 00 for definition of requirements for Shop Drawings, and Product Data.

1.7 Delivery, Storage, and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Strictly follow Manufacturer's instructions and warranty requirements for delivery, storage, and handling of raceway and boxes.

1.8 **Project Site Conditions**

A. Refer to Section 01 10 01 for full list of project site conditions.

1.9 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for offsite underground electrical Work.

PART 2 - PRODUCTS

2.1 <u>Acceptable Manufacturers</u>

A. Acceptable Manufacturers include:

ITEM MANUFACTURER MANUFACTURER LOCATION			
	ITEM	MANUFACTURER	MANUFACTURER LOCATION

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Fiberglass and	Armorcast Products Company	Ontario, CA (909) 390-1365
Composite Polymer-	Carson Industries H Series	Glendora, CA (909) 592-6272
Concrete Hand-Holes	J &.R Concrete Products	Perris, CA (951) 943-5855
	Accepted Equal	
Precast Concrete	Brooks Products	Ontario, CA (909) 947-7470
Hand-Holes	Eisel Enterprises, Inc.	Placentia, CA (714) 993-1706
	Ford Meter Box Co.	Wabash, IN (260) 563-3171
	Jensen Precast	Sparks, NV (775) 352-2700
	J &.R Concrete Products	Perris, CA (951) 943-5855
	Oldcastle Precast (formerly Utility Vault Company)	Fontana, CA (800) 626-3860
	Accepted Equal	
Conduit Hangers	Refer to Section 33 05 38.	

2.2 <u>Materials</u>

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Refer to Section 03 30 00 for requirements for concrete encasement.
- C. Refer to Section 26 05 33 for requirements for conduit.
- D. Materials for concrete hand-holes shall be:

ITEM	MATERIAL	SPECIFICATION
Hand-Holes	Steel-Reinforced	Weatherproof concrete with pull-in irons
	Concrete	
	Fiberglass-Reinforced	
	Polymer-Concrete	
Cable Racks	Galvanized Steel with	2.0 oz/sf conforming to ASTM A123
	Porcelain Blocks	
Cover and Frame	Ductile Iron	Traffic-rated 20-lb Lid and Lid Ring
		ELECT shall be cast into lid in 1" letters

E. Materials for duct spacers and supports shall be:

ITEM	MATERIAL	SPECIFICATION
Duct Spacers and Supports	High-Density	Interlocking
	Polyethylene (HDPE)	Provide 3" minimum spacing between conduits
	or High-Impact	
	Polystyrene	
Accessories		Provide hold down bars
		Provide duct-bank strapping

F. Materials for pull cord shall be:

ITEM	MATERIAL	SPECIFICATION
Cord	Polypropylene or nylon	3/16" diameter
		200-lbf-rated

G. The following product design criteria, options and accessories are required:

ITEM		DESCRIPTION
Pre-Cast Concrete Hand-Hole Sections	Base	Solid bottom with 12"x12" or 12" diameter opening to French drain beneath hand-hole.
	Sections	Mating edges shall be tongue-and-groove-type
	Top Slab	Gasketed removable top slab with lifting eyes and cast-in iron frame and cover. Provide cover extension rings as required.
	Design Surcharge and Lateral Earth Pressure	AASHTO H25 Loading
	Minimum 28-day Compressive Strength f'c	4500 psi
	Steel Reinforcing Yield Strength f _y	60 ksi

ITEM	DESCRIPTION	
	Size	As shown on Plans or as required for number and size of entering conduits.
Openings	Knockouts	Full round openings with thin walls Diameter = pipe penetration OD + 4"

- H. Install the following types of conduits and fittings in locations listed, unless otherwise shown on Plans.
 - 1. Definitions and requirements of NEC apply unless modified below.
 - 2. Installation of buried or concealed conduit Work shall be witnessed and accepted by Owner's Representative.

EXPOSURE	ALLOWABLE SIZE	ALLOWABLE MATERIALS
	RANGE	
Underground Duct Banks	2" and larger	Rigid Non-Metallic Conduit (Schedule 40 PVC) or PVC-Coated Rigid Steel Conduit Provide red-colored concrete encasement.

- I. For runs not sized on drawings, compute maximum conduit fill using NEC requirements for Type THW conductors (larger if applicable), although actual wiring may be with conductor types having smaller cross sections.
 - 1. For multi-conductor cables, size conduit to < 40% fill considering overall outside diameter of multi-conductor cable.
- J. The following electrical design criteria are required for equipment specified in this section:

ITEM	DESCRIPTION			
Electrical Work	NEC Article 505 Classification	Nonhazardous		

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install raceway and boxes before submitting Shop Drawings or ordering.
 - 1. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Plans show approximate intended locations of handholes and routing of duct-banks and direct-buried conduit.
 - 1. Field conditions may require routing to be modified.
- C. In vehicular and non-vehicular traffic areas, locate and provide excavation for hand-holes before trenching for duct bank.
- D. Hand-holes shall be placed at low points.
 - 1. Duct banks shall slope at least 4% or as shown on Plans to drain to hand-holes.
 - 2. Provide hand-holes at approximate locations shown on Plans.
 - 3. Provide hand-holes as required to accommodate pulling distances, directional changes, and to keep pulling tensions within allowable cable tensions.
 - 4. Do not place hand-holes in swales or ditches.
 - 5. Determine exact locations of hand-holes after careful consideration has been given to grading, paving, and locations of other utilities.
 - 6. Obtain acceptance of proposed hand-hole locations from Owner's Representative before excavating and placing manholes and hand-holes.
- E. Refer to Section 31 23 33 for requirements for trenching, backfilling and compacting.

3.2 Installation

- A. Refer to Sections 01 73 00, 01 73 24, and 01 73 33 for basic execution and installation requirements.
- B. Provide concrete-encased duct-bank beneath traffic areas.

- 1. Provide direct-buried or multiple underground conduit installations at other locations.
- C. Refer to Section 33 05 26 for identification procedures for buried raceways.
- D. Furnish and install raceway, hand-holes, and manholes at locations shown on Plans and Submittals.
- E. The following installation standards shall be followed:
 - 1. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 2. Other applicable OSHA and Cal OSHA regulations
 - 3. California Electrical Code Article 230 "Services"
 - 4. California Electrical Code Article 338 "Service-Entrance Cable: Types SE and USE
 - 5. California Electrical Code Article 340 "Underground Feeder and Branch-Circuit Cable: Type UF
 - 6. Servicing Electrical Utility requirements
 - 7. Other applicable building, fire, and electrical code requirements
 - 8. Manufacturer's installation and warranty requirements
- F. Refer variances between above documents and Contract Documents to Owner's Representative.
- G. Install hand-holes as follows:
 - 1. Place manhole or hand-hole base on foundation of compacted ½"-½" crushed rock or gravel ≥ 8" thick and 6" larger than footprint of manholes or handholes on all sides.
 - 2. Install so top of cover is 1" above finished grade.
 - 3. Where existing grades are higher than finished grades, install sufficient number of courses of curved segmented concrete block between top of hand-hole frame to temporarily elevate manhole cover to existing grade level.
 - 4. Grout or seal joints, per Manufacturer's instructions.
 - 5. After installation is complete, backfill and compact soil around hand-hole.
- H. Install conduits as follows:
 - 1. After excavating for hand-holes, excavate trenches for conduits.
 - 2. Place conduit supports and spacers at the following intervals"

	CONDUIT DIAMETER									
PIPE MATERIAL	≤ ½"	3/4"	1"	11/4"	1½"	2"	21/2"	3"	3½"	≥4"
Rigid Non-Metallic Conduit	3' r	nax spacii	ng	5' max spacing 7' max spacin			spacing			
Rigid Steel Conduit	10'	max spaci	ing	14' max spacing 20' max spacing		cing				

- 3. During construction and after conduit installation is complete, plug ends of conduits.
- 4. Stagger conduit joints at intervals of 6" vertically.
- 5. Anchor conduits to supports and spacers to prevent movement during placement of concrete or soil.
- 6. Make conduit joints watertight in accordance with Manufacturer's recommendations.
- 7. Accomplish changes in direction of runs exceeding total of 15° by long sweep bends having radius ≥ 25'.
 - a. Sweep bends may be made up of 1 or more curved or straight sections or combinations thereof.
- 8. Furnish manufactured bends at end of runs.
 - a. Provide radius \geq 18" for conduits < 3" and \geq 36" for conduits \geq 3".
- 9. Make field cuts requiring tapers with proper tools to match factory tapers.
- 10. After conduit run has been completed, pull standard flexible mandrel having length ≥ 12" and diameter ¼" less than inside diameter of conduit through each conduit.
 - a. Then pull brush with stiff bristles through each conduit to remove foreign material remaining in conduit.
- 11. Pneumatic rodding may be used to draw in lead wire.
 - a. Install heavy nylon cord free of kinks and splices in unused new ducts.
 - b. Extend cord 3' beyond ends of conduit.

- 12. Transition from rigid non-metallic conduit to rigid metallic conduit, per Section 26 05 33 prior to entering structure or going above ground.
 - a. Rigid non-metallic conduit may be extended directly to manholes, handholes, pad mounted transformer boxes and other exterior pad mounted electrical equipment where conduit is concealed within enclosure.
 - b. Terminate rigid PVC conduits with end bells.
 - c. Terminate steel conduits with insulated bushings.
- 13. Maintain ≥12" vertical separation between buried raceways and other systems at crossings.
- 14. Maintain ≥12" horizontal separation between buried raceways and other utility piping systems in parallel runs.
- 15. Placement of conduits stubbing into hand-holes shall be located to allow for proper bending radiuses of cables.
- 16. Do not place concrete or soil until conduits have been observed by Owners Representative.
- 17. Refer to Section 33 05 26 for installation of detectable warning tape above conduits, or, if under slabs, directly beneath concrete subgrade.
- I. Repair damaged conduit as follows:
 - 1. Replace conduit damaged during or after installation.
 - 2. Replace crushed or clogged conduit or any conduit whose inner surface is damaged or not smooth.
 - 3. Repair cuts, nicks, or abrasions in zinc coating of galvanized conduit with galvanizing repair stick.
 - Repair cuts, nicks, or abrasions in PVC coating of PVC-coated conduit with Manufacturer's recommended PVC material and build up surface thickness to match factory coating thickness and color.
- J. Install direct-buried conduit as follows:
 - 1. Install so top of uppermost conduit ducts are ≥ 24" below grade and below pavement sub-grade throughout duct-bank alignment.
 - 2. Provide uniform clearance of ≥ 2" between conduits or as required in Section 26 05 33 for different cabling types.
 - 3. Maintain separation of multiple planes of conduits by 1 of following methods:
 - a. Install multilevel conduits using conduit supports and separators to maintain required separations
 - b. Backfill with 100-psi CLSM (flowable fill) or concrete per Section 03 30 00.
 - c. Install multilevel conduits 1 level at time.
 - d. Backfill each level with appropriate amount of soil and compact, per 31 23 33, to maintain required separations.
 - 4. For high-voltage and service entrance conduits, provide burial depth, bedding, and backfill per Electrical Utility service requirements, and provide concrete encasement.
 - 5. Where other utility piping systems are encountered or being installed along raceway route, refer conflicts to Owner's Representative before proceeding.
 - a. Do not place raceways over buried valves, couplings or appurtenances.
 - 6. Separate communication and instrumentation cables from power wiring in raceways, boxes, manholes, and hand-holes.
 - 7. Transitions from PVC to steel conduit shall occur underground.
- K. Install concrete-encased duct-banks as follows:
 - Duct-bank system shall consist of conduits encased in at least 2" of red concrete with separations between different cabling types as required in Section 26 05 33 or shown on Plans.
 - 2. Install so top of concrete-encased ducts are ≥ 24" below grade and below pavement sub-grade throughout duct-bank alignment.
 - 3. Where shown and for 10' to either side of area shown, duct-bank concrete shall be reinforced with #4 bars and #4 ties placed at 12" on-center, in accordance with Section 03 30 00.

- 4. Conduit supports shall provide clearance of ≥ 2" between trench bottom and bottom row of conduit.
- 5. Conduit separators shall provide uniform minimum clearance of 2" between conduits or as required in Section 26 05 33 for different cabling types.
- L. Install conduits embedded in concrete structures as follows:
 - 1. Install conduits in slabs other than slabs-on-grade as close to slab center as practical without disturbing steel reinforcement.
 - 2. Conduit outside diameters shall be ≤⅓ times slab thickness.
 - 3. Do not space parallel runs of conduit <3 diameters on center.
 - 4. In reinforced concrete construction, place conduit after reinforcing steel has been placed.
 - a. Conduit shall not displace steel reinforcement.
 - 5. Provide ≥1½" cover over conduits.
 - 6. Concrete encasement of conduits installed below concrete slabs shall be continuous with concrete slab where practical.
 - a. Otherwise, install below slab, under curing or damp-proofing membranes, and under sand blankets.
- M. Install empty conduit as follows:
 - 1. Provide 200-pound strength pull-cord in all empty conduits.
 - 2. Provide waterproof label on each end of pull-cords to indicate destination of other end.
 - 3. Show coordinate dimensions of all stub-outs on record drawings.
 - a. Place 1" by 12" by 12" concrete marker over stub-outs and engrave with words "Electrical Conduit."
 - 4. Cap spare conduits and provide #10 THHN green wire below threaded cap.
 - 5. Provide bonded bushing and bond wire.
- N. Seal conduits as follows:
 - 1. Upon completion of installation of conduits and boxes, inspect interiors of conduits and boxes; clear all blockages; and remove burrs, dirt, and construction debris.
 - 2. After cable has been installed and connected, seal conduit ends by non-hardening duct sealing compound forced into conduits to minimum depth equal to conduit diameter.
 - a. This shall apply for all conduits at hand-holes, manholes, and building entrance junction boxes, and for 1" and larger conduit connections to equipment.
- O. Provide conduit identification as follows:
 - 1. Provide conduits identification tags in manholes, hand-holes, building entrances, junction boxes, and equipment.
 - 2. Attach identification tags shall be attached to conduits with nylon tie wraps.
 - a. Position to be readily visible for inspection.
 - 3. Labels shall designate conduit destination.

3.3 Field Quality Control

- A. Install conduit exposed unless specifically noted otherwise.
 - 1. Concealed and underground conduits shall be inspected by Owner's Representative prior to concealment.
- B. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Offsite Electrical	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
Work	Diameter	Pull mandrel 1/4" smaller than conduit ID	1 each conduit	Contractor	Contractor
	Continuity	Test resistance of feeder conduits from service to point of final distribution using 1 conductor return. Resistance ≤25Ω.	1 each conduit	Contractor	Contractor
	11-month Warranty	Confirm Work conforms to Contract Documents and Manufacturer's printed	1 test	Owner	Contractor

					FIRST	RETESTS
			TEST STANDARD		TEST PAID	PAID FOR
	ITEM	TEST FOR	(ASTM OR OTHER TEST STANDARD)	FREQUENCY	FOR BY	BY
ſ		Inspection	literature			

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SECTION 26 05 47

CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 Work Included

A. Materials, testing, and installation of cabinets and enclosures.

1.2 Related Work

- A. Section 01 10 01: Summary of Work and Sequence of Construction
- B. Section 01 22 00: Unit Prices
- C. Section 01 33 00: Submittal Procedures
- D. Section 01 40 00: Quality Requirements
- E. Section 01 61 00: Common Product Requirements
- F. Section 01 65 00: Product Delivery Requirements
- G. Section 01 66 00: Product Storage and Handling Requirements
- H. Section 01 73 00: Execution
- I. Section 01 73 24: Seismic Restraint
- J. Section 05 05 19: Post-Installed Concrete Anchors
- K. Section 26 05 10: Common Work Results for Electrical
- L. Section 26 05 26: Grounding and Bonding for Electrical Systems
- M. Section 26 05 33: Raceway and Boxes for Electrical Systems
- N. Section 26 08 00: Commissioning of Electrical Systems
- O. Section 26 24 19: Motor Control Centers

1.3 System Description

A. Furnish and install cabinets and enclosures, including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and applicable building codes and standards.

1.4 **Quality Assurance**

A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.

1.5 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - 1. ANSI Z55.1 Gray Finishes for Industrial Apparatus and Equipment
 - California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 3. California Building Code (CBC)
 - 4. California Energy Code (CEnC)
 - 5. California Fire Code (CFC)
 - 6. NEMA/ANSI 250 Enclosures for Electrical Equipment
 - 7. NFPA 70 National Electric Code (NEC)
 - 8. UL50 Enclosures for Electrical Equipment Non-Environmental Considerations

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION				
	DRAWINGS				
Shop Drawings	Submit per equipment Shop Drawing requirements.				
	Submit information on proposed ventilation or HVAC equipment required to				
	protect furnished equipment. Include tabulation of Manufacturers' acceptable cabinet temperatures and				

SUBMITTAL	DESCRIPTION				
	humidity's for control equipment furnished.				
	Include equipment Manufacturer's recommendations for venting, forced air				
	ventilation, or refrigeration required to provide enforceable warranties for their				
	equipment.				
	MANUFACTURER'S LITERATURE				
Product Data	Submit per Product Data requirements.				
Installation Instructions	Submit per Installation Instruction requirements.				
	QUALITY ASSURANCE AND CONTROL SUBMITTALS				
Certificate of Compliance	Submit coating system and application certification per Certificate of				
Compliance requirements.					
	CLOSEOUT SUBMITTALS				
Warranty	Furnish 1-year warranty from date of final acceptance				

B. Refer to Section 01 33 00 for definition of requirements for Shop Drawings, Product Data, Installation Instructions, and Certificates of Compliance.

1.7 <u>Delivery, Storage, and Handling</u>

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Strictly follow Manufacturer's instructions and warranty requirements for delivery, storage, and handling of cabinets and enclosures.

1.8 **Project Site Conditions**

A. Refer to Section 01 10 01 for full list of project site conditions.

1.9 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for cabinets and enclosures.

PART 2 - PRODUCTS

2.1 <u>Acceptable Manufacturers</u>

A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
NEMA 4X – Stainless	Adalet / ScottFetzer Genlo Victory Series	Cleveland, OH (216) 267-9000
Steel Watertight,	Hoffman-Panduit / Pentair	Anoka, MN (763) 545-1730
Corrosion-Resistant	Hubbell Wiegmann	Santa Fe Springs, CA (714) 620-6300
Enclosures	Accepted equal	
NEMA 4X – Fiberglass	Adalet / ScottFetzer Genlo Series	Cleveland, OH (216) 267-9000
Watertight, Corrosion-	Carlon / Lamson & Session Co	Cleveland, OH (800) 346-2646
Resistant Enclosures	Hoffman-Panduit / Pentair	Anoka, MN (763) 545-1730
	Hubbell Wiegmann	Santa Fe Springs, CA (714) 620-6300
	Accepted equal	
NEMA 12 – Industrial	Adalet / ScottFetzer Genlo Victory Series	Cleveland, OH (216) 267-9000
Use Enclosures	Hoffman-Panduit / Pentair	Anoka, MN (763) 545-1730
	Hubbell Wiegmann	Santa Fe Springs, CA (714) 620-6300
	Integra Enclosures / Winncom	Solon, OH (888) 946-6266
	Accepted equal	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Cabinets and enclosures shall meet selection requirements of NEC Table 110.20.
- C. Materials for cabinets shall be:

ITEM	MATERIAL	SPECIFICATION
NEMA 4X – Watertight,	Stainless Steel	NEMA 4X
Corrosion-Resistant Enclosures		Thickness ≥14-gauge

ITEM	MATERIAL	SPECIFICATION
		Gasketed
		Conform to UL50
NEMA 4X – Watertight,	Fiberglass-Reinforced	NEMA 4X
Corrosion-Resistant Enclosures	Polyester	Shall contain >25% fiberglass by weight
NEMA 4X – Watertight,	Polycarbonate	
Corrosion-Resistant Enclosure		
Transparent Covers		
NEMA 12 – Industrial Use	Steel	NEMA 12
Enclosures		Thickness ≥14-gauge
		Gasketed
		Conform to UL50

D. The following product design criteria, options and accessories are required:

ITEM	sign criteria, options and accessories are required: DESCRIPTION			
All Cabinets and Enclosures	Construction	Galvanized sheet steel, stainless sheet steel, fiberglass, or polycarbonate as required for NEMA ratings. Flush- or surface-mounted boxes as shown Metal frames shall use reinforced code-gauge metal		
	Doors	Provide separate hinged doors for each starter, feeder, panel, controller, or other unit. Door size shall permit ≥110° door swing within dimensional constraints of equipment room. Doors shall be key-lockable. Key door locks alike per Owner's requirements.		
	Dimensions	Size to conform with NEC.		
	Nameplates	Refer to Section 26 05 10.		
	Ventilation	Provide adequate ventilation for enclosed equipment		
	Exterior Finish	For steel provide rust-inhibiting primer and then Manufacturer's factory-baked enamel Refer to Section 09 90 00 Color ANSI 61 Light gray. Plate unpainted parts for corrosion resistance		
		For stainless steel, do not paint. Grind door front smooth		
		For plastic or FRP, do not paint		
	Interior Finish	For steel provide rust-inhibiting primer and then Manufacturer's factory-baked enamel on interior panels and directory frame print pockets. Refer to Section 09 90 00 Color White		
		For stainless steel, do not paint. Grind door front smooth		
	Print Pocket	For plastic or FRP, do not paint Provide with index card holders and cards mounted behind heavy transparent plastic on backside of cabinet doors		
	Directory Frame	Provide interior directory metal frame, heavy transparent plastic cover and enclosed directory card on backside of panel doors		
Wall-Mount Cabinets	Construction	Conform to NEMA type shown		
	Back Panel	Provide removable steel back panels for mounting equipment. Equip cabinet back panels with ground bus bar.		
	Knockouts	Provide appropriate size and quantity of knock-outs for conduit entry.		
Floor-Mount Vertical Cabinets	Construction	Conform to NEMA type shown Free-standing, floor-mounted preassembled type Provide 19" EIA adjustable mounting rails for front and rear equipment mounting. Group cabinets side by side with side panels on each section.		

ITEM		DESCRIF	PTION	
	Rear Doors	Vented except as otherwise shown		
	Front Doors	Vented top and bottom except as otherwise shown.		
	Side Panels	Thickness ≥ 18-g	auge	
	Top Panel	Plain		
	Exterior Dimensions	Overall Width	20"	
		Overall Height	87" nominal	
		Overall Depth	20" nominal	
	Interior Dimensions	Panel Width	19"	
		Panel Height	78¾"	
	Compartment	Unit Spaces	Divide each vertical standard section	
	Dimensions		into 12 usable 6.5"-high unit spaces	
		Space Factors	2 unit spaces = 13" = 1 space factor	
			Do not provide fractional space factor	
			compartments except where shown on Plans.	
	Empty Panel Spaces	Provide 10" wide	panels of color matching cabinet for	
	Emply Famer Spaces	unused vertical m		
		Filler panel height	•	
Pedestals	Construction		A type shown for outdoor or wet locations.	
		Continuously weld		
		Secure panel with		
		Pre-drill pedestal	for mounting of equipment	
	Access Panel	Provide gasketed	panel to access enclosed equipment.	
	Dimensions	As shown		
	Exterior Finish	For steel, refer to		
		Color ANSI 61 Lig		
		For stainless steel, do not paint.		
	L.C. C. Frank	Grind door front smooth Use Manufacturer's enamel on directory frame print		
	Interior Finish	pockets and interi		
		Color White	or pariers.	
Power Strips	General		hardwired outlet strips as required to	
		support installed equipment.		
	Case	Metallic		
	Plug-In Power Strips			
		locking-type receptacle		
NEMA 4X – Watertight,	Enclosure	Continuously welded seams Provide rolled lip around sides of door and around s		
Corrosion-Resistant Stainless				
Steel Enclosures	Door	enclosure opening		
	Door	pulling stainless-s	n piano hinges with door removable by	
	Gasket	Attach with oil-res		
	Justice	Secure with steel		
	Hardware	Provide clamps, screws, hinge pins, hasp, and staple for		
		padlocking	,g- p,p, sa stapes to	
NEMA 4X – Watertight,	Enclosure	<u> </u>	ompression molded	
Corrosion-Resistant Fiberglass	Door		nufactured from nonmetallic materials	
Enclosures	Gasket		ted into molded labyrinth on cover	
	Hardware		lic latches suitable for padlocking	
NICMA 40 Inchite this III -	Fralesure	Continuent	dad aa awa	
NEMA 12 – Industrial Use Enclosures	Enclosure	Continuously weld	around sides of door and around sides of	
LIGOSUIGS		enclosure opening		
	Door	Provide full-length	n piano hinges with door removable by	
	2001	pulling stainless-s	teel hinge pin.	
	Gasket		sistant adhesive and secure with steel	
		retaining strips		
	Hardware	Provide clamps, screws, hinge pins, hasp, and stap		
	padlocking			

ITEM	DESCRIPTION		
	Lighting and Utility	For PLC enclosures, provide 120VAC 15-amp duplex	
	Circuitry (PLC	output and single-pole 120VAC 15-amp circuit breaker.	
	enclosures)	Provide fluorescent lamp in panel.	

E. The following electrical design criteria are required for equipment specified in this section:

ITEM	DESCRIPTION			
Electrical Work	NEC Article 505 Classification	Nonhazardous		
Enclosures – Indoor Dry	NEMA 250 Enclosure Rating	NEMA 12 – Industrial Use		
Locations				
Enclosures – Indoor or Vault-	NEMA 250 Enclosure Rating	NEMA 12 – Industrial Use		
Enclosed Damp Locations				
Enclosures – Outdoor or Wet	NEMA 250 Enclosure Rating	NEMA 4X – Watertight, Corrosion-Resistant,		
Locations		Stainless steel		
		Mount enclosures ≥¼" from walls to provide air		
		space.		
		Enclosure entrances shall be threaded.		
All Enclosures	Construction	Lockable		
		With powdercoat epoxy finish on steel surfaces		
	IEC 60529 Enclosure Rating for	IP 65 dust-tight + low-pressure water jet		
	Underground Equipment			

PART 3 - EXECUTION

3.1 <u>Preparation</u>

- A. Make field measurements needed to install cabinets and enclosures before submitting shop drawings or ordering.
 - 1. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Examine areas and conditions under which Work of this section will be performed.
 - 1. Correct conditions detrimental to timely and proper completion of Work.

3.2 Installation

- A. Refer to Sections 01 73 00 and 01 73 24 for basic execution and installation requirements.
- B. Furnish and install cabinets and enclosures at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 2. Other applicable OSHA and Cal OSHA regulations
 - 3. California Electrical Code Article 312 "Cabinets, Cutout Boxes, and Meter Socket Enclosures"
 - 4. California Electrical Code Chapter 4 "Equipment for General Use"
 - 5. Other applicable building, fire, and electrical code requirements
 - 6. Manufacturer's installation and warranty requirements
- D. Refer variances between above documents and Contract Documents to Owner's Representative.
- E. Install cabinets and enclosures to tolerances recommended by Manufacturer.
 - 1. Unless otherwise shown, install cabinets and enclosures true, plumb, and level using precision gauges and levels.
- F. Provide pedestals conforming to NEC as required for proper equipment installation.
 - 1. Install pedestal in accessible locations.
 - 2. Coordinate installed conduit locations so conduit is stubbed up inside pedestal enclosure.
 - 3. Provide working clearances meeting NEC requirements for electrical equipment.

- 4. Secure to concrete with Type 304 SS anchor bolts, self-drilling anchors, or expansion anchors per Section 05 05 19.
 - a. Do not use powder-actuated fasteners.
 - b. Locate anchors so they are only accessible from inside enclosure.
- G. Provide cabinets conforming to NEC as required for proper equipment installation.
 - 1. Install cabinets and enclosures in accessible locations.
 - 2. Provide working clearances meeting NEC requirements for electrical equipment.
 - 3. Pedestal cabinets shall be large enough and equipment shall be spaced to provide room for airflow and maintenance.
 - 4. Secure to concrete with Type 304 SS anchor bolts, self-drilling anchors, or expansion anchors per Section 05 05 19.
 - a. Do not use powder-actuated fasteners.
 - 5. Close unused cabinet openings to provide protection equal to that of cabinet walls.
- H. Provide venting, ventilation or air conditioning as shown, and as required to:
 - 1. Conform to electrical equipment warranty requirements.
 - 2. Prevent condensation from damaging enclosed electrical equipment.
 - 3. Maintain interior cabinet temperatures at ≤ 95 *F.
 - a. Locate heat-producing equipment including power supplies near top of cabinets.
 - 4. Where forced air cooling is required, provide ventilation fans, vents, and filters.
 - a. For cabinets with forced ventilation, doors and side panels shall be solid with no louvers.
 - 5. Construct top-mounted air-conditioning units to prevent condensation from damaging electrical equipment or enclosure.

3.3 Field Quality Control

A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Cabinets	Installation &	Visual inspection of finished installation	1 inspection	Owner	Owner
and	Leakage	·	·		
Enclosures	Condensation	No visible condensation from top-mounted AC units	1 inspection	Owner	Owner
	NEC	Meet NEC §110.26 clearance requirements	1 inspection	Owner	Owner
	Clearances				
	Field	Demonstrate compliance to Contract	1 test	Contractor	Contractor
	Performance	Documents and Manufacturer's printed			
		Literature			
	11-month	Demonstrate compliance to Contract	1 test	Owner	Contractor
	Warranty	Documents and Manufacturer's printed			
	Inspection	Literature			

3.4 Protection

- A. Dress cables neatly within cabinets and enclosures.
 - 1. Trim and dispose of excess cable.
- B. After equipment is installed, touch up scratches and marks incurred during shipment or installation.
 - 1. If required by Owner's Representative due to excessive scratching, repaint entire assemblies.

END OF SECTION

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SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 Work Included

- A. Testing, commissioning and startup of electrical system equipment, components, materials, wiring, and grounding.
- B. Provide services of Owner-accepted third-party Electrical Testing Agency (ETA) to provide the following acceptance tests and inspections in accordance with applicable sections of NETA ATS, Contract Documents, and Manufacturer's recommendations:
 - 1. Field tests for electrical power conductors and cables
 - 2. Field tests of grounding and bonding systems
 - a. Refer to Section 26 05 26 for field tests of grounding and bonding systems.
 - 3. Short circuit and coordination study.
 - a. Refer to Section 26 08 13 for short circuit and coordination study requirements.
 - 4. Arc-flash hazard analysis and report.
 - a. Refer to Section 26 08 16 for arc flash hazard analysis and report.
 - 5. Tests identified as optional in NETA ATS are only required where specified.
- C. Refer to Section 01 79 00 for system demonstration requirements.
- D. Refer to sections for individual equipment items for additional testing and commissioning requirements.
- E. Testing, commissioning and startup of the following electrical Work will be performed by others and are excluded from the scope of this section
 - 1. Testing of revenue-type electricity monitoring
 - 2. Testing of instrumentation and controls systems
 - 3. Testing of security system.
 - 4. Testing of telecommunications system.

1.2 Related Work

- A. Section 01 10 01: Summary of Work and Sequence of Construction
- B. Section 01 22 00: Unit Prices
- C. Section 01 33 00: Submittal Procedures
- D. Section 01 40 00: Quality Requirements
- E. Section 01 61 00: Common Product Requirements
- F. Section 01 73 00: Execution
- G. Section 01 75 00: Starting and Adjusting
- H. Section 01 78 23: Operation and Maintenance Data
- I. Section 01 78 36: Project Warranties
- J. Section 01 79 00: Demonstration and Training
- K. Section 26 05 10: Common Work Results for Electrical
- L. Section 26 05 19: Low-Voltage Electrical Power Conductors and Cables
- M. Section 26 05 26: Grounding and Bonding for Electrical Systems
- N. Section 26 08 13: Short Circuit and Coordination Study
- O. Section 26 08 16: Arc-Flash Hazard Analysis and Report

1.3 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Perform factory tests required by applicable industry standards or NRTL before shipping equipment.

C. Factory tests will not be accepted as substitute for specified field accepted tests.

1.4 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 2. California Electrical Code (CEC)
 - 3. IEEE 400 Field Testing and Evaluation of Insulation of Shielded Power Cable Systems
 - 4. IEEE 400.3 Partial Discharge Testing of Power Cable Systems in Field Envir0onment
 - 5. NETA ATS Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems
 - 6. NFPA 70 National Electric Code (NEC)
 - 7. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance (ANSI)
 - 8. NFPA 70E Electrical Safety Requirements for Employer Workplaces
 - 9. NRTL Nationally Recognized Testing Laboratory
 - 10. TIA/EIA/ANSI 455-78-B Optical Fibres Part 1-40 Measurement Methods and Test Procedures Attenuation

1.5 **Submittals**

- A. Furnish the following submittals with bid or within 72 hours following bid opening.
 - 1. Failure to submit required information on time may cause Owner to determine and assign Owner-accepted testing company to be employed by Contractor at no cost to Owner.

SUBMITTAL	DESCRIPTION				
	PREMOBILIZATION SUBMITTALS				
Electrical Test Agency	Submit name and qualifications of ETA				
Qualifications	Submit documentary evidence ETA has been in business in California for ≥5 years				
	Submit name and qualifications of lead engineer or engineering technician performing required testing services along with documentary evidence proposed onsite foreman has worked in such capacity in employ of subcontractor ≥3 years and has completed ≥3 installations of product. Include reference names and telephone numbers				
	Submit ETA's quality assurance program				
	Submit ETA's instrument calibration and equipment testing program				
	Submit ETA's electrical safety program.				

B. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
	QUALITY ASSURANCE AND CONTROL SUBMITTALS	
Pre-Test Submittals	Submit equipment Manufacturer's instructions for testing manufactured products	
	Submit phasing diagrams showing coordinated phasing for 3φ power showing	
	coordinated phase rotations with generators and motors through transformers.	
	Submit photocopies of continuity tests before energizing equipment.	
	Submit test data forms	
	CLOSEOUT SUBMITTALS	
Post-Test Submittals	Submit summary of testing for Work including date and time of tests	
	Submit information from pre-energization testing.	
	Submit description of equipment tested	
	Submit description of tests and test procedures	
	At least 45 days prior to planned testing, submit acceptance and system functions	
	test plan for each equipment item or system to be field tested	
	Include applicable procedures, forms, and lists of test equipment.	
	Do not perform testing until test plan and procedures have been accepted.	
	Submit tabulated data for each piece of equipment tested, including circuit number,	
	equipment or motor name and tag number (where applicable), nameplate full-	
	ampere rating, motor service factor, motor ambient temperature rating, overload	
	relay rating, measured full load current, and measured discharge pressures (where applicable)	
	Submit certified copies of inspection reports, test reports, and system function tests.	
	Reports shall include certification of compliance with specified requirements	
	including test instrument calibration, identification of deficiencies, and	

SUBMITTAL	DESCRIPTION			
	recommendation of corrective action when appropriate.			
	Type and neatly bind test reports to form part of final record.			
	Submit conclusions and recommendations			
	Submit completed test forms in appendix, including witness's signatures.			
	Submit list of test equipment in appendix including calibration documents			
	Submit test report ≤10 days after each test is completed			
	Refer to Section 26 08 13 for short circuit and coordination report submittal requirements.			
	Refer to Section 26 08 16 for arc-flash hazard analysis and report submittal requirements.			
Deviations from Contract	Note or indicate wiring deviations from Contract Documents on Project Record			
Documents	Documents.			

- C. Refer to Section 01 33 00 for definition of requirements for submittals.
- D. Include the following minimum information in each data record:
 - 1. Identification of ETA.
 - 2. Equipment identification: Equipment ID code based on Drawings
 - a. Where applicable, include building number, and system identifier.
 - 3. Humidity, temperature, and other conditions that may affect results of tests or calibration of test equipment.
 - 4. Date inspection, test, or function test was performed.
 - 5. Identification and signature of testing technician.
 - 6. Description of inspections, tests, maintenance, and function tests performed and recorded.
 - 7. Test equipment used and references to calibration records.
 - 8. Indication of as-found condition and as-left results.
- E. Include the following information in final test report:
 - 1. Summary of project.
 - 2. Description of equipment inspected and tested.
 - 3. Description of inspections and tests.
 - 4. Data record resulting from each inspection and test.
 - 5. Results of system function tests.
 - 6. Power system studies.
 - 7. Analysis of tests, identification of deficiencies, and recommendations for corrective action.
- F. Refer to Part 3 below for schedule of required field tests.

1.6 Project Site Conditions

A. Refer to Section 01 10 01 for full list of project site conditions.

1.7 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for commissioning of electrical systems.

PART 2 - PRODUCTS

2.1 Acceptable Testing Firms

- A. Retain qualified engineering appraisal and testing firm to perform inspections, tests, and evaluation to determine equipment designated herein is installed and adjusted for successful energization and operation.
- B. Testing firm shall meet Federal OSHA criteria for accrediting testing laboratories, Title 29, Part 1910.7, and have work history and qualifications acceptable to Owner.
 - 1. Appraisal and testing firm shall have ≥2 years of experience in appraising and testing equipment of nature to be tested.

- 2. Managing or supervising representatives of appraisal and testing firm shall have extensive knowledge of products involved and ≥2 years hands-on experience conducting appraisals and tests.
- 3. Conduct testing under supervision of managing or supervising representatives.
- 4. Testing technicians shall be trained and experienced in type of testing to be performed.
- C. ETA shall be independent testing organization which shall function as unbiased testing authority, independent of Manufacturers, suppliers, and installers of equipment or systems evaluated.
 - 1. ETA shall be regularly engaged in testing of electrical equipment devices, installations, and systems.
 - 2. ETA shall have documented quality assurance program, documented inspection and test and procedures, and documented electrical safety program.
 - 3. ETA shall have completed ≥10 acceptance testing, inspection and calibration projects of similar scope to this project.
 - 4. ETA shall have a calibration program
 - a. Test instruments used shall be calibrated per NETA ATS.
 - 5. ETA technicians performing testing, inspection, calibration, and adjustments shall be "qualified persons" as defined by NFPA 70E and NEC.
 - 6. Technicians performing electrical tests and inspections shall be trained and experienced concerning apparatus and systems being evaluated.
 - 7. Technicians shall be capable of conducting tests in safe manner with knowledge of hazards involved and appropriate safety-related work practices.
 - 8. Technicians shall be qualified to evaluate test data and make judgment on serviceability of specific equipment.
 - 9. Testing, inspection, calibration, and adjustments shall be performed or supervised on Project site by ETA employee with following minimum qualifications:
 - a. Personnel shall have ≥5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices, and
 - b. Personnel shall have 1 of the following certifications/registrations:
 - c. Certification to at least Level III per ANSI/NETA ETT Standard for Certification of Electrical Testing Technicians (ANSI), or
 - d. Certification to at least NICET ET-grade in Electrical Testing Engineering Technology.
 - 10. Responsible ETA employee shall coordinate with Owner's system integrators and operators.
- D. As an alternative, ETA testing firms and technicians may be certified by electrical equipment Manufacturers and accepted by Owner for types of tests required on their equipment.
- E. Testing firm shall use comprehensive report forms to document engineering appraisal and test results on equipment and products tested.
 - 1. Upon testing completion, managing or supervising engineering representative shall sign forms prior to inclusion in final report.
- F. Obtain written acceptance from Owner of testing firm prior to beginning testing.
 - 1. Testing service or personnel may be accepted or rejected based on, but not limited to testing equipment intended to be used, qualifications of firm, completeness of testing forms, and experience and reputation of personnel.
- G. Acceptable testing companies include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
3-Point Fall-of-Potential	Halco Testing Services	Los Angeles, CA (800) 300-5773
Ground Testing	Industrial Tests, Inc.	Rocklin, CA (888) 809-8550
Equipment	Power Engineers, Inc.	Anaheim, CA (714) 507-2700
	Accepted equal	·

- 1. Above companies may not provide all testing.
- 2. Contractor may employ more than 1 company.

H. Acceptable Manufacturers of testing equipment include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
3-Point Fall-of-Potential	Associated Research, Inc.	Lake Forest, IL (847) 367-4077
Ground Testing	Biddle-Megger	Chandler, AZ (800) 230-6008
Equipment	Accepted equal	

PART 3 - EXECUTION

3.1 Preparation

- A. Examine areas and conditions under which Work of this section will be performed.
 - 1. Correct conditions detrimental to timely and proper completion of Work.
- B. Verify correct phase rotation of equipment before making connections at service entrance, transformers, or motors permanent.
 - Coordinate with Servicing Electrical Utility for phase rotations and Phase A, B, and C markings.
 - 2. Create phasing diagram showing coordinated phase rotations with generators and motors through transformers.
 - 3. Coordinate motor phasing inspections with Owner's Representative.
 - 4. Submit written report to Owner's Representative for each motor verifying phasing has been checked and corrected.
 - 5. Install and insulate these connections temporarily while determining proper rotation.
 - 6. Make permanent connections after rotation has been established and subsequent to completion of component insulation resistance and dielectric tests.
- C. Schedule project to allow adequate time for electrical acceptance testing before electrical Work is energized.
 - 1. Notify ETA when equipment becomes available for acceptance inspections and tests.
 - 2. Coordinate Work to expedite inspections and tests.
- D. Notify Owner's Representative ≥7 Calendar Days before tests to allow Owner to witness testing.
 - 1. Notify Owner again 24 hours before start of testing.
 - 2. Owner will arrange for witnessing of tests and inspections by appropriate personnel when required by submitted Test and Inspection Plan, applicable codes and consensus standards, or when Owner deems appropriate.
- E. Supply 1 set of following to ETA prior to final testing:
 - 1. Preliminary short-circuit analysis
 - 2. Preliminary coordination study and protective device setting table
 - 3. Complete set of electrical Contract Documents plus pertinent Change Orders
 - 4. Accepted construction submittal documents.
 - 5. Site specific hazard notification and safety training.
 - 6. Other information necessary for safe and accurate test and inspection of system.
- F. Perform installation insulation-resistance, continuity, and rotation tests for electrical Work prior to tests performed by ETA.
- G. Provide suitable and stable electrical power, adequate lighting and HVAC as required at each test site for ETA to perform specified acceptance testing.

3.2 Field Quality Control

- A. Refer to Section 01 73 00 for basic execution requirements.
- B. Conform to the following testing standards:
 - 1. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 2. Other applicable OSHA and Cal OSHA regulations
 - 3. California Electrical Code
 - 4. NETA (National Electrical Testing Association) ATS standards

- a. NETA ATS 7.1 for switchgear and switchboards.
- b. NETA ATS 7.2.1.1 for small dry-type transformers.
- c. NETA ATS 7.2.1.2 for large dry-type transformer tests.
- d. NETA ATS 7.3.2 for low-voltage cable inspections and tests.
- e. NETA ATS 7.6.1.1 for low-voltage molded-case circuit breaker tests.f. NETA ATS 7.6.1.2 for low voltage power circuit breaker inspections and tests.
- g. NETA ATS 7.8 for network protector inspections and tests.
- h. NETA ATS 7.10 for instrument transformer inspections.
- i. NETA ATS 7.11 for metering inspections and tests.
- j. NETA ATS 7.13 for grounding inspections and tests.
- k. NETA ATS 7.14 for ground fault protection inspections and tests.
- I. NETA ATS 7.15 for motor inspections and tests
- m. NETA ATS 7.15.2 for generator inspections and tests
- n. NETA ATS 7.16 for motor controller inspections and tests.
- 5. Manufacturer's installation and warranty requirements
- 6. Other applicable ANSI, ASTM, and NEMA standards.
- C. Refer variances between above documents and Contract Documents to Owner's Representative.
- D. Test electrical equipment in 3 phases.
 - 1. Pre-energization testing.
 - 2. Equipment energized with no load.
 - 3. Equipment energized under load.
- E. Perform calibration and setting checks with calibrated test instruments of at least twice that of accuracy of equipment, device, relay or meter under test.
 - 1. Dated calibration labels shall be visible on test equipment.
 - 2. Calibrations > 6 months old are not acceptable on field test instruments.
 - a. Inspect test instruments for proper operation prior to testing.
 - 3. Record serial and model numbers of instruments used on test forms.
- F. Testing of installed equipment shall result in acceptable test results.
 - 1. Equipment for which acceptable test data has not been submitted, or has been submitted but rejected, will be deemed as not meeting Contract Requirements.
- G. Upon Owner's acceptance of Overcurrent Protective Coordination Study and Arc Flash Hazard Analysis, adjust protective device settings based on study recommendations.
- H. Repair or replace items not passing tests.
- Do not place equipment into service until required tests have been completed, test results have been evaluated and accepted, and recommended or required adjustments have been completed.
- J. Provide supervision, labor materials, tools, test instruments, and equipment or services required to test, adjust, set, calibrate, and operationally check Work and components of various electrical systems and circuitry.
 - 1. During checkout and startup of plant systems, provide skilled workers for checkout and troubleshooting as required by Owner's Representative.
 - a. Since coordination with other crafts and contractors may be required, make workers assigned to checkout available outside normal working hours when necessary.
 - 2. Provide services of factory-authorized representative on-site as needed to provide:
 - a. Installation assistance, inspection and startup of complete electrical system.
 - b. Field testing and adjustment.
 - c. Instruction of Owner's personnel in operation and maintenance.
- K. Tests shall:
 - 1. Provide initial equipment/system acceptance,
 - 2. Provide recorded data for future maintenance and troubleshooting, and

- 3. Provide assurance each system component is installed satisfactorily and can be expected to perform and continue to perform its function with reasonable reliability.
- L. Schedule tests and inspections as job progresses.
 - 1. Allow Owner's Representative to inspect materials, equipment, and workmanship.
 - 2. After each electrical system installation is complete, perform tests to verify system is in proper working order and in accordance with Contract Documents, Manufacturer's Installation Instructions, and applicable codes.
 - 3. Conduct tests in presence of Owner's Representative.
 - a. Notify Owner's Representative 7 days in advance of tests scheduled to be performed.
 - 4. Perform insulation and ground resistance tests before operating tests.
- M. Perform specified tests in presence of Owner's Representative.
 - 1. Furnish testing equipment and pay costs of tests, including replacement parts and labor necessary due to damage resulting from damaged equipment or from test and correction of faulty installation.
 - 2. Correct test failures in manner satisfactory to Owner's Representative.
- N. Perform insulation tests on electrical equipment at the following times and conditions:
 - 1. Prior to energizing and/or placing into service.
 - 2. When damage to insulation is suspected.
 - 3. After repairs or modifications to equipment affecting insulation.
 - 4. When necessary to evaluate condition of equipment insulation, especially in high ambient moisture conditions, and to determine need for drying, cleaning, or other maintenance work or protection of such equipment.
 - 5. Where lightning or other surge conditions are known to have passed through circuit.
- O. Make openings in circuits for test instruments and place and connect instruments, equipment, and devices, required for tests.
 - 1. Upon completion of tests, remove instruments and instrument connections and restore circuits to permanent condition.
- P. Pay for tests, including expenses incident to retests occasioned by defects or failures of equipment to conform to Contract Documents.
- Q. Do not void equipment warranties or guarantees by testing.
 - 1. Checks and tests shall be supplemental to and compatible with Manufacturer's Installation Instructions and warranty requirements.
 - 2. Where deviations are warranted, obtain Manufacturer's written acceptance prior to testing.
 - 3. Where repairs, modifications, adjustments, or tests are to be made, notify Owner's Representative and make such repairs, modifications, adjustments and tests in accordance with Manufacturer's recommendations.
- R. Report to Owner's Representative electrical equipment or systems determined to be damaged, or faulty.
 - 1. Report to Owner, within 3 Working Days, Work or construction found defective based on acceptance tests or inspections by ETA.
 - 2. Obtain acceptance from Owner's Representative for corrective action and retesting.
 - 3. Within 21 Calendar Days of direction from Owner, rework, repair or replace Work found defective based on acceptance tests or inspections.
 - a. Replace wiring and equipment found defective.
 - 4. Retest Work failing acceptance tests or inspections.
- S. Coordinate Work to expedite project schedule.
- T. Field inspection and testing shall conform to NETA ATS and include:

				FIRST	RETESTS
		TEST STANDARD		TEST PAID	PAID FOR
ITEM	TEST FOR	(ASTM OR OTHER TEST STANDARD)	FREQUENCY	FOR BY	BY

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
112	12011 OK	POWER SYSTEM ANALYSIS	- NEGOLITOT	101121	
Overcurrent Protection Fault Study	Prepare Study and Report	Refer to Section 26 08 13	1 study of electrical system	Contractor	Contractor
Coordination Study	Prepare Study and Report	Refer to Section 26 08 13	1 study of electrical system	Contractor	Contractor
Harmonic Evaluation of Distribution System	Prepare Study and Report	Refer to Section 26 08 13	1 study of electrical system	Contractor	Contractor
Load Flow Study	Prepare Study and Report	Refer to Section 26 08 13	1 study of electrical system	Contractor	Contractor
Stability Study	Prepare Study and Report	Refer to Section 26 08 13	1 study of electrical system	Contractor	Contractor
Arc Flash Hazard Analysis and Report	Prepare Study and Report	Refer to Section 26 08 16	1 report on electrical system	Contractor	Contractor
	•	FIELD TESTS AND INSPECTION	S	•	•
Conductors and Cables Section	Installation Examination	Verify correctness of wiring by visually comparing conductor connections with connection diagrams.	1 inspection	Contractor	Contractor
26 05 19		Inspect for physical damage and correct connections	1 inspection	Contractor	Contractor
		Inspect for damage to insulation and jackets	1 inspection	Contractor	Contractor
		Inspect connections for high resistance	1 inspection	Contractor	Contractor
		Inspect compression-applied connections for correct cable match and indentation	1 inspection	Contractor	Contractor
	Low Voltage Cable	Refer to NETA ATS 7.3.2	1 inspection	Contractor	Contractor
	Field Tag Verification	Verify proper identification numbering and/or color coding for cables and wiring during continuity testing.	1 test each phase of each circuit	Contractor	Contractor
	Continuity	Make individual circuit continuity checks using electrical circuit testers.	1 test each phase of each circuit	Contractor	Contractor
	High Resistance	Test connections for high resistance using low resistance ohmmeter	1 test each phase of each circuit	Contractor	Contractor
	Short Circuits	Verify Work is free from improper grounds, short circuits and overloads.	1 test each phase of each circuit	Contractor	Contractor
	High-Potential Test	Conduct tests at 1000VDC for 2 minutes Wire and cable shall withstand test high voltage without breakdown and have steady or decreasing leakage during test	1 test each phase of each circuit ≤600VAC	Contractor	Contractor
	Insulation Resistance (Megger Test) Conductors	Conduct tests at 1000VDC for 2 minutes to measure insulation resistance. Resistance between conductors and	1 test each phase of each circuit ≤600VAC	Contractor	Contractor

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
	≤600VAC	between each conductor and ground shall be > 1 / 10 / 25 megΩ and recommendations of cable Manufacturer Measure insulation resistance for motor feeders after disconnecting motors and other equipment that might be damaged. Measuring from load side of conductors or circuit breakers.	before energizing		
	Uniform Resistance	On circuits ≥#6AWG, verify uniform resistance of parallel conductors.			
Grounding and Bonding Section	3-Point Fall-of- Potential Ground Test	Refer to Section 26 05 26 and NETA 7.13	1 test each ground electrode	Contractor	Contractor
26 05 26	Ground Fault Protective Equipment	Refer to Section 26 27 26 and NETA 7.14	1 test before energizing	Contractor	Contractor
Low-Voltage Transformers Section 26 22 00	Operation	Refer to Section 26 27 00 and NETA ATS 7.2 and 7.10	1 test before energizing	Contractor	Contractor
Switchboards Section 26 24 13	Operation	Refer to Section 26 24 13 and NETA ATS 7.1 Test each switchboard and each included circuit breaker	1 test before energizing	Contractor	Contractor
	Metering	Refer to NETA ATS 7.11	1 test before energizing	Contractor	Contractor
Panelboards Section 26 24 16	Operation	Refer to Section 26 24 16 and NETA ATS 7.6.1 Test each panelboard and each included circuit breaker	1 test before energizing	Contractor	Contractor
Motor Control Center Section 26 24 19	Operation	Refer to Section 26 24 19 and NETA ATS 7.1 Test each motor control center and each included circuit breaker. Verify motor overload protection in each controller is appropriate for application Test each transformer. Test each panelboard and each included circuit breaker	1 test before energizing	Contractor	Contractor
Low-Voltage Circuit- Protective Devices Section 26 28 00	Circuit-Breaker Settings	Refer to Section 26 08 13, 26 28 00, and NETA ATS 7.6.1	All circuit breakers	Contractor	Contractor
Network Protectors	Operation	Refer to NETA ATS 7.8	All network protectors	Contractor	Contractor
	Reverse Current Sensitivity	Verify by opening transformer primary switch with feeder energized and no load on transformer and observing network protector opens on magnetizing current alone	All network protectors	Contractor	Contractor
Manual or Automatic Transfer Switches	Operation	Refer to Section 26 36 23 Test each transfer switch associated with NFPA Level 1 or 2 engine generator system	1 test before energizing	Contractor	Contractor

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Section 26 36 23		Test each transfer switch associated with NFPA 111 level 1 or UPS system			
Motors	Motor Inspection and Tests	NETA ATS 7.15	All motors ≥¾hp	Contractor	Contractor
	Motor Operating Test – Insulation Resistance, Continuity, Rotation	Perform routine insulation resistance, continuity and rotation tests for distribution and utilization equipment including motors >¾Hp before and in addition to tests performed by test laboratory. Supply suitable and stable test power source to test laboratory at each test site. Test laboratory shall specify requirements. Notify test laboratory when equipment becomes available for acceptance tests. Perform testing in presence of Owner's Representative. Test laboratory shall implement final settings and adjustments on protective devices and tap changes. Test laboratory shall record test results and upon completion, assemble and certify final test report	All motors ≥³¼hp	Contractor	Contractor
	Motor Operating Test - Current	Record current in each phase of each motor ≥¾-hp and include in O&M manual. Repair or replace motor or motor-driven equipment if current > motor nameplate FLC value.	Each phase of each motor ≥¾hp	Contractor	Contractor
	Vibration Baseline Test	Perform vibration baseline test	Each phase of each motor ≥10hp	Contractor	Contractor
		SYSTEM DEMONSTRATION			
Electrical Work	Power Company Voltage Test	When installation is complete and facility is in operation, check voltage at point of termination of Electric Utility supply to project.	1 test each system	Contractor	Contractor
		Check voltage amplitude and balance between phases for loaded and unloaded conditions	1 test each system	Contractor	Contractor
		If unbalance as defined by NEMA >1%, or if voltage varies throughout day and from loaded to unloaded conditions by >+5% nominal, make written request to Electrical Utility to either correct condition or provide written statement voltage variations and/or unbalance fall within their normal standards.	As required	Contractor	Contractor
	Electrical Switchgear System Function Tests	Verify proper operation of main circuit breaker Verify proper operation of arc-flash reduction maintenance switch Verify proper operation of branch breakers	1 test each switchboard	Contractor	Contractor
	Low Voltage	Verify proper operation of circuit	1 test each	Contractor	Contractor

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
	Motor Control Center System Function Test	breakers, starters, drives, controllers, relays and safety devices Refer to NETA ATS 7.16	motor control center		
		Verify proper operation of power monitor, transformers, panelboard and circuit breakers.			
		Verify proper operation of interlock systems.			
	Standby Power Generation	Refer to Section 26 32 13 and NETA ATS 7.15.2.	1 each Generator	Contractor	Contractor
	System Demonstration	Refer to Section 26 08 00.	All electrical systems	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

END OF SECTION

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SECTION 26 08 13

SHORT CIRCUIT AND COORDINATION REPORT

PART 1 – GENERAL

1.1 Work Included

- A. Short circuit and coordination report for electrical Work.
- B. Refer to Section 26 08 00 for requirements for commissioning electrical systems.

1.2 Related Work

- A. Section 01 10 01: Summary of Work and Sequence of Construction
- B. Section 01 22 00: Unit Prices
- C. Section 01 33 00: Submittal Procedures
- D. Section 01 35 26: Governmental Safety Requirements
- E. Section 01 40 00: Quality Requirements
- F. Section 01 61 00: Common Product Requirements
- G. Section 01 65 00: Product Delivery Requirements
- H. Section 01 66 00: Product Storage and Handling Requirements
- I. Section 01 73 00: Execution
- J. Section 01 79 00: Demonstration and Training
- K. Section 26 05 10: Common Work Results for Electrical
- L. Section 26 08 00: Commissioning of Electrical Systems
- M. Section 26 08 16: Arc-Flash Hazard Analysis and Report
- N. Section 26 24 19: Low-Voltage Motor Control Centers
- O. Section 26 28 00: Low-Voltage Circuit-Protective Devices

1.3 System Description

- A. Prepare power system analysis of short-circuit calculations, protective device coordination study and harmonic analysis.
 - 1. Studies shall include all portions of electrical distribution system for normal, standby, and emergency power sources down to and including (120/240VAC) distribution system.
 - a. Include, if present, battery systems with storage capacity ?1kWh or float voltage >100VAC
 - b. Extend short-circuit and coordination studies to include branch-circuit overcurrent protective devices for safety class systems, safety significant systems, and emergency systems (NEC Article 700) if present
 - 2. Include protection studies for motors supplied with solid state overload and overcurrent protection devices.
 - 3. Include evaluation of harmonic distortion and furnishing and installation of filters and equipment required for harmonic suppression.
 - 4. Replace equipment and devices that do not function.

1.4 **Quality Assurance**

- A. Short circuit studies, protective device evaluation studies, and protective device coordination studies shall be performed by low voltage switchgear Manufacturer or by electrical testing service regularly engaged in short circuit and protective device coordination studies for ≥ 10 years.
 - 1. Studies shall be signed by California-registered professional electrical engineer responsible for studies.
 - 2. Perform coordination study using Owner-accepted computer software program.
 - 3. Software shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

- a. Computer software program shall report device settings and ratings of overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
- 4. Software shall perform sequence of operation that evaluates, verifies, and confirms operation and selectivity of protective devices for various types of faults directly from 1-line diagram and via normalized time current characteristic curve views.
- B. Upon Owner's acceptance of Overcurrent Protective Coordination Study and Arc Flash Hazard Analysis, adjust protective device settings based on study recommendations.

1.5 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - 1. ANSI/IEEE C2 National Electrical Safety Code
 - 2. ANSI/IEEE C57.109 Guide for Transformer Through-Fault-Current Duration
 - 3. ANSI/IEEE 141 Electrical Power Distribution for Industrial Plants
 - 4. ANSI/IEEE 242 Protection and Coordination of Industrial and Commercial Power Systems.
 - 5. ANSI C37.010 Standard Application Guide for AC High-Voltage Circuit Breakers
 - 6. ANSI C37.5 Calculations of Fault Currents for Application of Power Circuit Breakers
 - 7. ANSI C37.13 Low-Voltage AC Power Circuit Breaker (600-Volt Insulation Class)
 - 8. ANSI Z244-1 Personnel Protection
 - California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 10. California Electrical Code (CEC)
 - 11. City, County and District Electrical Codes.
 - 12. IEEE 112 Test Procedure for Polyphase Induction Motors and Generators
 - 13. IEEE 241 Electric Power Systems in Commercial Buildings
 - 14. IEEE 242 Protection and Coordination of Industrial and Commercial Power Systems
 - 15. IEEE 399 Industrial and Commercial Power Systems Analysis (Brown Book)
 - 16. IEEE 519 Harmonic Control in Electrical Power Systems
 - 17. National Electrical Manufacturers Association (NEMA) Standards.
 - 18. National Electrical Safety Code.
 - 19. NECA Standard of Installation
 - 20. NETA ATS Acceptance Testing Specifications for Electrical Power Equipment and Systems
 - 21. NFPA 70 National Electric Code (NEC)
 - 22. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance (ANSI)
 - 23. NFPA 70E Electrical Safety Requirements for Employer Workplaces
 - 24. NFPA 78 Lighting Protection Code
 - 25. NFPA 101 Life Safety Code
 - 26. NEMA MG1 Motors and Generators.
 - 27. OSHA CFR 1910 Occupational Safety and Health Standards
 - 28. OSHA CFR 1926 Occupational Safety and Health Standards
 - 29. Public Utilities Service Requirements.
 - 30. Underwriter's Laboratories Inc.(UL) Standards.

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	SUBMITTAL DESCRIPTION					
	QUALITY ASSURANCE AND CONTROL SUBMITTALS					
Overcurrent Protection	Refer to description below.					
Fault Study	Submit paper copy plus copy on CD ROM or flash drive					
Coordination Study	Refer to description below.					
	Submit paper copy plus copy on CD ROM or flash drive					
Harmonic Evaluation	Refer to description below.					
	Submit paper copy plus copy on CD ROM or flash drive					
Load Flow Study	Refer to description below.					
	Submit paper copy plus copy on CD ROM or flash drive					
Stability Study	Refer to description below.					
	Submit paper copy plus copy on CD ROM or flash drive					

B. Conform to NETA ATS and referenced codes and standards for power system study

requirements.

- C. Submit power system analysis before receiving final acceptance of distribution equipment Shop Drawings and/or release of equipment for manufacture.
 - 1. Acceptance from Owner's Representative may be obtained for preliminary submittal of sufficient detail to ensure device selection will be adequate.
 - 2. Preliminary submittal shall show computer program used in performing Work of this Section.
- D. Submit study results for solid state motor protective device types and settings before loading motor.
- E. Base final settings of protective device on results of power system analysis accepted by Owner's Representative prior to project acceptance.
- F. Indicate in submittal, changes to protection scheme or equipment selection that will result in improved system reliability and safety.
- G. Overcurrent Protection Fault Study prepared by California-licensed engineer shall cover transformers, relays, fuses, circuit breakers, busses, cables and other overcurrent protection:
 - 1. Software used for study shall generate fault current report including device duty evaluation described in ANSI/IEEE C37.5.
 - Conform to procedures described in IEEE 399.
 - Calculations verifying interrupting ratings of overcurrent protective devices shall conform to IEEE141, IEEE 241 and IEEE 242
 - 4. Perform field Work needed to obtain data on existing relays, circuit breakers, fuses, and transformers included in coordination study.
 - a. Obtain required relay, fuse, and circuit breaker coordination curves; transformer damage curves; motor data; etc., for new and existing electrical equipment.
 - b. Coordinate with Electrical Utility to obtain required protective device curves.
 - c. Obtain written data from Electrical Utility regarding maximum available short circuit current, voltage, and X/R ratio of utility' power system
 - d. Include motor starting profiles for motors \geq 50-hp.
 - e. Base study on final electrical equipment submittals and final pulled conductor lengths for feeders.
 - f. Include transformer damage curves and protection evaluated in accordance with ANSI/IEEE C57.109.
 - 5. Study shall estimate worst-case available short-circuit current values for entire electrical distribution system from normal and alternate power sources.
 - a. Proceed from smallest 480VAC, 3φ, 60-Hz circuit protective device on load end, to nearest protective device on Electrical Utility's line side, and to nearest protective device on Owner's distribution system.
 - b. Include studies of system- switching configurations and alternate operation configurations that could result in maximum fault conditions
 - Calculate momentary and interrupting duties based on maximum available short circuit current in RMS symmetrical amps at circuit-breaker positions throughout electrical power distribution system.
 - 7. At minimum, calculate short-circuit momentary and interrupting duty on basis of maximum available fault current at each bus in distribution system down to the following points in low-voltage system:
 - a. 480VAC system where available short circuit current < 14,000 amps RMS symmetrical.
 - b. 208VAC or 240VAC system where available short circuit current < 10,000 amps RMS symmetrical.
 - 8. Calculation shall be for current immediately after initiation and for 3φ bolted short circuit
 - a. Electric utility's supply termination point
 - b. Incoming switchgear
 - c. Standby generators and automatic transfer switches

- d. Branch circuit panelboards
- e. Switchgear, switchboards, busways, bus ducts
- f. Distribution panelboard
- 9. Produce tabulation of protective relay and circuit breaker trip settings and recommended fuse sizes and types.
- 10. Fault Study report shall include:
 - a. Summary of input data
 - b. Calculated X/R ratios and equipment interrupting rating (½-cycle) fault currents on electrical distribution system diagram.
 - c. Calculation methods and assumptions including adjustments used when considering resistance and impedance tolerances.
 - d. One-line diagram of system being evaluated with available fault at each bus
 - e. Results, conclusions, and recommendations
- H. Overcurrent Protection Coordination Study prepared by California-licensed engineer shall provide necessary calculations required to select or check selection of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low-voltage breaker trip characteristics and settings.
 - 1. Use data collected for Fault Study to perform Coordination Study.
 - 2. At minimum, include in coordination study all voltage classes of equipment from utility incoming line protective device(s) down to and including each low voltage load protective rated ≥100A.
 - 3. Prepare written report using results of fault-current study.
 - a. Conform to procedures described in IEEE 399.
 - b. Calculate maximum and minimum ½-cycle short circuit currents
 - c. Calculate maximum and minimum interrupting duty (5 cycles to 2 seconds) short circuit currents
 - d. Calculate maximum and minimum ground fault currents
 - e. Protect transformers against damage from through fault currents according to ANSI C57.109, IEEE C57.12.00, IEEE 242
 - f. Evaluate low-voltage circuit breakers per IEEE 1015 and IEEE C37.20.1
 - 4. Computer-generated overcurrent protection coordination study report shall include:
 - a. Device tags
 - b. Current transformer ratios, and tap, time-dial, and instantaneous-pickup values
 - c. Circuit breaker sensor ratings, and long-time, short-time, and instantaneous settings
 - d. Fuse current ratings and types
 - e. Ground fault relay-pickups and time-delay settings
 - 5. Time/current coordination curves prepared to determine settings of overcurrent protective devices to achieve selective coordination shall include the following on 5-cycle log-log graph paper:
 - a. Device tags
 - b. Time/current curves for each protective relay or fuse showing graphically that settings will provide protection and selectivity within industry standards.
 - c. Identify each curve, and specify tap and time dial settings.
 - d. Show voltage and current ratios for curves.
 - e. Position time/current curves for each device to maximize selectivity and minimize system disturbances during fault clearing.
 - f. Time/current curves and points for cable and equipment damage.
 - g. Circuit interrupting device operating and interrupting times.
 - h. Melting and clearing curves for fuses
 - i. Maximum fault-current cutoff points
 - j. Show maximum fault values on graph.
 - k. Sketch of bus and breaker arrangement.
 - I. Magnetizing inrush points of transformers.
 - m. 3\psi and 1\psi damage points for transformers
 - n. Adhere to restrictions of ANSI and LAEC and maintain proper coordination intervals and separation of characteristics curves.

- o. Graphically demonstrate adequate time separation exists between devices installed in series, including power utility company's upstream devices.
- p. Prepare separate sets of curves for switching schemes and for emergency periods where power source is local generation.
- 6. Provide computer-generated data sheet reports for overcurrent protective device settings.
- 7. Results of study shall govern final selection of protective devices.
- I. Bind Fault Study and Coordination Studies into standard 8½" by 11" report.
 - 1. Report shall include:
 - a. Single-line diagram of power system
 - b. Impedance diagram of power system, including resistances and reactances of cables.
 - c. Computerized fault current calculations
 - d. Tabulation of protective devices, which shall be identified on single-line diagram, and recommended settings.
 - e. Time/current coordination curves
 - f. Specific recommendations, if any
 - g. Test instrumentation, condition and connections, as applicable, for each study
- J. Prepare harmonic evaluation of distribution system, at all voltage levels indicating harmonic currents anticipated at each voltage level.
 - 1. Conform to procedures described in IEEE 399
 - 2. Submit report of findings.
 - a. Report shall show sources of harmonic currents, voltages, and line notching of all equipment.
 - b. Report shall state tolerance of sensitive equipment to harmonics.
 - c. Measure harmonics present in output of harmonic-generating equipment and at input terminals of sensitive equipment.
 - d. Install filters to prevent equipment malfunction, due to harmonics.
 - e. Perform and document harmonic measurements after filter installations.
 - f. Measure equipment required to conform to IEEE 519 to determine output harmonic content.
 - g. Take corrective action necessary to attain compliance with IEEE 519 tables.
 - h. Perform measurements and documentation to demonstrate compliance with standards.
- K. Submit studies for harmonic current, voltage and line notching test results prior to acceptance testing of project and subsequent to installation of harmonic generating and harmonicsensitive equipment.
- L. Prepare load flow study.
 - 1. Conform to procedures described in IEEE 399
- M. Prepare stability study.
 - 1. Conform to procedures described in IEEE 399
- N. Where overload protection as phase overcurrent for motors is specified to be solid-state protective modules, adjust modules with respect to actual installed motor torque, current and thermal characteristics so best possible motor protection results.
 - Submit protective settings and receive acceptance before respective motors are run under load.
- O. Final selection of protective device settings or sizes shall be subject to review and acceptance by Owner.

1.7 Project Site Conditions

A. Refer to Section 01 10 01 for full list of project site conditions.

1.8 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for short circuit and coordination report.

PART 2 - PRODUCTS

2.1 Acceptable Testing Firms

A. Refer to Section 26 08 00 for requirements for acceptable testing firms for short circuit and coordination report.

PART 3 - EXECUTION

3.1 Field Quality Control

- A. Promptly bring problem areas or inadequacies in equipment due to prospective short-circuit currents to Owner's Representative's attention.
- B. Provide services of qualified field engineer and necessary tools and equipment to test, calibrate, and adjust protective relays and circuit breaker trip devices as recommended in power system analysis.
- C. The following testing standards shall be followed:
 - 1. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 2. Other applicable OSHA and Cal OSHA regulations
 - 3. California Electrical Code
 - 4. Manufacturer's installation and warranty requirements
 - 5. NETA (National Electrical Testing Association) standards
 - 6. Other applicable ANSI, ASTM, and NEMA standards.
- D. Refer variances between above documents and Contract Documents to Owner's Representative.

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SECTION 26 08 16

ARC-FLASH HAZARD ANALYSIS AND REPORT

PART 1 – GENERAL

1.1 Work Included

- A. Arc-flash hazard analysis and report for electrical Work.
- B. Refer to Section 26 08 00 for requirements for commissioning electrical systems.

1.2 Related Work

- A. Section 01 10 01: Summary of Work and Sequence of Construction
- B. Section 01 22 00: Unit Prices
- C. Section 01 33 00: Submittal Procedures
- D. Section 01 35 26: Governmental Safety Requirements
- E. Section 01 40 00: Quality Requirements
- F. Section 01 61 00: Common Product Requirements
- G. Section 01 65 00: Product Delivery Requirements
- H. Section 01 66 00: Product Storage and Handling Requirements
- I. Section 01 73 00: Execution
- J. Section 01 79 00: Demonstration and Training
- K. Section 26 05 10: Common Work Results for Electrical
- L. Section 26 08 00: Commissioning of Electrical Systems
- M. Section 26 08 13: Short-Circuit and Coordination Report
- N. Section 26 24 19: Low-Voltage Motor Control Centers
- O. Section 26 28 00: Low-Voltage Circuit-Protective Devices

1.3 System Description

A. Prepare arc flash hazard analysis and report.

1.4 Quality Assurance

A. Arc-flash hazard analysis and report shall be prepared in accordance with IEEE 1584 and signed by California-registered professional electrical engineer.

1.5 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - 1. ANSI/IEEE C2 National Electrical Safety Code
 - 2. ANSI Z244-1 Personnel Protection
 - California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 4. California Electrical Code (CEC)
 - 5. City, County and District Electrical Codes.
 - 6. IEEE 1584 Performing Arc-Flash Hazard Calculations
 - 7. National Electrical Manufacturers Association (NEMA) Standards.
 - 8. National Electrical Safety Code.
 - 9. NECA Standard of Installation
 - 10. NETA Acceptance Testing Specifications for Electrical Power Equipment and Systems
 - 11. NFPA 70 National Electric Code (NEC)
 - 12. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance (ANSI)
 - 13. NFPA 70E Electrical Safety Requirements for Employer Workplaces
 - 14. NFPA 78 Lighting Protection Code
 - 15. NFPA 101 Life Safety Code
 - 16. OSHA CFR 1910 Occupational Safety and Health Standards
 - 17. OSHA CFR 1926 Occupational Safety and Health Standards
 - 18. Public Utilities Service Requirements.
 - 19. Underwriter's Laboratories Inc.(UL) Standards.

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
QUALITY ASSURANCE AND CONTROL SUBMITTALS		
Arc Flash Hazard	Refer to description below.	
Analysis and Report	Submit paper copy plus copy on CD ROM or flash drive.	

- B. Arc Flash Hazard Analysis and report prepared by California-licensed electrical engineer shall cover switchgear, motor control center, panel boards and control panels, demonstrating constructed facility meets applicable electrical and worker safety standards for new installations (OSHA 29 CFR 1910, NEC, NFPA 70E).
 - 1. Perform flash hazard analysis calculations using NFPA 70E or IEEE 1584 calculation formulas.
 - 2. Detail in report, for each component/equipment:
 - a. Flash Protection Boundary (FPB) for warning labels (orange<40cal/cm²) or danger labels (red ≥40cal/cm²) for each piece of newly installed electrical equipment per ANSI/NEMA Z535.4.
 - b. Fault current fault flowing
 - c. Time for fault protective device to clear fault
 - d. Arc flash energy (cal/cm²)
 - e. Level of Personnel Protective Equipment (PPE) required to work within FPB
 - f. Copy of arc flash red warning label required by NEC 110.16.
 - g. Summary of input data used for analysis
 - 3. Provide Flash Hazard Analysis report in standard 8½" by 11" report.
 - 4. Install warning and danger labels and obtain written acceptance of report from Owner prior to energizing equipment.

1.7 Project Site Conditions

A. Refer to Section 01 10 01 for full list of project site conditions.

1.8 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for arc-flash hazard analysis and report.

PART 2 - PRODUCTS

2.1 Acceptable Testing Firms

A. Refer to Section 26 08 00 for requirements for acceptable testing firms for arc-flash hazard analysis and report.

PART 3 - EXECUTION

3.1 Field Quality Control

- A. Promptly bring problem areas or inadequacies in equipment due to prospective short-circuit currents to Owner's Representative's attention.
- B. Provide services of qualified field engineer and necessary tools and equipment to test, calibrate, and adjust protective relays and circuit breaker trip devices as recommended in power system analysis.
- C. The following testing standards shall be followed:
 - 1. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 2. Other applicable OSHA and Cal OSHA regulations
 - 3. California Electrical Code
 - 4. Manufacturer's installation and warranty requirements
 - 5. NETA (National Electrical Testing Association) standards

- 6. Other applicable ANSI, ASTM, and NEMA standards.
- D. Refer variances between above documents and Contract Documents to Owner's Representative.
- E. Perform arc-flash hazard analysis and shock hazard analyses based on final short-circuit study and final coordination study.
 - 1. Use procedures outlined in IEEE Std 1584 and NFPA 70E.
- F. Provide the following information in tabular form for arc-flash warning labels described in Section 26 05 10.
 - 1. Equipment name and ID code based on Drawings
 - 2. Flash hazard protection boundary (inches)
 - a. Calculate in accordance with IEEE Std 1584 or NFPA 70E.
 - 3. Arc-flash incident energy at 18" (cal/cm2),
 - a. Calculate in accordance with IEEE Std 1584 or NFPA 70E.
 - 4. Required personnel protective equipment (PPE) category including class rating for insulating gloves based on system voltage (eq Class 00 for up to 500 volts).
 - 5. Working distance (inches)
 - a. Select from IEEE Std 1584 or NFPA 70E (Annex D) based on equipment type.
 - 6. Hazard/risk category number
 - a. Select from NFPA 70E Table 130.7(C)(9) for operations with doors
 - 7. System phase-to-phase voltage
 - 8. Condition that exposes worker to electrical shock hazard
 - 9. Limited Shock Approach Boundary
 - a. Select from NFPA 70E Table 130.2(C) based on nominal system phase-to-phase voltage.
 - 10. Restricted Shock Approach Boundary
 - Select from NFPA 70E Table 130.2(C) based on nominal system phase-to-phase voltage.
 - 11. Prohibited Shock Approach Boundary
 - a. Select from NFPA 70E Table 130.2(C) based on nominal system phase-to-phase voltage.
 - 12. Name and address of supplier
 - 13. Voltage rating for insulated or insulating tools based on system voltage (eg 1000VAC).
 - 14. Date hazard analysis was performed.
 - 15. "Served from" circuit directory information including serving equipment ID code, location (eq room number), circuit number, and circuit voltage/phases/wires.
 - 16. If applicable, "serves" circuit directory information including served equipment ID code, location (*eg* room number), circuit number, and circuit voltage/phases/wires.

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SECTION 26 22 00

LOW VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 Work Included

 A. Materials, testing, and installation of ventilated low voltage (600VAC and less) dry-type transformers.

B. Transformers specified in this section include:

ITEM	DESCRIPTION	PRIMARY VOLTAGE	SECONDARY VOLTAGE	SECONDARY AMPERAGE	KVA
PL1	Control and Lighting Transformer	480VAC	120VAC	200A	400VA

1.2 Related Work

- A. Section 01 10 01: Summary of Work and Sequence of Construction
- B. Section 01 22 00: Unit Prices
- C. Section 01 33 00: Submittal Procedures
- D. Section 01 40 00: Quality Requirements
- E. Section 01 61 00: Common Product Requirements
- F. Section 01 65 00: Product Delivery Requirements
- G. Section 01 66 00: Product Storage and Handling Requirements
- H. Section 01 73 00: Execution
- I. Section 01 73 24: Seismic Restraint
- J. Section 05 05 19: Post-Installed Concrete Anchors
- K. Section 09 90 00: Painting and Coating
- L. Section 26 05 10: Common Work Results for Electrical
- M. Section 26 08 00: Commissioning of Electrical Systems
- N. Section 26 29 14: Low-Voltage Motor Control Centers

1.3 System Description

A. Furnish and install complete operating low voltage transformer including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.

1.4 Quality Assurance

A. Use adequate number of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.

1.5 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - 1. ANSI C89.2/NEMA ST20 Dry-Type Transformers for General Applications
 - 2. ANSI Z55.1 Gray Finishes for Industrial Apparatus and Equipment
 - 3. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety OrdersCalifornia Building Code (CBC)
 - 4. California Electrical Code (CEC)
 - 5. California Fire Code (CFC)
 - 6. IEEE C57.12.50 Ventilated Dry-Type Distribution Transformers, 1 to 500 kVA, Single-Phase, and 15 to 500 kVA, Three-Phase, with High-Voltage 601 to 34 500 Volts, Low-Voltage 120 to 600 VoltsNEMA/ANSI 250 Enclosures for Electrical Equipment
 - 7. NEMA ST1 Specialty Transformers
 - 8. NEMA ST20 Dry-Type Transformers for General Applications
 - 9. NEMA TP-1 Guide for Determining Energy Efficiency for Dry-Type Transformers

- 10. NETA ATS Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems
- 11. NFPA 70 National Electric Code (NEC)
- 12. UL 506 Transformers

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION				
DRAWINGS					
Shop Drawings	Submit for transformers under electrically controlled equipment Shop Drawing requirements.				
	Show outline dimensions, weights, location and size of conduit terminations,				
	wiring diagrams, and mounting provisions.				
	Show catalog designations				
	Submit ratings and characteristics including				
	Primary and secondary voltage,				
	2. Phases,				
	3. Connections,				
	4. Enclosure type				
	5. Dimensions				
	6. Conduit entry restrictions.				
	MANUFACTURER'S LITERATURE				
Product Data	Submit current transformer data sheets per Product Data requirements.				
Installation Instructions	Submit per Installation Instruction requirements.				
	QUALITY ASSURANCE AND CONTROL SUBMITTALS				
Certificate of Compliance	Submit coating system and application certification per Certificate of				
	Compliance requirements.				
Test Record Transcripts	Submit for factory tests per Test Record Transcript requirements.				
	CLOSEOUT SUBMITTALS				
O & M Instructions	Submit per Operation and Maintenance Instruction requirements				
Warranty	Furnish 1-year warranty from date of final acceptance				

B. Refer to Section 01 33 00 for definition of requirements for Shop Drawings, Product Data, Installation Instructions, O&M Instructions, Certificates of Compliance, Test record transcripts, and material samples.

1.7 Delivery, Storage, and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Strictly follow Manufacturer's instructions and warranty requirements for delivery, storage, and handling of low voltage transformers.
- C. At time of delivery, inspect transformer exterior for damage or defects.
 - 1. Repair damage and retest, using original factory test procedures and parts.

1.8 Project Site Conditions

A. Refer to Section 01 10 01 for full list of project site conditions.

1.9 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for low-voltage transformers.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Dry Type Control	Eaton Cutler Hammer	Cleveland, OH (800) 386-1911
Transformers	General Electric Company	Fairfield, CT (800) 626-2000
	Schneider Electric Square D Class 9070 Type T	Andover, MA (888) 778-2733

ITEM	MANUFACTURER	MANUFACTURER LOCATION
	Accepted equal	

- B. Equipment furnished shall operate through its full operating range powered by amperages specified or shown on Plans.
 - 1. Equipment requiring more amperage than specified or shown is unacceptable in absence of written statement from Owner electrical infrastructure and switchgear can support increased amperage.

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Transformers shall be UL-listed where listing applies.
- C. Materials for low-voltage transformers shall be:

ITEM	MATERIAL	SPECIFICATION
Windings	Copper	

D. The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION	
Туре		Provide energy efficient Type TP1
UL Listing		Required wherever UL listing applies
Transformer Rating	kVA	Refer to Plans
_		Size to accommodate required control power, remote
		loads, plus additional 200VA for remote devices and future
		use
	Primary Voltage	480VAC secondary 3Φ 60Hz
	Secondary Voltage	120VAC secondary 1Φ 60Hz
	Life Expectancy	Normal life expectancy at rated kVA as defined in NEMA ST20
Overcurrent Protection	Primary Protection	Thermal magnetic circuit breaker
	Secondary Fuses	Fuse 1 side of secondary winding and ground other side.
Enclosures	Indoor Transformers	General-purpose dry-type
	Outdoor Transformers rated	Sand-and-resin-encapsulated with totally enclosed non-
	≤25kVA	ventilated enclosures of class equal to temperature rise
		Embed in resin and filler system to attenuate sound level.
	Outdoor Transformers rated >25kVA	Ventilated with NEMA2 enclosure and weather shield
Sound Levels	Rating (kVA)	Average Sound Level (dB) per NEMA ST20
	0-9	≤40dBA
	10-50	≤45dBA
	51-150	≤50dBA
	151-300	≤55dBA
	301-500	≤60dBA
	Furnish transformers with sou prevent sound amplification.	and levels >50dBA with resilient vibration-isolating mounts to
Single-Phase Transformers		and levels >50dBA with resilient vibration-isolating mounts to Core and coil, 2-winding, self-cooled dry type
Single-Phase Transformers	prevent sound amplification.	•
Single-Phase Transformers Single-Phase Dry-Type	prevent sound amplification. Type	Core and coil, 2-winding, self-cooled dry type
•	prevent sound amplification. Type Rating	Core and coil, 2-winding, self-cooled dry type Continuous operation in at 40°C (104°F) Construct per ANSI C898.2 and NEMA ST20 Listed per UL506
Single-Phase Dry-Type	prevent sound amplification. Type Rating	Core and coil, 2-winding, self-cooled dry type Continuous operation in at 40°C (104°F) Construct per ANSI C898.2 and NEMA ST20
Single-Phase Dry-Type Transformers 2kVA and	prevent sound amplification. Type Rating Construction	Core and coil, 2-winding, self-cooled dry type Continuous operation in at 40°C (104°F) Construct per ANSI C898.2 and NEMA ST20 Listed per UL506 Design for 180°C with Class B 80°C rise Provide electromagnetic shielding
Single-Phase Dry-Type Transformers 2kVA and below Single-Phase Dry-Type	prevent sound amplification. Type Rating Construction Insulation	Core and coil, 2-winding, self-cooled dry type Continuous operation in at 40°C (104°F) Construct per ANSI C898.2 and NEMA ST20 Listed per UL506 Design for 180°C with Class B 80°C rise
Single-Phase Dry-Type Transformers 2kVA and below	prevent sound amplification. Type Rating Construction Insulation Shielding	Core and coil, 2-winding, self-cooled dry type Continuous operation in at 40°C (104°F) Construct per ANSI C898.2 and NEMA ST20 Listed per UL506 Design for 180°C with Class B 80°C rise Provide electromagnetic shielding
Single-Phase Dry-Type Transformers 2kVA and below Single-Phase Dry-Type	prevent sound amplification. Type Rating Construction Insulation Shielding Construction Maximum Coil Hot-Spot	Core and coil, 2-winding, self-cooled dry type Continuous operation in at 40°C (104°F) Construct per ANSI C898.2 and NEMA ST20 Listed per UL506 Design for 180°C with Class B 80°C rise Provide electromagnetic shielding Construct per ANSI C898.2 and NEMA ST20
Single-Phase Dry-Type Transformers 2kVA and below Single-Phase Dry-Type	prevent sound amplification. Type Rating Construction Insulation Shielding Construction Maximum Coil Hot-Spot Temperature	Core and coil, 2-winding, self-cooled dry type Continuous operation in at 40°C (104°F) Construct per ANSI C898.2 and NEMA ST20 Listed per UL506 Design for 180°C with Class B 80°C rise Provide electromagnetic shielding Construct per ANSI C898.2 and NEMA ST20 Listed per UL506 ≤ 185°C
Single-Phase Dry-Type Transformers 2kVA and below Single-Phase Dry-Type	prevent sound amplification. Type Rating Construction Insulation Shielding Construction Maximum Coil Hot-Spot	Core and coil, 2-winding, self-cooled dry type Continuous operation in at 40°C (104°F) Construct per ANSI C898.2 and NEMA ST20 Listed per UL506 Design for 180°C with Class B 80°C rise Provide electromagnetic shielding Construct per ANSI C898.2 and NEMA ST20 Listed per UL506
Single-Phase Dry-Type Transformers 2kVA and below Single-Phase Dry-Type	prevent sound amplification. Type Rating Construction Insulation Shielding Construction Maximum Coil Hot-Spot Temperature	Core and coil, 2-winding, self-cooled dry type Continuous operation in at 40°C (104°F) Construct per ANSI C898.2 and NEMA ST20 Listed per UL506 Design for 180°C with Class B 80°C rise Provide electromagnetic shielding Construct per ANSI C898.2 and NEMA ST20 Listed per UL506 ≤ 185°C

ITEM		DESCRIPTION
Transformers 5-25kVA		Listed per UL506 Provide two 2½% FCBN and two 2½% FCAN taps on primary side Encapsulate core and coil in insulating resin
	Maximum Coil Hot-Spot Temperature	≤185°C
	Insulation	Design for Class F 115°C rise Rated for at least 185°C
	Shielding	Provide electromagnetic shielding
Dry-Type Transformers 25- 500kVA	Construction	Construct per ANSI C898.2 and NEMA ST20 Listed per UL506 Provide two 2½% FCBN and two 2½% FCAN taps on primary side
	Maximum Coil Hot-Spot Temperature	≤185°C
	Insulation	Design for Class F 115°C rise Rated for at least 185°C
	Shielding	Provide electromagnetic shielding

E. The following electrical design criteria are required for equipment specified in this section:

ITEM		DESCRIPTION
Electrical Work	NEC Article 505	Nonhazardous
	Classification	
Enclosures – Indoor Dry	NEMA 250 Enclosure	NEMA 12 – Industrial Use
Locations	Rating	
Enclosures – Indoor Damp	NEMA 250 Enclosure	NEMA 12 – Industrial Use
Locations	Rating	
Enclosures – Outdoor or Wet	NEMA 250 Enclosure	NEMA 4X – Watertight, Corrosion-Resistant, Stainless
Locations	Rating	steel
Transformer Mounting	MCC Control XFMR	Mount in MCC as shown
	XFMRs ≤25 kVA	Mount on walls
	XFMRs >25kVA	Mount on floor on housekeeping pads

- A. Mount transformers rated and below on walls.
- B. Mount transformers rated >25 kVA on the floor on housekeeping pads.

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install low voltage transformers before submitting shop drawings or ordering.
 - 1. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Examine areas and conditions under which Work of this section will be performed.
 - 1. Correct conditions detrimental to timely and proper completion of Work.

3.2 Installation

- C. Refer to Sections 01 73 00 and 01 73 24 for basic execution and installation requirements.
- D. Furnish and install low voltage transformers at locations shown on Plans and Submittals.
- E. Conform to the following installation standards:
 - 1. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 2. Other applicable OSHA and Cal OSHA regulations
 - 3. California Electrical Code Article 450 "Transformers and Transformer Vaults Including Secondary Ties."
 - 4. Other applicable building, fire, and electrical code requirements

- 5. NETA (National Electrical Testing Association) ATS standards
 - a. NETA ATS 7.2.1.1 for small dry-type transformers.
 - b. NETA ATS 7.2.1.2 for large dry-type transformer tests.
 - c. NETA ATS 7.10 for instrument transformers.
- 6. Manufacturer's installation and warranty requirements
- 7. Applicable ANSI standards
- F. Refer variances between above documents and Contract Documents to Owner's Representative.
- G. Install low voltage transformers to tolerances recommended by Manufacturer.
 - 1. Unless otherwise shown, install low voltage transformers true, plumb, and level using precision gauges and levels.
- H. Furnish adequate space around transformer to dissipate transformer full load heat losses by ventilation without creating excessive operating temperature.
- I. Furnish and install supports for transformers.
- J. Mount dry-type 0-600VAC primary transformers where shown.
 - 1. Load vibration isolators external to unit properly.
 - a. Provide complete isolation with no direct transformer unit metal in contact with mounting surface.
 - Connect electrical circuits to transformers using moisture-proof, flexible conduit in manner preventing transformer vibrations from being transmitted to building or equipment.
 - 3. Ground neutrals and enclosures of transformers and moisture proof flexible conduit in accordance with applicable codes and as shown.
 - 4. Connect voltage taps on transformers to approximate rated output voltage under normal plant load conditions as closely as possible.
- K. Mount dry-type shielded 0-600VAC primary isolation transformers where shown as described above for dry type transformers.
 - 1. In addition, ground isolation shields to unit enclosure with conductor of same material and at least as big as shield ground lead provided with unit.

3.3 Field Quality Control

A. Field testing shall include:

ITEM	TECT FOR	TEST STANDARD	FREQUENCY	FIRST TEST PAID	RETESTS PAID FOR
ITEM	TEST FOR	(ASTM OR OTHER TEST STANDARD)	FREQUENCY	FOR BY	BY
Low Voltage	Installation	Visual inspection of finished installation	1 inspection	Owner	Owner
Transformers	Connection	Test factory and field installed terminal	1 test each	Contractor	Contractor
	Torque	connections for Manufacturer-	connection		
		recommended torque before energizing			
		transformer.			
	Primary and	Verify voltages conform to Manufacturer's	1 test each	Contractor	Contractor
	Secondary	standards.	transformer		
	Voltages	Record phase-to-phase, phase-to-neutral,			
		and neutral-to-ground voltages at no load			
		after energizing and at operating load after			
		startup.			
		Adjust tap connection settings to provide			
		secondary voltage within 21/2%.of nominal			
		under normal load.			
		Record as-left tap connections.			
	Insulation	Measure insulation resistance from	1 test each	Contractor	Contractor
		primary and secondary windings to ground	transformer		
		and between primary and secondary.			
		Resistance shall be ≥10 megΩ.			
	Field	Demonstrate compliance to Contract	1 test	Contractor	Contractor

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
	Performance	Documents and Manufacturer's printed literature Test per NETA ATS 7.2 or 7.10 as appropriate			
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

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SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of panelboards.
- B. Refer to Section 01 73 24 for seismic restraint requirements.
- C. Refer to Section 26 28 00 for low-voltage circuit-protective devices, circuit breakers, and fuses.

1.2 Related Work

- A. Section 01 10 01: Summary of Work and Sequence of Construction
- B. Section 01 22 00: Unit Prices
- C. Section 01 33 00: Submittal Procedures
- D. Section 01 40 00: Quality Requirements
- E. Section 01 61 00: Common Product Requirements
- F. Section 01 65 00: Product Delivery Requirements
- G. Section 01 66 00: Product Storage and Handling Requirements
- H. Section 01 73 00: Execution
- I. Section 01 73 24: Seismic Restraint
- J. Section 09 90 00: Painting and Coating
- K. Section 26 05 10: Common Work Results for Electrical
- L. Section 26 05 19: Low-Voltage Electrical Power Conductors and Cables
- M. Section 26 05 47: Cabinets and Enclosures
- N. Section 26 08 00: Commissioning of Electrical Systems
- O. Section 26 24 13: Switchboards
- P. Section 26 28 00: Low-Voltage Circuit-Protective Devices

1.3 System Description

A. Furnish and install complete operating panelboard including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.

1.4 Quality Assurance

- A. Use adequate number of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Panelboards shall bear UL label.

1.5 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - 1. ANSI Z55.1 Gray Finishes for Industrial Apparatus and Equipment
 - 2. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 3. California Building Code (CBC)
 - 4. California Electrical Code (CEC)
 - 5. California Fire Code (CFC)
 - 6. NEMA/ANSI 250 Enclosures for Electrical Equipment
 - 7. NEMA ICS2 Industrial Control and Systems
 - 8. NEMA PB1 Panelboards
 - 9. NFPA 70 National Electric Code (NEC)
 - 10. UL 67 Panelboards

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION			
DRAWINGS				
Shop Drawings	Submit for panelboards under electrically controlled equipment Shop Drawing			
	requirements.			
	Show ratings and characteristics including			
	1. Voltage ratings			
	2. Bussing arrangement			
	3. Neutral bus rating			
	4. Continuous current ratings			
	5. Fault current withstand ratings			
	6. Enclosure type			
	7. Ratings and arrangement of overcurrent protective devices			
	8. Mounting provisions.			
	Conduit entry restrictions Weights of accomplises.			
	10. Weights of assemblies Submit outline dimensions.			
	Show circuit arrangements			
	MANUFACTURER'S LITERATURE	1		
Product Data	Submit per Product Data requirements.			
	Refer to Section 26 28 00 for Product Data requirements for low-voltage			
	circuit-protective devices, circuit breakers, and fuses.			
Installation Instructions	Submit per Installation Instruction requirements.			
	QUALITY ASSURANCE AND CONTROL SUBMITTALS			
Test Record Transcripts	Submit for factory tests per Test Record Transcript requirements.			
	CLOSEOUT SUBMITTALS			
O & M Instructions	Submit per Operation and Maintenance instruction requirements			
Warranty	Furnish 1-year warranty from date of final acceptance			

B. Refer to Section 01 33 00 for definition of requirements for Shop Drawings, Product Data, Installation Instructions, O&M Instructions, and Test Record Transcripts.

1.7 <u>Delivery, Storage, and Handling</u>

- A. Refer to Section 01 61 00 / for basic requirements for delivery, storage, and handling of products and materials.
- B. Strictly follow Manufacturer's instructions and warranty requirements for delivery, storage, and handling of panelboards.

1.8 **Project Site Conditions**

A. Refer to Section 01 10 01 for full list of project site conditions.

1.9 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for panelboards.

PART 2 - PRODUCTS

2.1 <u>Acceptable Manufacturers</u>

A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Panelboards	Allen-Bradley / Rockwell Automation	Milwaukee, WI (414) 382-2000
	Eaton Cutler Hammer	Cleveland, OH (800) 386-1911
	General Electric Company	Fairfield, CT (800) 626-2000
	Schneider Electric Square D (Type NQOD, NF, or I-Line)	Andover, MA (888) 778-2733
	Siemens USA	Washington, DC (800) 743-6367
	Accepted equal	

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- B. Equipment furnished shall operate through its full operating range powered by amperages specified or shown on Plans.
 - 1. Equipment requiring more amperage than specified or shown is unacceptable absent written statement from Owner electrical infrastructure and switchgear can support increased amperage.

2.2 Materials

A. Refer to Section 01 61 00 for basic requirements for products and materials.

B. Materials for panelboards shall be:

ITEM	MATERIAL	SPECIFICATION
Panel Interiors		Factory-assembled.
		Provide space for future circuit breakers behind easily removable front cover.
		Design shall permit circuit breakers to be replaced without disturbing adjacent circuit breakers or removing main bus.
		Bolt together and rigidly support bus bars and connection straps on molded insulators.
Main and Neutral Bus	Silver-Plated Copper	Full-sized throughout length.
Bars		Insulated neutral shall be rated same as phase bus bars
		Provide for future circuit breaker mounting throughout full bus length.
		Provide machining, drilling, or tapping required to add or change circuit breakers in future.
Ground Bus Bar	Copper	Provide at least 1 terminal screw for each branch circuit.
		Mount to panelboard frame and bond to box.
Connections and Cross	Silver-Plated Copper	Provide solderless lugs and connection points on phase, neutral, and
Connections		ground bus bars.
		Provide sub-feed or thru-feed lugs where shown.
Circuit Breakers		Refer to Section 26 28 00.

C. The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION	
Panelboards (including	Design Standard	Conform to NEMA PB1 and UL 67
those used in motor		Conform to NEC Article 408
control centers)	Туре	Dead front
		Safety type
		Circuit-breaker type
		Suitable for use with 75°C wire at full NEC 75°C ampacity
	Voltage Ratings	As shown on panelboard schedule
	RMS Symmetrical	65,000A
	Short-Circuit Current	
	Rating at	
	208Y/120VAC or	
	120/240VAC	
	RMS Symmetrical	50,000A
	Short-Circuit Current	
	Rating at 480Y/277VAC	
	1001,011111	Where used as convice entrance provide panels III labeled for that
	UL Listing	Where used as service entrance provide panels UL labeled for that use.
		Furnish panels with fully rated short-circuit equipment rating.
		Series-connected equipment ratings are not acceptable.
Panel Interiors	Bus Bars	Provide ground bus bar installed on panelboard frame, bonded to
		box and containing ≥10 terminal screws.
		Provide full-size neutral bars including field-mounted bonding
		jumpers in panelboards connected to 3φ 4-wire service or 1φ 3-wire
		service.
		Phase bussing shall be full-height without reduction.
	Bus Bracing	Provide main bus-bracing for each panelboard adequate for
		symmetrical short-circuit current that will be available at terminals as
		shown.

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ITEM	DESCRIPTION	
	Terminal Blocks	Provide in panel for connecting panel-mounted devices to field wires. Do not terminate field wires directly on panel-mounted devices.
	Terminal Lugs	Provide terminal lugs prevented from turning per NEMA PB1.
	_	Lugs shall be compatible with conductor material and size.
	Breaker Connections to Bus	Bolted type
	Neutral Bussing	Provide with suitable lug for each outgoing feeder requiring neutral connection.
	Grounding Bus	Provide equipment grounding bus bonded to enclosure.
	Branch Circuitry	Arrange using double-row construction.
		Number and arrange branch circuits as shown.
		Design interiors so circuit breakers can be replaced without
		disturbing adjacent units and without removing main bus connectors,
		and so circuits may be changed without machining, drilling, or
	D 114# 1	tapping.
	Panel Wiring	Conform to Section 26 05 19.
	"Space Only"	Where "Space Only" is noted on Plans, provide connectors and mounting brackets for future insertion of overcurrent device of size indicated.
	Directories	Typed or computer-printed circuit directories on inside face of panel door.
		Do not provide handwritten directories. Show the following:
		Panelboard name designation
		Panelboard voltage rating
		Panelboard ampere rating
		Panelboard short-circuit rating
		Panelboard pole/circuit numbers and branch circuit descriptions as field-wired
		6. Show 2-pole and 3-pole circuit breakers.
		7. Label "spare" circuit breakers.
		Indicate load in Watts for each circuit
Nameplates		Refer to Section 26 05 10.
		Engrave identifying nomenclature, voltage and phase of panel as shown on Plans <i>eg</i> : "PANEL A, 120/240VAC, 1φ, 3-wire, 100A bus"

D. The following electrical design criteria are required for equipment specified in this section:

ITEM	DESCRIPTION	
Electrical Work	NEC Article 505	Nonhazardous
	Classification	
Enclosures – Indoor Dry	NEMA 250 Enclosure	NEMA 12 – Industrial Use
Locations	Rating	
Enclosures – Indoor	NEMA 250 Enclosure	NEMA 12 – Industrial Use
Damp Locations	Rating	
Enclosures – Outdoor or	NEMA 250 Enclosure	NEMA 4X – Watertight, Corrosion-Resistant, Stainless steel
Wet Locations	Rating	
Enclosures	Construction	Refer to Section 26 05 47
		MCC Mounted
		Bolt 1 or more vertical sections together to form rigid free-standing
		assembly.
		Design to allow adding future sections at either end and to permit
		interchanging units.
		Provide internal mounting angles continuous within shipping block
		Provide removable steel lifting angle on shipping blocks
	Dimensions	Provide sufficient width and depth to accommodate conduits
		required.
		Provide ≥2" between terminal blocks and wireways
		Provide wiring gutter space on both sides and top and bottom of ≥4"x4"
	Panel Front Trim	Same as box for surface-mounted panelboards.

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ITEM		DESCRIPTION
		Provide ¾" lip all around box for flush-mount panelboards Finish non-stainless sheet steel fronts with prime coat of rust inhibitor and Manufacturer's standard baked enamel or lacquer finish. Use adjustable clamps to secure front to boxes.
	Panel Door (Cover)	Door-in-door-type construction, 1 door over interior and 1 exposing wiring gutter. Provide concealed hinges.
	Directory	Provide interior directory metal frame, transparent plastic cover and enclosed directory card on backside of door.
	Latching Assembly	Provide flush-type lock and latch device. On NEMA 1 cabinets ≥48"-high or doors ≥30"-high, provide 3-point lockable latch assembly latching at top, bottom and middle of door Key doors alike and furnish 2 milled-type keys per lock.
	IEC 60529 Enclosure Rating for Underground Equipment	IP 65 water jet
	Dead Front	Dead front design
	Nameplates	Refer to Section 26 05 10. Provide on each compartment. Engrave with inscriptions shown on Contract Document single-line diagram Provide 6.25" x 2" door-mounted nameplate showing system Short-Circuit Current Rating (SCCR)
		Provide warning nameplate on each starter to warn operator to open circuit breaker before performing maintenance.
	Exterior Finish	For steel provide rust-inhibiting primer and then Manufacturer's factory-baked enamel Refer to Section 09 90 00 Color ANSI 61 Light Gray. Plate unpainted parts for corrosion resistance For stainless steel, do not paint. Grind door front smooth For plastic or FRP, do not paint.
	Interior Finish	For steel provide rust-inhibiting primer and then Manufacturer's factory-baked enamel on interior panels and directory frame print pockets. Refer to Section 09 90 00 Color ANSI 61 Light Gray For stainless steel, do not paint. For plastic or FRP, do not paint.
Power Supply	Lighting and Utility Circuits	120VAC – 1φ – 60Hz
	Battery Backup	Required

E. Mount components inside panels as follows:

- 1. Mount components, except those on front panels, behind on fixed or swing-out panels;
- 2. Mount terminal blocks for field connections on fixed channels located near bottom of sections but clear of conduit entry area.
- 3. Locate fixed panels so as not to prevent access within cabinets to other components, wiring, and terminal blocks on fixed panels or front panels.
- 4. Attach components with screws.
- 5. Subpanel shall be threaded.
- 6. Do not use rivets or back-of-panel nuts.

PART 3 - EXECUTION

3.1 <u>Preparation</u>

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- A. Make field measurements needed to install panelboards before submitting Shop Drawings or ordering.
 - 1. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Examine areas and conditions under which Work of this section will be performed.
 - 1. Correct conditions detrimental to timely and proper completion of Work.

3.2 <u>Installation</u>

- A. Refer to Sections 01 73 00 and 01 73 24 for basic execution and installation requirements.
- B. Furnish and install panelboards at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 2. Other applicable OSHA and Cal OSHA regulations
 - 3. California Electrical Code Article 408 "Switchboards and Panelboards"
 - 4. Other applicable building, fire, and electrical code requirements
 - 5. Manufacturer's installation and warranty requirements
- D. Refer variances between above documents and Contract Documents to Owner's Representative.
- E. Install panelboards to tolerances recommended by Manufacturer.
 - 1. Unless otherwise shown, install panelboards true, plumb, level, and square with walls using precision gauges and levels.
 - Mount panelboards so top of highest circuit breaker and height of top operating handle is ≤ 6'6" above floor.
- F. Mount surface-mounted panelboards to provide at least ½" air space between box and wall.
- G. Set main circuit breaker trip units and calibrated per set points determined by Overcurrent Protection Coordination Study.
 - 1. Refer to Section 26 05 10.

3.3 Field Quality Control

A. Field testing shall include:

		TEST STANDARD		FIRST TEST PAID	RETESTS PAID FOR
ITEM	TEST FOR	(ASTM OR OTHER TEST STANDARD)	FREQUENCY	FOR BY	BY
Panelboards	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
	Operation	Functionally test equipment control devices for tightness of connections and proper operation. Verify all phases of each load are disconnected and reconnected. For operator, instrument, and relay panels and cabinets or devices used solely for control, functionally test for proper operation and compliance with Plans. If functional testing is not acceptable to Owner's Representative for safety or operational reasons provide electrician to perform continuity and terminal connection verification checks instead of functional testing.	Each circuit breaker and relay	Contractor	Contractor
	Operation	Refer to Manufacturer's Installation	Each circuit	Contractor	Contractor
	of Battery	Instructions for test procedures.	breaker and		
	Systems,		relay		

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ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
	Static Inverters, UPS, VFDs				
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

3.4 **Spare Parts**

A. Furnish the following spare parts:

QUANTITY	PART
10	Lamps of each size and type used
1 quart	Touch-up paint of each color used
	Other spare parts recommended by Manufacturer

END OF SECTION

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SECTION 26 24 19

LOW-VOLTAGE MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of 600VAC-class motor control centers (MCC's) for use on alternating current power systems.
- B. When motor furnished differs from motors shown, make necessary adjustments to wiring, conduit, disconnect devices, motor starters, branch circuit protection or other affected material or equipment to accommodate installed motors.
- C. Refer to the following sections for Work not covered herein.
 - 1. Section 01 73 24 for seismic restraint requirements.
 - 2. Section 26 08 16 for requirements for Arc Flash Hazard Analysis and Report.
 - 3. Section 26 09 13 for electrical power monitor.
 - 4. Section 26 24 13 for requirements for metering compartments, main service disconnect breakers, metering transformers, and switchboards.
 - 5. Section 26 28 00 for low-voltage circuit-protective devices, circuit breakers, and fuses.
 - 6. Section 26 43 00 for surge protective devices.

1.2 Related Work

- A. Section 01 22 00: Unit Prices
- B. Section 01 33 00: Submittal Procedures
- C. Section 01 40 00: Quality Requirements
- D. Section 01 61 00: Common Product Requirements
- E. Section 01 65 00: Product Delivery Requirements
- F. Section 01 66 00: Product Storage and Handling Requirements
- G. Section 01 73 00: Execution
- H. Section 01 73 24: Seismic Restraint
- I. Section 01 75 00: Starting and Adjusting
- J. Section 01 78 23: Operation and Maintenance Data
- K. Section 01 78 36: Project Warranties
- L. Section 05 05 19: Post-Installed Concrete Anchors
- M. Section 09 90 00: Painting and Coating
- N. Section 26 05 10: Common Work Results for Electrical
- O. Section 26 05 19: Low-Voltage Electrical Power Conductors and Cables
- P. Section 26 05 26: Grounding and Bonding for Electrical Systems
- Q. Section 26 05 50: Cabinets and Enclosures
- R. Section 26 08 00: Commissioning of Electrical Systems
- S. Section 26 08 13: Short Circuit and Coordination Report
- T. Section 26 08 16: Arc-Flash Hazard Analysis and Report
- U. Section 26 09 13: Electrical Power Monitors
- V. Section 26 22 00: Low-Voltage Transformers
- W. Section 26 24 13: Switchboards
- X. Section 26 24 16: Panelboards
- Y. Section 26 26 23: Automatic Transfer Equipment
- Z. Section 26 27 26: Wiring Devices
- AA.Section 26 28 00: Low-Voltage Circuit-Protective Devices
- BB.Section 26 29 13: Solid-State Reduced-Voltage (SSRV) Soft-Start Controllers
- CC. Section 26 43 00: Surge Protective Devices
- DD. Section 40 90 10: Common Work Results for Instrumentation and Control

1.3 System Description

A. Furnish and install complete operating motor control center.

- 1. Provide for utility metering where shown per serving electric utility requirements.
- 2. Furnish ammeters, voltmeters, current and potential transformers, test blocks, control switches, fuses, circuit breakers, motor starters and other devices shown.
 - a. Provide shunt trips and ground fault protection as shown.
- 3. Include appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.
 - a. Where space for future devices is shown on Plans, furnish necessary mounting.
- 4. Provide motors with suitable controller and devices conforming to NEMA ICS2, NEC, and UL requirements which will properly control powered equipment.
- B. Manufacturer of MCC shall also be Manufacturer of furnished across-the-line motor starters, solid-state reduced-voltage starters.
 - 1. Do not use third-party supply and assembly.
- C. Contractor shall confirm motor full-load amperage ratings and provide these to MCC Manufacturer.

D. Motor control center control system output variables shall include:

ITEM	VARIABLE	DESCRIPTION
Output Signals	Run Condition (Lamp or	
(Discrete)	LED)	
	Run Time Meter	6 digit nonresettable run time meter required on each motor
	Alarms	Power fail relay – phase imbalance
	(Red Lamp or LED)	Power fail relay – phase reversal
		Power fail relay – phase loss

1.4 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Motor control equipment shall bear UL Label under UL845.

C. Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Motor Control Center	Functionality and Conformance to Listed Standards	See below.	1 test each MCC	Contractor	Contractor
	Coordination with Motor Loads	Verify motor ratings and coordinate starter overloads with actual horsepower ratings and amperages of motors and devices installed.	1 test each MCC	Contractor	Contractor
Ethernet/IC Communication	Functionality	Prior to shipment, test MCC to ensure each unit communicates properly.	1 test each MCC	Contractor	Contractor

- D. Conduct factory tests of MCC's.
 - 1. Follow IEEE, NEMA, ANSI, and Manufacturer's standards for functionality and conformance to standards:
 - 2. At minimum, take the following design readings:
 - a. Rated Continuous Current
 - b. Short-Circuit Current Ratings including measurements of Recovery Voltage.
 - c. Dielectric Withstand Tests
 - d. Switching Tests
 - e. Mechanical Life Tests
 - f. Basic Impulse Level
 - g. Momentary Withstand

- h. Short Time Withstand
- i. Fault Closing
- j. Load Interruption at various power factors
- 3. Provide reports to Owner demonstrating conformance to Contract Documents.
- 4. Manufacturer shall certify completed assemblies, identified hereinafter, perform normal functions without interruption or failures while under or after effects of specified shock.
- 5. Failure conditions shall include:
 - a. Closure of open contact long enough to cause circuit to be falsely "picked up" or energized.
 - Opening of closed contact long enough to cause circuit to be falsely "dropped out" or voltage reduced or interrupted.
 - c. Reduction of proper NEC clearances and insulation failures resulting in short circuits or ground faults.
- E. Factory tests on assembled MCC conforming to ANSI, ICS, IEEE, and NEMA standards shall include:
 - 1. Verify equipment is manufactured according to drawings and specification.
 - 2. Perform the following factory tests and quality checks on vacuum circuit breakers:
 - 3. Check and adjust mating and matching points by precise master fixture alignment to assure unit interchangeability.
 - 4. Test auxiliary wiring point-to-point for continuity and correctness per accepted schematic diagrams.
 - 5. Operate mechanism at maximum, minimum and rated voltages to assure smooth operation.
 - 6. Unblock devices and check mechanically.
 - 7. Verify current-consumption of drive motors.
 - 8. Measure resistance of operating coils.
 - 9. Measure resistance of each pole by low ohmic bridge.
 - 10. Trip test each breaker using each trip input separately.
 - 11. Perform high-potential test.
 - 12. Perform 1000VDC megger test.
 - 13. Perform final inspection.
- F. Perform the following factory tests and quality checks on assemblies:
 - 1. Check compartment frame multiple point alignment against master fixture.
 - 2. Perform final master breaker fixture alignment of mating and matching points including primary bushing and conductor matching, auxiliary contact mating, grounding shoe contact, plus checks to insure interchange ability of breakers.
 - 3. Unblock devices and check mechanically.
 - 4. Check auxiliary wiring point-to-point to assure correctness and continuity in accordance with accepted schematic diagrams.
 - 5. Check current and potential transformers.
 - 6. Verify ratio
 - 7. Check polarity
 - a. Dielectric test secondaries (2.0 kV)
 - b. Check each tap above in case of multi-ratio current transformers.
 - 8. Verify secondary wiring according to wiring diagrams.
 - 9. Test meters and transducers after installation to verify correct readings, directions, and phase relationship at low and high tap and range settings.
 - a. Factory test reports of meters and transducers are not required.
 - 10. Test protective relays.
 - a. Perform functional tests on relays after installation in switchgear.
 - b. Test relay current and potential circuits by secondary injection method at low and high tap and range settings.
 - c. Testing method should include phase meter check or current and/or voltage circuits.
 - d. Check target coils and lights.
 - e. Factory test reports or relays are not required.

- f. Perform high-potential tests on primary and secondary circuits.
- g. Perform 1000VDC megger tests.
- 11. Check screws, nuts and terminals for tightness.
- 12. Perform complete visual and final inspection.
- 13. Reblock devices requiring blocking for shipping after testing is completed and prior to shipping.

1.5 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - 1. ANSI Z55.1 Gray Finishes for Industrial Apparatus and Equipment
 - 2. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 3. California Building Code (CBC)
 - 4. California Electrical Code (CEC)
 - 5. California Fire Code (CFC)
 - 6. California Mechanical Code (CMC)
 - 7. EN 60439-1 Low-Voltage Switchgear and Control Gear Assemblies
 - 8. EUSERC Electric Utility Service Equipment Requirements Committee requirements
 - 9. IEEE C37.20.9 Testing Metal-Enclosed Switchgear Rated to 38kV for Internal Arcing Faults
 - 10. ISO 9001 Quality Management Systems Requirements
 - 11. NEMA/ANSI 250 Enclosures for Electrical Equipment
 - 12. NEMA ICS1 Industrial Control and Systems General Requirements
 - 13. NEMA ICS2 Industrial Control and Systems Controllers
 - 14. NEMA ICS18 Motor Control Centers
 - 15. IEEE KS1 Heavy Duty Enclosed and Dead-Front Switches
 - 16. NEMA PB2 Deadfront Distribution Switchboards
 - 17. NEMA ST1 Specialty Transformers
 - 18. NEMA TP1 Energy Efficiency Standard
 - 19. NETA ATS Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems
 - 20. NFPA 70 National Electric Code (NEC)
 - 21. NSF/ANSI 49 Biosafety Cabinetry: Design, Construction, Performance, and Field Certification
 - 22. UL 98 Enclosed and Dead-Front Switches
 - 23. UL 845 Motor Control Centers

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION		
	DRAWINGS		
Working Drawings	Submit ½"=1' scale drawings of electrical rooms or areas showing overall dimensions for equipment layout including NEC Article 110-26 Article 110-26 clearances and space available for conduits and protective devices.		
Shop Drawings	Submit schematic (elementary) diagrams and interconnection diagrams for MCC's under electrically controlled equipment Shop Drawing requirements.		
	Submit equipment schedules		
	Submit seismic anchorage requirements per Section 01 73 24.		
	 Design Information on assemblies and major components shall show Voltage ratings, Bussing arrangement Neutral bus rating Continuous current ratings, Fault current withstand ratings, Enclosure type Enclosure rating Ratings, and arrangement of overcurrent protective devices Time-current characteristics for overcurrent protective devices on conventional-sized transparencies Conduit entry restrictions Weights of assemblies List of accessories if any 		

SUBMITTAL	DESCRIPTION	
	Outline and Dimensional Drawings shall show:	
	Master drawing index	
	2. Front view elevation	
	3. Floor plan	
	4. Top view	
	5. Side view	
	6. Rear view	
	7. Conduit entry/exit locations 8. Cable terminal sizes	
	9. Bus splices	
	10. Where applicable, show connection details between close-coupled assemblies.	
	11. Where applicable, show composite floor plan of close-coupled assemblies.	
	Schematic Drawings shall show	
	Single-line diagram with each circuit numbered	
	2. Schedule showing circuit number, description, and rating of protective devices	
	3. Short circuit availability of bus	
	Nameplate schedule and information	
	Schedule of Electrical Devices shall show:	
	1. Component list	
	2. Starter sizes	
	3. Circuit breaker frame sizes	
	4. Continuous amp ratings	
"A - Obin 1" Ob	5. Pilot devices	
"As-Shipped" Shop Drawings	Manufacturer shall provide final interconnection drawings reflecting "As-Shipped" status of MCC.	
Drawings	Update Manufacturer's "As-Shipped" drawings to reflect field modifications.	
	Show terminal numbers for items in motor control sections and items in control section	
	on interconnection diagrams.	
	Show interior and field wire numbers on interconnection diagrams.	
	Show wiring from numbered terminals to control section and remote devices with	
	connections on both ends shown on schematic, wiring, and interconnection diagrams.	
	Number and identify terminals on remote devices so continuity may be checked by	
	Owner and later field-verified.	
	Submit CD with record drawing schematic, wiring, and interconnection diagrams in	
	AutoCAD.	
Draduat Data	MANUFACTURER'S LITERATURE	
Product Data	Submit per Product Data requirements.	
	Submit published Motor Control Center descriptive literature	
	Submit data sheets on major components including: 1. Disconnect switches	
	2. Motor starters	
	3. Pilot devices	
	4. Relays	
	Refer to Section 26 24 13 for Product Data Requirements for disconnect switches	
	Refer to Section 26 28 00 for Product Data requirements for low-voltage circuit-	
	protective devices, circuit breakers, and fuses.	
Installation	Submit per Installation Instruction requirements.	
Instructions	Include general description for reading nameplate data, serial numbers, UL markings	
	and short-circuit ratings.	
	Describe installation procedures including splicing procedures.	
	Describe conduit and cable installation.	
	Describe procedures for installing and removing plug-in units.	
	Describe operation of operator handles and unit interlocks.	
	Submit pre-energization checklist.	
	Describe procedures for energizing equipment.	
	Describe procedures for energizing equipment. Describe initial maintenance and trouble-shooting procedures.	
	QUALITY ASSURANCE AND CONTROL SUBMITTALS	
	QUALITI ASSURANCE AND CONTROL SUBMITTALS	

SUBMITTAL	DESCRIPTION			
Certificate of	Submit coating system and application certification per Certificate of Compliance			
Compliance	requirements.			
	Following field installation submit certification equipment has been properly installed			
	and tested and is ready to be energized.			
Engineering	Submit for seismic anchorage per Section 01 73 24.			
Calculations				
Test Record	Submit transcripts for factory tests per Test Record Transcript requirements.			
Transcripts	Include procedures, test conditions, results, and graphs.			
	Submit ground fault protection system field test results per Section 26 05 26.			
Contractor's	Contractor shall certify in writing:			
Certification 1. MCC is installed in accordance with Manufacturer's instructions.				
	Circuit breaker settings have been adjusted per field requirements			
	3. Power fuses have been selected and installed per field requirements			
	Solid-state motor overload settings have been adjusted per installed motor characteristics.			
	5. Timing devices required in starting circuitry are properly adjusted.			
	CLOSEOUT SUBMITTALS			
O & M Instructions	Submit per Operation and Maintenance instruction requirements			
	Submit operating instructions for major components including transfer switches,			
	disconnect switches, circuit breakers, and starters.			
	Submit listing of MCC spare parts and pricing			
	Submit name and phone number of local distributor for spare parts.			
Warranty	Furnish 1-year warranty from date of final acceptance			

- B. Refer to Section 01 33 00 for definition of requirements for Shop Drawings, Product Data, Installation Instructions, and O&M instructions, Engineering Calculations, Certificates of Compliance and Test Record Transcripts.
- C. Shop Drawings of service and metering sections where required shall be accepted by servicing electrical utility before fabrication.
- D. Motor horsepower ratings and enclosures shown are minimum expected.
 - 1. This does not limit equipment size.
 - When furnished motors exceed minimum ratings shown, make necessary adjustments to wiring, conduit, disconnect devices, motor starters, branch circuit protection and other affected material or equipment as required by NEC to accommodate motors and devices installed at no additional cost to Owner.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Strictly follow Manufacturer's instructions and warranty requirements for delivery, storage and handling of low-voltage motor control centers.
- C. Coordinate shipping splits with motor control center Manufacturer for entry into building.
- D. Ship motor control centers with external lifting angles at top and running continuous length of each shipping block.
 - 1. Lifting eyelets are not acceptable.
- E. During storage, connect internal space heaters (if specified) with temporary power.

1.8 Project Site Conditions

A. Refer to Section 01 10 01 for full list of project site conditions.

1.9 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for low-voltage motor control centers.

PART 2 - PRODUCTS

2.1 <u>Acceptable Manufacturers</u>

A. Acceptable Fabricators include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Motor Control Center Brithinee Electric Colton, CA (909)		Colton, CA (909) 825-6312
Fabricators	LittleJohn-Reuland Corporation	Vernon, CA (323) 587-5255
	Royal Industrial Solutions	Riverside, CA (951) 683-6625
Tesco Controls Sacramento,		Sacramento, CA (916) 395-8800
	Accepted equal	

B. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Motor Control Centers	Allen-Bradley / Rockwell Automation	Milwaukee, WI (414) 382-2000
	Tesco Controls, Inc.	Sacramento, CA (916) 395-8800
	Eaton Cutler Hammer	Cleveland, OH (800) 386-1911
	General Electric Company	Fairfield, CT (800) 626-2000
	Schneider Electric Square D Model 6	Andover, MA (888) 778-2733
	Accepted equal	
Motor Control Centers with Ethernet Incorporated Into	Allen-Bradley / Rockwell Automation Bulletin 1606- XLSDNET8 with Bulletin 1606-XLBUFFER buffer module	Milwaukee, WI (414) 382-2000
Design	Eaton Cutler Hammer	Cleveland, OH (800) 386-1911
	General Electric Company	Fairfield, CT (800) 626-2000
	Schneider Electric Square D	Andover, MA (888) 778-2733
	Accepted equal	
Disconnect Switches	Allen-Bradley / Rockwell Automation	Milwaukee, WI (414) 382-2000
	Eaton Cutler Hammer	Cleveland, OH (800) 386-1911
	General Electric Company	Fairfield, CT (800) 626-2000
	Schneider Electric Square D	Andover, MA (888) 778-2733
	Siemens USA	Washington, DC (800) 743-6367
	Accepted equal	J
Ethernet Power Supply	Allen-Bradley / Rockwell Automation Ethernet Intellicenter NEMA Centerline 2100 with ArcShield and Secure Connect and Exoscan	Milwaukee, WI (414) 382-2000
	Eaton Cutler Hammer	Cleveland, OH (800) 386-1911
	General Electric Company	Fairfield, CT (800) 626-2000
	Schneider Electric Square D	Andover, MA (888) 778-2733
	Accepted equal	Andover, WA (000) 110-2100
Ethernet Overload Relay	Allen-Bradley / Rockwell Automation 193-EC5/592- EC5 "E3 Plus"	Milwaukee, WI (414) 382-2000
•	Eaton Cutler Hammer	Cleveland, OH (800) 386-1911
	General Electric Company	Fairfield, CT (800) 626-2000
	Schneider Electric Square D	Andover, MA (888) 778-2733
	Accepted equal	, , ,
Combination NEMA- Rated Across-the-Line	Allen-Bradley / Rockwell Automation Bulletin 500 or 300	Milwaukee, WI (414) 382-2000
Starters	Eaton Cutler Hammer	Cleveland, OH (800) 386-1911
	General Electric Company	Fairfield, CT (800) 626-2000
	Schneider Electric Square D Class 8502 Vacuum Type	Andover, MA (888) 778-2733
	Schneider Electric Square D Class 8536 Vacuum Type	Andover, MA (888) 778-2733
	Accepted equal	
Pilot Devices for Units	Allen-Bradley / Rockwell Automation Bulletin 800T or	Milwaukee, WI (414) 382-2000
with Vertically-Operated	800H 30.5mm (where ≤3 pilot devices are used	
Disconnect Handles	Allen-Bradley / Rockwell Automation Bulletin 800F where ≥4 pilot devices are used	Milwaukee, WI (414) 382-2000
	Eaton Cutler Hammer	Cleveland, OH (800) 386-1911
	General Electric Company	Fairfield, CT (800) 626-2000
	Schneider Electric Square D	Andover, MA (888) 778-2733
	Accepted equal	
Pilot Devices for Units	Allen-Bradley / Rockwell Automation Bulletin 800F	Milwaukee, WI (414) 382-2000

ITEM	MANUFACTURER	MANUFACTURER LOCATION
with Horizontally-	Eaton Cutler Hammer	Cleveland, OH (800) 386-1911
Operated Disconnect	General Electric Company	Fairfield, CT (800) 626-2000
Handles	Schneider Electric Square D	Andover, MA (888) 778-2733
	Accepted equal	
Power Monitor	Refer to Section 26 09 13.	
Surge Protection	Refer to Section 26 43 00.	
Device		
Automatic Drains for	Crouse Hinds / Eaton ECD	Syracuse, NY (866) 764-5454
NEMA 4X Enclosures in	Accepted equal	
Wet Locations		
Solid-State Reduced-	Refer to Section 26 29 13.	
Voltage (SSRV) Motor		
Controllers		
RTD Monitors	General Electric Multilin RRTD	Fairfield, CT (800) 626-2000
	Accepted equal	
Overload Relays	Schneider Electric Square D Class 9068 Type SEO	Andover, MA (888) 778-2733
	Schneider Electric Square D Class 9065 SF420 for	Andover, MA (888) 778-2733
	Size 4 starters Class 10/20 Selectable Trip Class	
	Accepted equal	
Phase Failure Relays	Schneider Electric Square D RM35TF30	Andover, MA (888) 778-2733
	SymCom Motor Saver 250A	Rapid City, SD (605) 348-5580
	Accepted equal	
Run Time Meters	Cramer Company Model 635 Style X 120VAC	South Windsor, CT (860) 404-0408
	Reddington Counters / Trumeter "710-0002)	Deerfield Beach, FL (954) 725-6699
	Accepted equal	

- C. Manufacturer and manufacturing facilities shall be ISO 9001 or ISO 9002 certified.
- D. Manufacturer of assembly shall manufacture circuit protective devices within assembly.
- E. Equipment furnished shall operate through its full operating range powered by amperages specified or shown on Plans.
 - 1. Equipment requiring larger amperage than specified or shown is unacceptable in absent written statement from Owner electrical infrastructure and switchgear can support increased amperage.

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Motor control centers shall fit within space limitation shown on Plans.
- C. Motor control centers shall comply with applicable NEMA, UL and ANSI standards for industrial control.
- D. Materials for motor control centers shall be:

ITEM	MATERIAL	SPECIFICATION		
	CONDUCTORS			
Horizontal Bus	Silver-Plated Copper	Full-sized throughout length.		
Bars		Insulated neutral shall be rated same as phase bus bars		
Vertical Bus	Silver-Plated Copper	Full-sized throughout length.		
Bars		Provide full-height bussing in vertical sections		
		Insulated neutral shall be rated same as phase bus bars.		
Bus Bracing	Glass-Filled	High-strength, non-conductive, non-tracking		
	Polyester	Capable of withstanding fault currents shown		
Bus Bracing	Polycarbonate	Non-conductive molded cover		
Isolation from		Mount bus bars on supports of high impact-resistant non-tracking insulating		
Unit Spaces		material		
Unit Stabs for	Silver-Plated Copper			
Engaging Power				
Bus				

ITEM	MATERIAL	SPECIFICATION
Power Stab	Stainless Steel	
Backup Springs		
Horizontal	Silver- or Tin-Plated	Size: 1/4" x 1" or 1/4" x 2"
Ground Bus	Copper	
Vertical Ground	Un-plated Copper	Capable of accommodating plug-in units.
Bus		
Connections	Silver-Plated Copper	
Bus Connection	Stainless Steel	
Hardware		

E. The following product design criteria, options and accessories are required for motor control centers:

ITEM		DESCRIPTION
	_	CONSTRUCTION
Motor Control Center Ratings and Design Criteria	Design Standard	Design and label per UL845 Dead-front and dead-rear design per NEMA PB2 Conform to NEC 430 Wire remote control and signal circuits to separate terminal board
	0	compartment.
	Construction	NEMA Class II with line and main bus connections accessible from front
	Voltage Rating	600VAC 60Hz 3Φ As shown on Plans
	Ampere Rating	With line and load insulated bus bars
	Ampere Withstand Current Rating and Power Bus Bracing	As shown on Plans but not less than 42,000A RMS symmetrical short-circuit (fully rated)
	Short-Circuit Fault Current Withstand Rating	Full-rated short-circuit rating shall meet or exceed fault current shown. Do not use series short-circuit ratings for overcurrent devices except for panelboards.
	Full-Rated Short- Circuit Interrupting Rating	Base on applied MCC voltage.
	Device Heights	Conform to NEC and Servicing Electrical Utility requirements with switchgear mounted on housekeeping pad of height shown
	Accessibility	Type 2 per IEEE C37.20.9
	Covers	Bolt sides, top, and rear covers of code-gauge steel to switchboard frame.
Requirements for Outdoor	Front Access Space	Provide 10" minimum front access space (vestibule) between exterior door and front of interior switchboard door.
Units	Lights and	Provide switched LED lights
	Receptacles	Provide 1 convenience outlet
	Space Heaters,	Provide thermostatically controlled space heaters Locate in bottom of each vertical section Provide 120VAC external power source from lighting panel for heaters
Enclosure	Vertical Section Construction	Floor-supported, rear-aligned Bolt adjacent vertical sections together to form rigid free-standing assembly.
		Design to allow adding future sections at either end and to permit interchanging of units.
		Provide internal mounting angles continuous within shipping block. Do not use external mounting channels to maintain structure integrity.
		Provide removable steel lifting angle on shipping blocks
	Gasketing	Refer to NEMA enclosure rating below
	Access	Nonwalk-in Requiring front access only
	Removable End Plates	Provide removable closing plate on each end of MCC to cover horizontal bus and horizontal wireway openings. Provide insulating sheets on inside end of closing plates to help prevent burn-through of end closing plate if internal arcing fault occurs in horizontal bus compartment.
		1 bao comparanona

ITEM		DESCRIPTION
	Section Isolation	Equip each section with 2 full-metal side sheets to isolate each vertical
		section and reduce likelihood of fault propagation between sections.
	Color	ANSI 61 light grey
	Unpainted Parts	Plate unpainted parts for corrosion resistance
	Nameplates	Refer to Section 26 05 10 for laminated nameplates
		Provide nameplate for each circuit breaker to show load served.
		Designate switchboard in ½" high letters.
		Second line in ¼" high letters shall show voltage and phases.
Doors	Construction	Stainless steel nameplates required on each compartment. Provide each unit with removable door mounted on removable pin type
D0015	Construction	hinges.
		Doors shall be capable of being opened ≥110°.
		Doors shall be removable from any location in MCC without disturbing
		other unit doors.
		Fasten unit door to structure so it can be closed to cover unit space when
		unit is removed.
	Door Latches	Unit doors shall be held closed with quarter-turn latches.
		Provide unit door latches with arc-resistant latches to help keep door
		latched if internal arcing fault occurs.
	Door Interlocking	Mechanically interlock so doors cannot be opened with unit energized.
		Provide defeater mechanism to allow intentional access at any time.
N D I		Provide means of padlocking external disconnect handles in OFF position.
Non-Bussed		Provide where shown for PLC, transfer switch, and Owner-installed
Sections		equipment CONDUCTORS
Bussing	Minimum Continuous	Refer to Plans
Dussing	Current Rating	Therefore to triains
	Arrangement	Use A-B-C-Neutral type bus arrangement (left-to-right, top-to-bottom, and
	7 arangomon	front-to-rear) throughout
	Sizing Criteria	NEMA standard temperature rise criteria of 65°C ambient over 40°C
		ambient outside enclosure
Horizontal	Rating	As shown on Plans.
Power Bus Bars	Support, Bracing and	Mount with all 3 phases arranged in same vertical plane
	Isolation	Support, brace and isolate from vertical bus with non-conductive material
		specified above
	Continuity	For standard sections horizontal bus shall be continuous within each
	Caliana	shipping block and braced within each section
Vertical Power	Splices Effective Rating	Provide ≥2 bolts on each side 600A minimum
Bus Bars	Rating for Center-	300A above and below horizontal bus for effective rating of 600A
200 2010	Horizontal Bus	- 3000 above and below horizontal bus for effective fathing of 0000
	Construction (if	
	used)	
	Rating for Top- or	Full bus rated for 600A.
	Bottom-Mounted	
	Horizontal Bus (if	
	used)	
	Connection to	Connect to horizontal bus with ≥2 bolts.
	Horizontal Bus	Continuously broad vortical has by non-conductive meterial associated
	Bracing	Continuously braced vertical bus by non-conductive material specified above
		I Isolate vertical bus from unit spaces by non-conductive molded cover of
		material specified above.
	Plug-In Stab	Automatic shutters shall cover plug-in stab openings when units are
	Opening Covers	removed
Ground Bus	Construction	Minimum ¼" x 2" size
J. J. J. J. J. J. J. J. J. J. J. J. J. J		Horizontal ground bus secured to vertical ground buses mounted in each
		vertical section.
		Extend entire length of sections.

ITEM		DESCRIPTION
		Mount horizontal ground bus bottom of MCC unless otherwise shown on Plans.
		Provide pressure type mechanical lug mounted on ground bus in incoming line section.
		Provide unit load connector on units requiring load wire connections.
		Load connector shall provide termination point for load ground connector at units.
	Unit Ground Stab	Provide unit ground stab on unit inserts.
		Ground stab shall establish unit insert grounding to vertical ground bus
		before plug-in power stabs engage power bus. Grounding shall be maintained until after plug-in power stabs are
\\/:\\\\:\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	Llavinantal Winavyaya	disengaged.
Wireways	Horizontal Wireways	To maximize flexibility in locating conduit for MCC feeds and loads, provide 6" high full-depth horizontal wireways at top and bottom of MCC.
		Wireways shall be continuous across length of MCC except where access must be denied due to electrical isolation requirements. Isolate horizontal wireways from power bus.
		Where shown on Plans, provide pull boxes to extend height of top
		horizontal wireway by 12"
		Isolate horizontal wireways from bus.
		Provide removable wireway covers held in place by captive screws.
	Vertical Wireways	Provide full-height vertical wireway in each vertical section.
		Isolate vertical wireway from vertical and horizontal buses.
		Isolate wireway from plug-in units.
		Provide wireway tie bars. Cover vertical wireway with hinged and secured door.
		Provide wireway doors with arc-resistant latches to help keep door latched
		if internal arcing fault occurs.
Wiring	Wiring	NEMA Class 2 Interconnected Unit Type B wiring
		Provide small wiring, necessary fuse blocks and terminal blocks within
		MCC as required. Mount control components within MCC, including fuse blocks, relays,
		pushbuttons and switches and tag for identification corresponding to
		designations on Manufacturer's wiring diagrams.
	Control Wiring	UL Type SIS or MTW flexible stranded copper control wire
		Control wire inside panel shall be ≥#18AWG.
		PVC insulation White insulation for neutral wires.
		Green insulation for ground wires.
		Wiring shall be neat and workmanlike without splices and with uniform
		arrangement of circuits.
		Securely clamp wire bundles crossing hinges to both door and panel.
		Run parallel to hinge for $\geq \frac{1}{2}$ door length to prevent chafing.
		Run wire bundles or single wires in straight lines with 90° corners, where change of direction is required.
		Where possible, run wiring in plastic wire duct with covers.
		Where not possible to contain wiring in duct, wrap wiring with plastic spiral
		binding or bundle and secure wire with nylon ties.
		Do not splice wires inside wire ducts or spiral-wrapped wire bundles.
Control Terminal Blocks		Terminate control wiring from remote devices on labeled terminal strip.
DIUCKS		Use mechanical type terminals for line and load terminations, suitable for copper or aluminum cable.
		Terminal blocks for control wiring shall be molded type with barriers, rated
		for ≥ 300VAC, 25A, suitable for conductors ranging from #22AWG to #14AWG.
		Terminal blocks for control power terminations shall be fused type with fuse puller.
		Provide insulated locking spade terminals for control connections, except where saddle-type terminals are integral to devices.

ITEM		DESCRIPTION
		Provide terminal blocks with numbering strips for control-wire groups
		leaving MCC
		Connect current transformer secondary leads to conveniently accessible
		short-circuit terminal blocks before connecting to devices
		Size as shown on Plans
Control Terminal	Construction	Refer to Section 26 27 26.
Blocks for		Provide control terminal blocks on contactor and starter units.
Contactors and		Use pull-apart design on plug-in units for easy removal of unit from
Starters		structure.
		Use fixed-type control terminal blocks on non-plug-in contactor and starter
	NEMA O: 4 10	units or factory-mounted units
	NEMA Size 1 and 2	Provide pull-apart power terminal blocks on contactor and starter units
	(30 A and 60 A	which use vertically operated disconnects
	contactors)	Dravide non pull anart newer terminal blocks on contactor and starter units
	NEMA Size 3 (100 A contactors).	Provide non-pull apart power terminal blocks on contactor and starter units which use vertically operated disconnects
	COMBOLOTS).	May be omitted for NEMA-Rated starter units where power terminal blocks
		are not required by Manufacturer.
	NEMA Size 4 and	Power terminal blocks not required
	Above	1 - 511-51 totalinal blooks hot roquirou
	Location	Do not place terminal blocks adjacent to or inside vertical wireway.
Circuit Labeling		Refer to Section 26 05 19 for requirements for circuit labeling.
		WIRING DEVICES
Push-Buttons		Refer to Section 26 27 26.
and Selector		
Switches		
Pilot Devices		Refer to Section 26 27 26.
		Use for units with vertically operated disconnect handles
Control Relays		Refer to Section 26 27 26.
Time-Delay		Refer to Section 26 27 26.
Relays		
Elapsed Time		Synchronous, motor-driven, 0-99,999.9 hours range nonreset Type
Meters	1.044.40	Suitable for semiflush panel mounting LTAGE CIRCUIT PROTECTIVE DEVICES
Feeder Circuit	LOW VO	Refer to Section 26 28 00.
Breakers		1 10101 to 000tion 20 20 00.
Phase Failure		Provide phase failure or phase monitoring relays in MCC with form C
Relay Alarm		contact to remote PLC.
System		Contact shall actuate on
,		Phase imbalance
		2. Phase reversal
		3. Loss of phase.
		4. Low or high voltage
		5. Rapid cycling
		Incorporate adjustable trip delay into unit.
		Provide locking potentiometer, undervoltage adjustment
		Provide bicolor LED indicating with GREEN lamp for relay energized and
		RED lamp for trip conditions Shall have door-mounted manual or automatic reset button on door
		exterior
Thermal	General	Conform to NEMA ICS2
Overload	- OGIIGIAI	Provide ambient-temperature-compensated 3-pole bimetallic-type thermal
Protection		overload relays with interchangeable heaters, calibrated for 1.0 and 1.15
		service factor motors.
	Operation	Provide each motor controller with thermal overload protection in all
		ungrounded phases.
		Use thermal overload protection devices of inverse-time current
		characteristic type.
		Thermal overload relays shall be either:

ITEM		DESCRIPTION	
		Sensitive to motor current and mounted within motor controller or Combination of thermal protectors embedded within motor windings and controller-mounted thermal overload relays as shown.	
	Reset	When used without motor thermal protectors, provide controller-mounted overload relays of manual-reset type with externally operated reset button. When used in conjunction with thermal protectors, provide controller-mounted overload relays automatic reset type.	
	Relay Contacts	Provide electrically isolated NO and NC contacts on relay.	
	Trip Indication	Provide visual trip indication.	
	Test Trip Feature	Provide test trip feature for troubleshooting, operable without removing components or motor starter.	
	Adjustability	Overload shall have ±24% adjustability	
	Phase Sensitivity	Provide single-phase sensitivity	
	Alarm Contact	Provide isolated alarm contact	
	Manual Reset Button	Overload relays shall have manual reset button located on door exterior.	
	Motor Winding Overload Connection	Install and connect required thermal protector monitoring relays provided by motor Manufacturer in motor-control circuit and provide manual reset function.	
	Overload Relay Heaters	Select and install overload relay heaters after actual nameplate full-load current rating of motor has been determined.	
		OW VOLTAGE TRANSFORMERS	
Control and Lighting Transformer (Specifications	General	Refer to Section 26 22 00 except as modified below Provide fused control circuit transformer Ship current transformers loose to be field-installed onto incoming power conductors.	
for MCC Section	Construction	NEMA ST1, machine tool grade with isolated secondary winding	
Transformer take precedence over	kVA	Refer to Plans Size to accommodate required control power, remote loads, plus additional 200VA for remote devices and future use	
corresponding	Voltage Regulation	Limit to 10% during contact or pickup	
specifications in	Primary Voltage	480VAC secondary 3Φ 60Hz	
transformer Section 26 22	Secondary Voltage	120VAC secondary 1Φ 60Hz	
00)	Energy Efficiency	Control and power transformers designed for use in MCC's for use with motor control circuits are exempt from NEMA TP1 energy efficiency requirements.	
	Primary Protection	Thermal magnetic circuit breaker Primary circuit breaker compartment and transformer compartment shall be wired and interlocked together.	
	Secondary Fuse Protection	Fuse 1 side of secondary winding and ground other side. Primary circuit breaker compartment and transformer compartment shall be interlocked and factory-wired together.	
	Units in NEMA 1 Enclosures	Provide with vented, gasketed doors with filters over vent openings.	
	Units in NEMA 12 Enclosures	Provide with non-vented doors. If transformer derating is required, upsize transformer to provide equivalent rating shown.	
	PANELBOARDS		
Lighting Panel	Panelboard	Refer to Section 26 24 16.	
	Rating (Capacity) Branch Breakers	10kA interrupting capacity Bolt-on type as shown	

F. The following product design criteria, options and accessories are required for metering compartments and disconnect switches:

ITEM	DESCRIPTION	
		METERING COMPARTMENT
Metering Compartment	Construction	Refer to Section 26 24 13

ITEM		DESCRIPTION
Main Disconnect Switch	Labeling	Permanently label disconnect section at service entrance equipment and disconnection means per NEC Article 230 Part F
	Warning Sign	Provide warning sign giving location of disconnecting devices not located in MCC,
	Voltage Rating	480VAC 60Hz 3Ф
	Ampere Rating	As shown on Plans
	Ampere Withstand Current Rating	As shown on Plans but ≥42,000A RMS symmetrical short-circuit (fully rated)
	Main Disconnect Switch	Design and label per UL98 Capable of de-energizing all circuits in MCC Dead-front design per NEMA PB2 Conform to NEMA KS1 Type HD "Heavy-Duty"
	Main Disconnect	Operable with unit door closed MCC Manufacturer shall provide lugs to accommodate incoming power
	Lugs	conductors as shown on Plans. If no overcurrent protection is shown, provide main incoming lug
	Locking Hardware	compartment. Disconnect switches shall be capable of being padlocked in "ON" or "OFF" position.
	Fused Switches	Current-limiting as shown Equip fusible switches with rejection feature.
	Circuit Breakers	Size circuit breaker frame and trip rating as shown on Plans. Provide 100% ratings where shown. Interrupting capacity rating shall meet or exceed fault current (required bus
		Interrupting capacity (short-circuit withstand) rating shall meet or exceed fault current (required bus bracing) shown on Plans.
		Interrupting capacity based on slash rating is not acceptable For ≤400A frames, provide circuit breaker with thermal magnetic trip unit
	Telemetry Auxiliary Contact	For ≥600A frames, provide electronic trip unit Provide 1 NO and 1 NC circuit breaker auxiliary contact on main breaker which follows position of circuit breaker main contacts for indication of "ON" or "OFF/Tripped."
Space Requirements		Provide metering and current transformer space, pull sections and fully removable front covers of widths depths and heights required by serving electrical utility and as necessitated by physical requirements of conduits and cables entering sections.
Ground Fault Protection (where shown)		Zero-sequence solid-state relay ground-fault protection field adjustable with continuous time adjustments Fault current rating shall equal or exceed switchboard rating on Plans. Provide RESET and TEST functions using pushbuttons and pilot light or mechanical target to indicate ground fault has occurred. Main disconnect shunt trip and relay shall operate from fused 120VAC control source within main disconnect compartment or shall be integral to main circuit breaker. For grounded "wye" services >150VAC to ground, but ≤600 VAC, phase-to-phase, provide ground fault protection of equipment for each service disconnecting means for services rated ≥1000 amps, without a single main
		disconnecting means MCC COMPARTMENTS
Motor Circuit Disconnect	Nameplate	On front of enclosure, attach nameplate per Section 26 05 10 identifying loads
Switches	Voltage Rating	480VAC 60Hz 3Ф
	Design	Design and label per UL98 Dead-front design per NEMA PB2 Conform to NEMA KS1 Type HD "Heavy-Duty"
		Motor-rated, load-break, quick-make, quick-break type Horsepower-rated through 200hp Nonfusible or fusible as shown

Desilion. Switches on Circuits NEMA Heavy-duty Type HD	ITEM		DESCRIPTION
Location Front-accessible, Group-mounted Disconnect switches shall be capable of being padlocked in "ON" or "OFF position. Switches on Circuits O-240V Switches on 480-V Circuits Operating Handles Locate handle s6° above finish floor elevation. Interlocks Provide quick-make and quick-break operating handles Locate handle s6° above finish floor elevation. Interlocks Provide full-cover interlock to prevent unauthorized opening of hinged cover when switch is in "ON" position Provide interlock to prevent closing switch mechanism with hinged cover open. Telemetry Interface Feeder Disconnects and Transformer Disconnects Interruption genapticy (short-ficual withstand) rating shall meet or exceed fault current (required bus bracing) shown on Plans Interrupting capacity (short-ficual withstand) rating shall meet or exceed fault current (required bus bracing) shown on Plans Interrupting capacity beased on a slash rating is not acceptable Minimum frame size - 150 amps where Plans do not show higher size. For 400A and smaller frames, provide electronic trip unit Provide 1 NO and 1 NC circuit breaker auxiliary contact which follows position of circuit breaker main contacts for indication of "ON" or "OFF/Tripped." Manually Operated Motor Starter Disconnects – Electro-Mechanical NEMA Across-the- Line Starters Fractional Horsepower Motor Starter Disconnects – Electro-Mechanical NEMA Across-the- Line Starters Final daylus must switch ment on turned the part of position. Minimum frame size - 150 amps where Plans do not show higher size. Provide molded case emotor circuit protectors with Manufacturer's recommended trip setting for motor protection Interrupting capacity based on a slash rating is not acceptable Ship units with motor circuit protectors at I lowest setting per UL standards. Field adjust units based upon motor application. Minimum frame size - 150 amps where Plans do not show higher size. Provide molded case motor circuit protectors with Manufacturer's recommended trip setting for motor protection			
Locking Hardware Disconnects witches shall be capable of being padlocked in "ON" or "OFF position. Switches on Circuits O-240V Switches on 480-V Circuits Operating Handles Derothing Handles Derothing Handles Derothing Handles Locate handle s66° above finish floor elevation. Interlocks Interlocks Interlocks Provide full-cover interlock to prevent unauthorized opening of hinged cover when switch is in "ON" position Provide interlock to prevent unauthorized opening of hinged cover when switch is in "ON" position Provide interlock to prevent unauthorized opening of hinged cover when switch is in "ON" position Provide interlock to prevent unauthorized opening of hinged cover when switch is in "ON" position Provide interlock to prevent unauthorized opening of hinged cover when switch is in "ON" position Provide interlock to prevent unauthorized opening of hinged cover when switch is in "ON" position Provide interlock to prevent unauthorized opening of hinged cover when switch is in "ON" position Provide interlock to prevent unauthorized opening of hinged cover when switch is in "ON" position Provide interlock to prevent unauthorized opening of hinged cover when switch is in "ON" position Provide interlock to prevent unauthorized opening of hinged cover when switch mechanism with hinged cover open. Disconnects Disconnecting means for feeders and transformers shall be thermal magnet trip unit Provide interrupting capacity (short-circuit withstand) rating shall meet or exceed fault current (required bus bracker auxiliary contact which follows position of circuit breaker main contacts for indication of "ON" or "OFF/Tripped." Manually Operated Motor Starters, Fractional Horsepower Motor Starter Disconnects – Electro-Mechanical NEMA Across-the- Line Starters Interrupting capacity (short-circuit withstand) rating shall meet or exceed fault current (required bus bracing) shown on Plans, Interrupting capacity prejude short or indication of "ON" or "OFF/Tripped." NEMA standard rating NEMA Size 1 minimum Interrupting cap		Location	, , , , , , , , , , , , , , , , , , , ,
Locking Hardware Disconnect switches shall be capable of being padlocked in "ON" or "OFF position. Switches on Circuits O-240V Switches on 480-V Circuits Operating Handles Provide quick-make and quick-break operating handles Locate handle 56° above finish floor elevation. Interlocks Provide full-cover interlock to prevent unauthorized opening of hinged cover when switch is in "ON" position Provide interlock to prevent closing switch mechanism with hinged cover open. Telemetry Interface Provide auxiliary contact on main breaker to indicate to telemetry when breaker is closed. Feeder Disconnects and Transformer Disconnects Interrupting capacity (short-circuit withstand) rating shall meet or exceed fault current (required bus bracing) shown on Plans. Interrupting capacity (short-circuit withstand) rating shall meet or exceed fault current (required bus bracing) shown on Plans. Interrupting capacity (short-circuit withstand) rating shall meet or exceed fault current (required bus bracing) shown on Plans. Interrupting capacity (short-circuit breaker with thermal magnet trip unit For 600A and smaller frames, provide circuit breaker with thermal magnet trip unit Provide 1 NO and 1 NC circuit breaker auxiliary contact which follows position of circuit breaker main contacts for indication of "ON" or "OFF/Tripped." Manually Operated Motor Starter Disconnects - Electro-Nechennical NEMA Across-the- Line Starter Disconnects - Electro-Nechennical NEMA Across-the- Line Starter Disconnecting means shall be motor circuit protectors. Units shall conform to ILB45, NEMA (CS18, and NFPA 70. MEMA standard rating NEMA Size 1 minimum Interrupting capacity (short-circuit withstand) rating shall meet or exceed fault current (required bus bracing) shown on Plans. Interrupting capacity (short-circuit withstand) rating shall meet or exceed fault current (required bus bracing) shown on Plans. Interrupting capacity power and a slash rating is not acceptable Ship units with motor circuit protectors with Manufacturer's recommended trip s		Location	
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and Transformer Disconnects magnetic-trip circuit breakers (motor circuit protectors) as shown on Plans		Telemetry Interface	Provide auxiliary contact on main breaker to indicate to telemetry when breaker is closed.
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Manually Operated Motor Starters, Fractional Horsepower Provide for locking in OFF position. Motor Starter Disconnects – Electro-Mechanical NEMA Across-the-Line Starters Interrupting capacity (short-circuit withstand) rating shall meet or exceed fault current (required bus bracing) shown on Plans. Interrupting capacity based on a slash rating is not acceptable Ship units with motor circuit protectors with Manufacturer's recommended trip setting for motor protection lindicate tripping by operating handle position Provide interrupting capacity required for connection to system with short circuit tapacity indicated. Motor Starter Disconnects – Solid Stare Reduced- Motor Starter Disconnects – Solid Stare Reduced- Conform to NEMA ICS 2 with enclosures shown, rated 1 hp at 1Φ voltage of 115VAC and 230VAC, and with thermal overload protection, and toggle or pushbutton operation. Minimum for OFF position. Disconnecting means shall be notor circuit protectors. Units shall conform to UL845, NEMA ICS18, and NFPA 70. NEMA standard rating NEMA Size 1 minimum Interrupting capacity (short-circuit withstand) rating shall meet or exceed fault current (required bus bracing) shown on Plans. Interrupting capacity based on a slash rating is not acceptable Ship units with motor circuit protector set at lowest setting per UL standards. Field adjust units based upon motor application. Minimum frame size - 150 amps where Plans do not show higher size. Provide molded case motor circuit protectors with Manufacturer's recommended trip setting for motor protection lindicate tripping by operating handle position Provide interrupting capacity required for connection to system with short circuit capacity indicated. Provide 1 NO and 1 NC circuit breaker auxiliary contact which follows position of circuit breaker main contacts for indication of "ON" or "OFF/Tripped." Disconnecting means for solid state controllers shall be fusible disconnect with current limiting fuses. Short circuit rating shall be 100,000A (RMS symmetrical)			position of circuit breaker main contacts for indication of "ON" or
Motor Starter Disconnects – Electro-Mechanical NEMA Across-the- Line Starters Disconnecting means shall be motor circuit protectors. Units shall conform to UL845, NEMA ICS18, and NFPA 70. NEMA standard rating NEMA Size 1 minimum Interrupting capacity (short-circuit withstand) rating shall meet or exceed fault current (required bus bracing) shown on Plans. Interrupting capacity based on a slash rating is not acceptable Ship units with motor circuit protector set at lowest setting per UL standards. Field adjust units based upon motor application. Minimum frame size - 150 amps where Plans do not show higher size. Provide molded case motor circuit protectors with Manufacturer's recommended trip setting for motor protection Indicate tripping by operating handle position Provide interrupting capacity required for connection to system with short circuit capacity indicated. Provide 1 NO and 1 NC circuit breaker auxiliary contact which follows position of circuit breaker main contacts for indication of "ON" or "OFF/Tripped." Motor Starter Disconnects – Solid Stare Reduced- Disconnecting means for solid state controllers shall be fusible disconnect with current limiting fuses. Short circuit rating shall be 100,000A (RMS symmetrical).		Motor Starters, Fractional	Conform to NEMA ICS 2 with enclosures shown, rated 1 hp at 1Φ voltages of 115VAC and 230VAC, and with thermal overload protection, and toggle or pushbutton operation.
NEMA Across-the-Line Starters NEMA standard rating NEMA Size 1 minimum		Motor Starter	Disconnecting means shall be motor circuit protectors.
Interrupting capacity (short-circuit withstand) rating shall meet or exceed fault current (required bus bracing) shown on Plans. Interrupting capacity based on a slash rating is not acceptable Ship units with motor circuit protector set at lowest setting per UL standards. Field adjust units based upon motor application. Minimum frame size - 150 amps where Plans do not show higher size. Provide molded case motor circuit protectors with Manufacturer's recommended trip setting for motor protection Indicate tripping by operating handle position Provide interrupting capacity required for connection to system with short circuit capacity indicated. Provide 1 NO and 1 NC circuit breaker auxiliary contact which follows position of circuit breaker main contacts for indication of "ON" or "OFF/Tripped." Motor Starter Disconnects – Solid Stare Reduced- Disconnecting means for solid state controllers shall be fusible disconnect with current limiting fuses. Short circuit rating shall be 100,000A (RMS symmetrical).			
Interrupting capacity based on a slash rating is not acceptable Ship units with motor circuit protector set at lowest setting per UL standards. Field adjust units based upon motor application. Minimum frame size - 150 amps where Plans do not show higher size. Provide molded case motor circuit protectors with Manufacturer's recommended trip setting for motor protection Indicate tripping by operating handle position Provide interrupting capacity required for connection to system with short circuit capacity indicated. Provide 1 NO and 1 NC circuit breaker auxiliary contact which follows position of circuit breaker main contacts for indication of "ON" or "OFF/Tripped." Motor Starter Disconnects – Solid Stare Reduced- Disconnecting means for solid state controllers shall be fusible disconnect with current limiting fuses. Short circuit rating shall be 100,000A (RMS symmetrical).		NEMA Across-the-	Interrupting capacity (short-circuit withstand) rating shall meet or exceed
standards. Field adjust units based upon motor application. Minimum frame size - 150 amps where Plans do not show higher size. Provide molded case motor circuit protectors with Manufacturer's recommended trip setting for motor protection Indicate tripping by operating handle position Provide interrupting capacity required for connection to system with short circuit capacity indicated. Provide 1 NO and 1 NC circuit breaker auxiliary contact which follows position of circuit breaker main contacts for indication of "ON" or "OFF/Tripped." Motor Starter Disconnects – Solid Stare Reduced- Disconnecting means for solid state controllers shall be fusible disconnect with current limiting fuses. Short circuit rating shall be 100,000A (RMS symmetrical).		Line otarters	
Minimum frame size - 150 amps where Plans do not show higher size. Provide molded case motor circuit protectors with Manufacturer's recommended trip setting for motor protection Indicate tripping by operating handle position Provide interrupting capacity required for connection to system with short circuit capacity indicated. Provide 1 NO and 1 NC circuit breaker auxiliary contact which follows position of circuit breaker main contacts for indication of "ON" or "OFF/Tripped." Motor Starter Disconnects – Solid Stare Reduced- Disconnecting means for solid state controllers shall be fusible disconnect with current limiting fuses. Short circuit rating shall be 100,000A (RMS symmetrical).			standards.
Provide molded case motor circuit protectors with Manufacturer's recommended trip setting for motor protection Indicate tripping by operating handle position Provide interrupting capacity required for connection to system with short circuit capacity indicated. Provide 1 NO and 1 NC circuit breaker auxiliary contact which follows position of circuit breaker main contacts for indication of "ON" or "OFF/Tripped." Motor Starter Disconnects – Solid Stare Reduced- Disconnecting means for solid state controllers shall be fusible disconnect with current limiting fuses. Short circuit rating shall be 100,000A (RMS symmetrical).			
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Provide 1 NO and 1 NC circuit breaker auxiliary contact which follows position of circuit breaker main contacts for indication of "ON" or "OFF/Tripped." Motor Starter Disconnects – Solid Stare Reduced- Short circuit rating shall be 100,000A (RMS symmetrical).			Indicate tripping by operating handle position Provide interrupting capacity required for connection to system with short
Disconnects – Solid Stare Reduced- with current limiting fuses. Short circuit rating shall be 100,000A (RMS symmetrical).			Provide 1 NO and 1 NC circuit breaker auxiliary contact which follows position of circuit breaker main contacts for indication of "ON" or "OFF/Tripped."
Motor Controllers		Disconnects – Solid Stare Reduced- Voltage (SSRV)	

G. The following product design criteria, options and accessories are required for motor starters and controllers:

ITEM		DESCRIPTION
Plug-in Starter Units	Construction	NEMA Size 5 FVNR starters and below shall be plug-in units, consisting of unit assembly, unit door assembly, and unit support pan, and unit door assembly. Mount contactors in MCC enclosure unless otherwise shown.
	Overload and Phase Protection	See above
	Unit Door Assembly	Provide units with removable doors fastened to structure so doors can be closed when unit is removed.
	Unit Support Pan	Provide unit support pan to support and guide units. Pans shall remain in structure when units are removed to provide isolation between units.
	Service Position	Provide service position for plug-in units allowing unit to be supported but disengaged from bus.
	Padlocking	Unit shall be padlockable in SERVICE position. SERVICE position will be used to isolate unit from bus to allow servicing of connected load equipment.
	Power Stabs	Provide backup springs maintaining high-pressure 4-point connection to vertical bus.
		Wiring from unit disconnecting means to plug-in stabs shall not be exposed to rear of unit. Provide separate isolated pathway for each phase to minimize possibility of unit-fault conditions reaching power bus system
	Power Cable Termination at Plug- in Stab	Maintanance-free crimp type.
Operator Disconnect Handle on Plug-	Construction	Heavy-duty, non-conductive industrial-duty, flange-mounted handle mechanism for control of disconnect switch or circuit breaker. Do not use rotary operators.
In Starter Units	Pivoting	Operator disconnect handles may pivot in vertical or horizontal plane
	ON-OFF Indication	Handle position shall indicate on-off condition using red and green color indicators with words ON and OFF, and international symbols I and O along with pictorial indication of handle position.
	Padlocking	Handles shall be capable of being locked in OFF position with up to 3 padlocks.
	Interlocking	Interlock handle with unit door per NEMA and UL requirements so: 1. Units may not be inserted or withdrawn with disconnect in ON position. 2. Unit door may not be opened when disconnect is in ON position. 3. Disconnect may not be switched to ON position unless unit door is closed. 4. Provide means for purposely defeating interlocks during maintenance or testing by qualified personnel. Provide kirk-key interlocks where shown on Plans
Combination NEMA-Rated Across-the-Line Starters	Full-Voltage Magnetic Contactors	Full-voltage, non-reversing, horsepower-rated starters, providing combined protection against running and stalled overloads. Conform to NEMA ICS1 and ICS2 Class A Conform to NEC Article 430, and applicable NEMA and UL requirements Starters shall be of NEMA size shown. Do not use NEMA sizes <nema 1="" 20="" 3-pole="" better<="" class="" contactors.="" do="" fractional="" iec-rated="" nema="" not="" or="" size="" sizes.="" solid="" state="" td="" use=""></nema>
	Control Power Transformer Ethernet Interface	Provide where shown with rated 120VAC secondary and primary and secondary fusing. Where Ethernet interface is specified for motor starter units Ethernet requirements shall take precedence over these overload relay
	Overload and Phase Protection	requirements See above

ITEM	DESCRIPTION	
	Auxiliary Contacts	Provide starters with at least 1 NO and 1 NC auxiliary contact in addition to
		hold-in contact and auxiliary contacts shown on Plans Starter shall
		accommodate ≥6 auxiliary contacts beyond hold-in contact.
	HOA Selector Switch	Door-mounted switch for HAND-OFF-AUTO operation.
		HAND Mode shall provide local control.
		In AUTO Mode, start control shall be provided through remote contact.
		Provide extra set of contacts on selector for monitoring switch position.
	Pilot Lights	120VAC LED pilot lights,
		Push-to-test type
		22.5mm diameter
		Mounted on enclosure door showing
		1. RUN (Red)
		2. OFF (Green)
Solid-State		Refer to Section 26 29 13
Reduced-		
Voltage (SSRV)		
Motor		
Controllers		

H. The following product design criteria, options and accessories are required for RTD temperature monitoring and alarm systems:

ITEM		DESCRIPTION
Resistance-	General	Provide RTD temperature monitoring and alarm system for each motor
Temperature	Requirements	specified with RTDs as shown on Plans.
Detector (RTD)		Temperature monitor shall provide monitoring and protection for motor
Temperature		starter, motor bearing, and load bearing windings.
Monitoring and		Temperature monitoring system shall be compatible with RTDs installed.
Alarm System		Temperature monitor shall be capable of monitoring each RTD individually
		through direct digital readout and allow for manual adjustments of alarm
		set points.
	Output Contacts	Each RTD monitor shall have 3 Form C dry output contacts for pre-alarm,
		alarm, and trip controls and 4-20ma temperature output for remote
		monitoring.
	Required Features	1. Capacity for ≥8 RTD inputs.
		Display of actual temperatures and set points.
		3. Maximum temperature recall.
		4. Broken sensor alarm.
		5. Manual test of output relays.
		6. Tamperproof set points.
		7. Novolatile memory, retaining set points, maximum values, temperature sensor, etc., after loss of control supply.
		8. Two programmable analog 4-20ma outputs, including "hottest winding
		RTD" and "hottest bearing RTD".
		9. Serial Modbus RS485.

I. The following product design criteria, options and accessories are required for Ethernet IP communication systems:

ITEM		DESCRIPTION		
Requirements	Unit shall have Ethernet wiring incorporated into its design.			
		Supply each motor starter, AC drive, and soft starter unit in MCC with means to communicate via Ethernet/IP network		
Ethernet Cable	Cable Ratings	600VAC UL PLTC rated.		
		Do not use 300VAC-rated cable.		
	Layout	Connect cable from each section to 1 another in top or bottom wireways. Route Ethernet cable through MCC section from top or bottom wireways. To prevent accidental mechanical damage during MCC installation, locate cable behind barriers to isolate cable from unit space and wireways. Provide 8 Ethernet ports in rear of each vertical wireway of standard sections to simplify installation, relocation, and addition of plug-in units.		

ITEM	DESCRIPTION		
		Ethernet/IP device within each unit shall be factory connected to Ethernet	
		port in vertical wireway.	
Power Supplies	Requirements	Power supply shall provide 24VDC for devices requiring it. MCC manufacturer shall check user's design to ensure adequate power supplies have been specified to conform with network requirements. Power supply output shall be rated 8A, 24VDC. Provide power supply unit with buffer module to provide ≥500 ms ridethrough at full load.	
Ethernet/IP Interface for Motor Starter Units	Overload Relay	Motor starter units shall have electronic overload relay incorporating: 1. Built-in EtherNet/IP communication 2. LEDs for status indication 3. Test / Reset Button 4. Selectable trip of NEMA Class 5 to 30. 5. Unless indicated, set trip class for NEMA Class 20 operation. 6. Four inputs and 2 outputs. 7. Refer to Plans for connection requirements. 8. Protective functions Functions shall provide programmable trip level, warning level, time delay	
	Protective Functions	and inhibit window. Include thermal overload, phase loss, stall, jam, underload, current imbalance, remote trip and PTC thermistor input.	
	Ground Fault Protection	If ground fault protection is required, protection range shall be: 1A to 5A for NEMA Size 3 and smaller starters; 20 mA to 5A for NEMA Size 4 and larger starters.	
	Current Monitoring Functions	Include phase current, average current, full-load current, current imbalance percent, percent thermal capacity utilized and ground fault current (if required).	
	Other Monitoring Functions	Include voltage, energy, and frequency measuring capabilities.	
	Diagnostic Information	Include device status, warning status, time to reset, trip status, time to overload trip and history of last 5 trips.	
	Preventative Maintenance Information	Include allowable starts per hour, required time between starts, starts counter, starts available, time until next start, total operating hours, and elapsed operating time	
	Logic Processor	Include on-board logic processor to allow basic logic to be performed within overload relay based on network data and status of inputs to overload relay.	
	Ethernet/IP Overload Relay	Support the following CIP messaging types: Polled I/O messaging, Change-of-state/cyclic messaging, Explicit messaging, Group 4 offline node recovery messaging, and Unconnected Message Manager (UCMM). Provide the following functions to minimize network configuration time: Full parameter object support, Configuration consistency value, and Add-on Profile.	
	Ethernet/IP Interface for Solid-State Reduced-Voltage Motor Controllers	Supply Ethernet/IP communications interface to allow for communications between solid-state components and Ethernet system.	
	Ethernet/IP Interface for Other Units	Provide Ethernet/IP interface for other units as shown on Plans Refer to Plans for wing diagrams for points to be monitored	
	Programming and Testing	 MCC Manufacturer shall load IP Address into each unit. IP Address shall be as shown on Plans or provided by Owner. Each unit shall have label showing IP Address for devices within it. MCC Manufacturer shall provide disk containing applicable electronic data sheet (EDS) files for EtherNet/IP devices. MCC Manufacturer shall provide licenced software for RSNetWorx for Ethernet and Devicenet. 	

J. The following electrical design criteria are required for equipment specified in this section:

ITEM	DESCRIPTION		
Electrical Work	NEC Article 505	Nonhazardous	
	Classification		
Enclosures –	NEMA 250	NEMA 12 – Industrial Use	
Indoor Dry	Enclosure Rating		
Locations			
Enclosures –	NEMA 250	NEMA 12 – Industrial Use	
Indoor Damp	Enclosure Rating		
Locations	NEMA 050	NEW W. W. C. L. D. L. C. C. L.	
Enclosures –	NEMA 250	NEMA 4X – Watertight, Corrosion-Resistant, Stainless steel	
Outdoor or Wet Locations	Enclosure Rating		
Enclosures	Construction	Refer to Section 26 05 47	
LIIGIOSUIES	Construction	Freestanding, rear-aligned	
		Bolt 1 or more vertical sections together to form rigid free-standing assembly.	
		Design to allow adding future sections at either end and to permit	
		interchanging units.	
		Provide internal mounting angles continuous within shipping block	
		Provide removable steel lifting angle on shipping blocks	
	Dimensions	As shown on Plans	
		90" high, 20" deep, except where larger dimensions required.	
	IEC 60529 Enclosure	IP 65 water jet	
	Rating for	,	
	Underground		
	Equipment		
	Front Door	Hinged	
		Lockable	
	Dead Front	Dead front design	
	Nameplates	Refer to Section 26 05 10.	
		Provide on each compartment. Engrave with inscriptions shown on Contract Document single-line diagram	
		Provide 6.25" x 2" door-mounted nameplate showing system Short-Circuit	
		Current Rating (SCCR)	
		Provide warning nameplate on each starter to warn operator to open circuit	
		breaker before performing maintenance.	
	Exterior Finish	For steel provide rust-inhibiting primer and then Manufacturer's factory-	
		baked enamel	
		Refer to Section 09 90 00	
		Color ANSI 61 Gray.	
		Plate unpainted parts for corrosion resistance	
		For stainless steel, do not paint.	
		Grind door front smooth	
	Interior Finish	For plastic or FRP, do not paint For steel provide rust-inhibiting primer and then Manufacturer's factory-	
	Intenor Finish	baked enamel	
		on interior panels and directory frame print pockets.	
		Refer to Section 09 90 00	
		Color ANSI 61 Gray	
		For stainless steel, do not paint.	
		For plastic or FRP, do not paint.	
Power Supply	Motor Circuit	460VAC – 3Φ – 60Hz	
	Battery Backup	Required	
	Heating Circuit	460VAC – 3Φ – 60Hz	
	Control Panel	120VAC – 1φ – 60Hz	
	Instruments	24 VDC at control panel	
	Solenoid	As shown on plans	
	Lighting Circuit	120VAC – 1Φ – 60Hz	

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install motor control centers before submitting shop drawings or ordering.
 - 1. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
 - 2. Layout switchgear to maintain NEC Article 110-26 clearances on all sides of equipment.
- B. Examine areas and conditions under which Work of this section will be performed.
 - 1. Correct conditions detrimental to timely and proper completion of Work.

3.2 Installation

- A. Refer to Sections 01 73 00 and 01 73 24 for basic execution and installation requirements.
- B. Refer to Section 31 23 00 for open trench requirements.
- C. Furnish and install motor control centers at locations shown on Plans and Submittals.
- D. Conform to the following installation standards:
 - 1. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 2. Other applicable OSHA and Cal OSHA regulations
 - 3. California Electrical Code Article 430 "Motors, Motor Circuits, and Controllers."
 - 4. Other applicable building, fire, plumbing, mechanical and electrical code requirements
 - 5. NEMA ICS2 Industrial Control and Systems Controllers
 - 6. NETA (National Electrical Testing Association) ATS standards
 - a. NETA ATS 7.1 for switchgear and switchboards.
 - 7. Manufacturer's installation and warranty requirements
- E. Refer variances between above documents and Contract Documents to Owner's Representative.
- F. Install motor control centers to tolerances recommended by Manufacturer.
 - 1. Unless otherwise shown, install motor control centers true, plumb, and level using precision gauges and levels.
- G. Install motor control centers as follows:
 - 1. Tighten accessible bus connections and mechanical fasteners to Manufacturer's torque requirements.
 - 2. Select and install fuses in fusible switches based upon field requirements.
 - 3. Adjust circuit breaker settings based upon field requirements.
 - 4. Adjust solid state overloads to match installed motor characteristics.
- H. Secure switchboards to floors or mounting pads as follows:
 - 1. Mount MCC to housekeeping pad per Manufacturer's Installation Instructions and submitted Engineering Calculations for seismic anchorage.
 - 2. Grout mounting channels provided with MCC into floor or mounting pads.
 - 3. Secure MCC to concrete with Type 304 SS anchor bolts, self-drilling anchors, or expansion anchors per Section 05 05 19.
 - a. Do not use powder-actuated fasteners.
 - 4. Provide shims where necessary to attain level horizontal and vertical plumb conditions.
 - 5. Securely mount surface boxes, cabinets, and apparati.
 - 6. Do not fasten supports to piping, ductwork, conduit, or mechanical equipment.
 - 7. Do not drill or cut structural steel members.
 - 8. Brace MCC every 10' and within 3' of each end with 1/4" angle iron, P1000 Unistrut and fittings, or equal.
 - 9. Bolt adjacent sections of lineup to each other per Manufacturer's recommendations.
 - 10. Mount back of floor-mounted MCCs as close as possible to building wall to prevent buildup of debris behind switchboard.
- I. Provide venting, ventilation or air conditioning as shown, and as required to:

- 1. Conform to electrical equipment warranty requirements.
- 2. Prevent condensation from damaging enclosed electrical equipment.
- 3. Maintain interior cabinet temperatures at ≤ 95 *F.
 - a. Locate heat-producing equipment including power supplies near top of cabinets.
- 4. Where forced air cooling is required, provide ventilation fans, vents, and filters.
 - a. For cabinets with forced ventilation, doors and side panels shall be solid with no louvers.
- 5. Construct top-mounted air-conditioning units to prevent condensation from damaging electrical equipment or enclosure.
- J. Bond switchboard enclosure to grounding system with equipment grounding conductor.
- K. Set main circuit breaker trip units and calibrated per set points determined by Overcurrent Protection Coordination Study.
 - 1. Refer to Specification Section 26 05 10.

3.3 Field Quality Control

A. Field testing and adjustment shall include:

		TEST STANDARD		FIRST TEST PAID	RETESTS PAID FOR
ITEM	TEST FOR	(ASTM OR OTHER TEST STANDARD)	FREQUENCY	FOR BY	BY
Motor	Installation	Visual inspection of finished installation.	1 inspection	Owner	Owner
Control		Inspect doors, panels, and sections and			
Centers		repair physical damage, dents, and			
		scratches.			
		Verify proper alignment and anchorage.	4.1		
	System	Refer to Section 26 08 00 and NETA	1 demonstration	Contractor	Contractor
	Demonstration	ATS 7.1	of complete electrical system		
	Key Interlock	Attempt to close locked-open devices.	1 test each	Contractor	Contractor
	Systems	Attempt to open locked-closed devices.	interlock		
		Make key exchange with devices			
		operated in off-normal positions			
	Connections	Examine connections for tightness and	1 inspection	Contractor	Contractor
		proper compression.			
		Check tightness of accessible bolted			
		bus joints by calibrated torque-wrench			
		method and compare to Manufacturer's			
	N1 1.4	recommended foot-lb torques	4.2 (1)	0 1 1	0 1 1
	Nameplate	Compare equipment nameplate	1 inspection	Contractor	Contractor
	Information	information with Record Drawing single-			
	Dawar Francisco	line diagram and report discrepancies.	1 test each	Contractor	Comtractor
	Power-Frequency Voltage Withstand	Verify integrity of insulation, breaker operation, and that all phases of each	phase of each	Contractor	Contractor
	Test	load are disconnected	circuit breaker		
	Breaker Settings	Spot check against short-circuit study.	1 inspection	Contractor	Contractor
	Adjustable Breaker	Set adjustable trip circuit breakers 2	1 adjustment	Contractor	Contractor
	Setting	settings above that causing breaker to	each adjustable	Contractor	Contractor
	Coung	trip during motor starting.	breaker		
		Do not adjust setting >1300% of motor	Di Galloi		
		nameplate current rating.			
	Programmable	Make per Manufacturer's	Each motor	Contractor	Contractor
	Adjustments	recommendations.	circuit		
	,	Initial setting for current limit shall be			
		300%.			
		Adjust undercurrent setting to protect			
		pump motors from loss of suction or			
		shutoff head conditions			
	Motor Current	Record current in each phase of each	Each phase of	Contractor	Contractor
		motor and include in O&M manual.	each motor		

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
		Repair or replace motor or motor-driven			
		equipment if current exceeds motor			
		nameplate FLC value.			
	Ground Fault	NEC 230-95C	1 test	Contractor	Contractor
	Protective Equipment	Submit written record to Owner's Representative.			
		Record current pickup level and time- delay settings to which equipment was finally adjusted.			
		Measure and record relay pickup current and relay time delay at two			
		values above pickup. Test for correct system operation at			
		57% rated voltage. If relay pickup current is not within 10%			
		of Manufacturer's calibration marks or			
		fixed setting or relay timing does not			
		conform with Manufacturer's published			
		time-current characteristic curves, repair or replace equipment and repeat test.			
	Voltage	When installation is substantially	1 test	Contractor	Contractor
	Voltage	complete and plant is in operation,	1 1001	Contractor	Contractor
		check voltage at servicing electrical			
		utility point of termination to project.			
		Check voltage amplitude and balance			
		between phases for loaded and			
		unloaded conditions			
		If phase unbalance (as defined by			
		NEMA) exceeds 1%, or if voltage varies			
		throughout day and from loaded to			
		unloaded conditions more than ±5% of			
		nominal, make written request to at			
		servicing electrical utility for condition to			
		be corrected.			
		If corrections are not made, request			
		from Electrical Utility official a written statement voltage variations and/or			
		unbalance are within their normal			
		standards.			
	Field Performance	Demonstrate compliance to Contract	1 test	Contractor	Contractor
		Documents and Manufacturers' printed Literature		25	25
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturers printed	1 test	Owner	Contractor
		Literature			

B. Field Adjustments

- 1. Retighten current-carrying bolted connections and support framing and panels to NEMA standards.
- 2. Field-adjust trip settings of motor starter magnetic trip-only circuit breakers.
- 3. Adjust equipment to conform to Manufacturers' recommendations and warranty requirements.
- 4. Prepare tabulation of motors showing the following to be included in O&M Manual:
 - a. Motor name
 - b. Motor horsepower
 - c. Nameplate full-load current.
 - d. Measured load current
 - e. Heater catalog number

- f. Protective device
- g. Trip setting
- 5. Attach copy of starter Manufacturer's overload heater selection tables to tabulation, showing only tables for starters provided.

C. Field Acceptance Tests

- 1. Perform field acceptance tests after installing equipment.
- 2. Verify equipment has arrived onsite in good condition and has been installed properly.
- 3. Demonstrate assembly and components are operable and operate in accordance with requirement and intent of Contract Documents.
- 4. Perform testing in accordance with Manufacturer's standard procedure and applicable codes as accepted by Owner's Representative.
- 5. Test equipment for field tests will be provided by Contractor.
- 6. Perform test at time accepted by Owner's Representative.
- Field tests shall be witnessed by Owner's Representative and properly documented using accepted test report sheets.
 - Submit completed reports to Owner's Representative ≤24 hours after performance of tests.
- D. Provide services of factory-authorized representative on-site for ≥2 man-days (travel time excluded) to provide:
 - 1. Installation assistance, inspection and startup of complete motor control center system.
 - 2. Field testing and adjustment.
 - 3. Instruction of Owner's personnel in operation and maintenance.
 - 4. Following installation and adjustment, certify equipment has been properly installed and tested and is ready to be energized.
- E. MCC Manufacturer shall be capable of providing programming for programmable logic controller and operator interface if provided within MCC.

3.4 Protection

- A. Dress cables neatly within motor control center cabinets and enclosures.
 - 1. Trim and dispose of excess cable.
- B. Keep motor control centers covered during construction.
 - 1. Prevent plaster, paint, or dust from defacing finish of equipment.
 - 2. Clean interior and exterior after connections are completed.
 - 3. Check factory connections and re-torque tight as required.
 - 4. After equipment is installed, touch up scratches and marks incurred during shipment or installation.
 - a. Field- or factory-repair damage to condition acceptable to Owner.
 - 5. Prior to final acceptance, reclean interior of equipment of foreign materials and debris.
 - 6. Repair blemishes or defects on exterior of equipment by painting equipment with paint supplied by Manufacturer of equipment to match factory finishes.
 - a. If required by Owner's Representative due to excessive scratching, repaint entire assemblies.

3.5 Spare Parts

A. Furnish the following spare parts:

QUANTITY	PART
3	Spare fuses each size power fuse used
>10% of	Spare fuses for primary and secondary control power transformer protection
installed	
quantity	
1	Spare starter for each NEMA size provided
5	Each type control relay provided
5	Each type tine delay relay provided
20	Each type lamp provided
1 quart	Touch-up paint of each color used

Other spare parts recommended by Manufacturer

END OF SECTION

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SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of switches, receptacles, and other wiring devices.
- B. Refer to the following sections for Work not covered herein.
 - 1. Section 28 31 00 for intrusion switches.

1.2 Related Work

- A. Section 01 10 01: Summary of Work and Sequence of Construction
- B. Section 01 22 00: Unit Prices
- C. Section 01 33 00: Submittal Procedures
- D. Section 01 40 00: Quality Requirements
- E. Section 01 61 00: Common Product Requirements
- F. Section 01 65 00: Product Delivery Requirements
- G. Section 01 66 00: Product Storage and Handling Requirements
- H. Section 01 73 00: Execution
- I. Section 26 05 10: Common Work Results for Electrical
- J. Section 26 05 19: Low-Voltage Electrical Power Conductors and Cables
- K. Section 26 05 26: Grounding and Bonding for Electrical Systems
- L. Section 26 28 00: Low-Voltage Circuit-Protective Devices
- M. Section 28 31 00: Intrusion Detection

1.3 System Description

A. Furnish and install wiring devices including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building and electrical codes and standards.

1.4 Quality Assurance

- A. Use adequate number of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Switches and Receptacles	UL Listing	UL Standards	All wiring devices	Contractor	Contractor

1.5 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 2. California Building Code (CBC)
 - 3. California Electrical Code (CEC)
 - 4. California Fire Code (CFC)
 - 5. California Mechanical Code (CMC)
 - 6. Fed Spec W-C-596 Connector, Receptacle, Electrical, General Purpose, Duplex, General Grade and Hospital Grade, Grounding, 2-Pole, 3-Wire, 20 Amperes 125Voltsw, 50/60 Hertz, Box-Mount and Snap-In Mount
 - 7. Fed Spec W-S-896E Switches, Toggle and Lock., Flush-Mounted (AC)
 - 8. Fed Spec W-S-896F (1P-ZP-3W) Switch, Toggle, Single Unit with Wall Plates for Switches and Receptacles.

- 9. NEMA/ANSI 250 Enclosures for Electrical Equipment
- 10. NEMA KS1 Enclosed Switches
- 11. NEMA WD1 General Purpose Wiring Devices.
- 12. NEMA WD6 Wiring Device Configurations.
- 13. NFPA 70 National Electric Code (NEC)
- 14. UL 20 General Use Snap Switches
- 15. UL 943 Ground Fault Circuit Interrupters
- 16. UL 2682 Switch-Rated Plugs and Receptacles

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION		
	MANUFACTURER'S LITERATURE		
Product Data	luct Data Submit per Product Data requirements.		
Material List	Submit material list for each type of switch, receptacle, and cover plate.		
	Submit material list for each additional type of wiring device listed herein.		
Indicate type, voltage rating, continuous current rating, conduit entry restrictions, enclosure type, dimensions, material, color, and Manufacturer.			
	QUALITY ASSURANCE AND CONTROL SUBMITTALS		
Certificate of Compliance	ertificate of Compliance Submit evidence of UL listing		
CLOSEOUT SUBMITTALS			
Warranty	Furnish 1-year warranty from date of final acceptance		

B. Refer to Section 01 33 00 for definition of requirements for Product Data, and Certificates of Compliance.

1.7 <u>Delivery, Storage and Handling</u>

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Strictly follow Manufacturer's instructions and warranty requirements for delivery, storage and handling of wiring devices.

1.8 **Project Site Conditions**

A. Refer to Section 01 10 01 for full list of project site conditions.

1.9 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for wiring devices.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Acceptable Manufacturers for basic wiring devices include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION		
	20-AMP 125VAC RECEPTACLES			
Receptacles	Appleton / Emerson	Rosemont, IL (800) 621-1506		
	Arrow-Hart / Eaton	Beachwood, OH (216) 523-5000		
	Crouse Hinds / Eaton	Syracuse, NY (866) 764-5454		
	General Electric	Fairfield, CT (800) 626-2000		
	Hubbell / Bryant	Milford, CT (800) 288-6000		
	Leviton Manufacturing Co "Lev-Spec"	Melville, NY (800) 323-8920		
	Pass & Seymour / Legrand	West Hartford, CT (877) 295-3472		
	Sierra Electric Corporation	San Francisco, CA (415) 752-2850		
	Accepted equal			
Receptacles NEMA 5-	Arrow-Hart / Eaton 5361 Series	Beachwood, OH (216) 523-5000		
20 20A-125VAC	General Electric GE4102 Series	Fairfield, CT (800) 626-2000		
Straight-Blade	Hubbell / Bryant 5361 Series	Milford, CT (800) 288-6000		
Grounding Type	Leviton Manufacturing Co "Lev-Spec" 5361-I Series	Melville, NY (800) 323-8920		
Single-Outlet	Pass & Seymour / Legrand 5361 Series	West Hartford, CT (877) 295-3472		

ITEM	MANUFACTURER	MANUFACTURER LOCATION	
	Accepted equal		
Receptacles NEMA 5-	Arrow-Hart / Eaton 5362 Series	Beachwood, OH (216) 523-5000	
20 20A-125VAC	General Electric GE4108 Series	Fairfield, CT (800) 626-2000	
Straight-Blade	Hubbell / Bryant 5362 Series	Milford, CT (800) 288-6000	
Grounding Type	Leviton Manufacturing Co "Lev-Spec" 5362-I Series	Melville, NY (800) 323-8920	
Duplex-Outlet	Pass & Seymour / Legrand 5362-A Series	West Hartford, CT (877) 295-3472	
	Accepted equal		
Receptacles NEMA 5-	3M "GFI-2701"	St Paul, MN (888) 364-3577	
20 20A-125VAC	Arrow-Hart / Eaton GF5342 Series	Beachwood, OH (216) 523-5000	
Straight-Blade GFCI	Hubbell / Bryant GF5362 Series	Milford, CT (800) 288-6000	
Ground Fault Current	Leviton Manufacturing Co "6899-HGI"	Melville, NY (800) 323-8920	
Interrupter Duplex -	Pass & Seymour / Legrand 2091-F Series	West Hartford, CT (877) 295-3472	
Outlet	Schneider Electric Square D	Andover, MA (888) 778-2733	
	Accepted equal		
Receptacles NEMA 5-	Hubbell / Bryant 6352-IS Series	Milford, CT (800) 288-6000	
20 20A-125VAC	Leviton Manufacturing Co "6399-HGI"	Melville, NY (800) 323-8920	
Straight-Blade GFCI Surge suppression Outlet	Accepted equal		
Receptacles NEMA 5-	Arrow-Hart / Eaton 6200 Series	Beachwood, OH (216) 523-5000	
20 20A-125VAC 2-Pole	General Electric GL0520 Series	Fairfield, CT (800) 626-2000	
3-Wire Locking and	Hubbell / Bryant 2310 Series	Milford, CT (800) 288-6000	
Grounding Type	Leviton Manufacturing Co "Lev-Spec" 2310 Series	Melville, NY (800) 323-8920	
Crounding Typo			
	Pass & Seymour / Legrand L520-R Series	West Hartford, CT (877) 295-3472	
Compaign Desistant	Accepted equal	M:If-and CT (900) 200 6000	
Corrosion-Resistant	Hubbell Electrical Products "53CM62GY"	Milford, CT (800) 288-6000	
Receptacles	Accepted equal	TACLES	
Decented to NEMA 6	20-AMP 250VAC RECEP Arrow-Hart / Eaton 5861 Series		
Receptacles NEMA 6- 20 20A-250VAC 2-Pole		Beachwood, OH (216) 523-5000	
3-Wire Straight-Blade	General Electric GE4182 Series	Fairfield, CT (800) 626-2000	
Grounding Type	Hubbell / Bryant 5461 Series	Milford, CT (800) 288-6000	
Grounding Type	Leviton Manufacturing Co "Lev-Spec" 5461-I Series	Melville, NY (800) 323-8920	
	Pass & Seymour / Legrand 5871-A Series	West Hartford, CT (877) 295-3472	
D. () NEMAO	Accepted equal	D 1 011 (040) 500 5000	
Receptacles NEMA 6-	Arrow-Hart / Eaton 6210 Series	Beachwood, OH (216) 523-5000	
20 20A-250VAC 2-Pole	General Electric GL0620 Series	Fairfield, CT (800) 626-2000	
3-Wire Locking and	Hubbell / Bryant 2320 Series	Milford, CT (800) 288-6000	
Grounding Type	Leviton Manufacturing Co "Lev-Spec" 2320 Series	Melville, NY (800) 323-8920	
	Pass & Seymour / Legrand L620-R Series	West Hartford, CT (877) 295-3472	
	Accepted equal		
Welding Receptacles	Crouse Hinds / Eaton	Syracuse, NY (866) 764-5454	
	Accepted equal		
	RECEPTACLE PLA		
Receptacle Plates	Ideal Industries, Inc.	Sycamore, IL (815) 895-5181	
	Hubbell RACO TayMac	Milford, CT (800) 288-6000	
	Kyle Switch Plates	Livermore, CA (800) 551-5953	
	Sierra Electric Corporation	San Francisco, CA (415) 752-2850	
	Accepted equal		
Receptacle Plates –	Crouse Hinds / Eaton	Syracuse, NY (866) 764-5454	
"While-in-Use" Outdoor	General Electric	Fairfield, CT (800) 626-2000	
Weatherproof (WP)	Hubbell / Bell	Milford, CT (800) 288-6000	
	Hubbell / Bryant RB5000 Series	Milford, CT (800) 288-6000	
	Pass & Seymour / Legrand	West Hartford, CT (877) 295-3472	
	Sierra Electric Corporation	San Francisco, CA (415) 752-2850	
	Accepted equal		
	SWITCHES	1	
Wall Switches SPST Arrow-Hart / Eaton 1991 Series Beachwood, OH (216) 523-5000			
Wall ewiteries of 61 / Will what / Eater 1991 oction Beddinwood, 611 (210) 020 0000			

ITEM	MANUFACTURER	MANUFACTURER LOCATION
	General Electric GE5951-G Series	Fairfield, CT (800) 626-2000
	Hubbell / Bryant 1221 Series	Milford, CT (800) 288-6000
	Leviton Manufacturing Co "Lev-Spec" 1221-2I Series	Melville, NY (800) 323-8920
	Pass & Seymour / Legrand 20AC1 Series	West Hartford, CT (877) 295-3472
	Accepted equal	, , ,
Wall Switches DPST	Arrow-Hart / Eaton 1992 Series	Beachwood, OH (216) 523-5000
	General Electric GE5952-G Series	Fairfield, CT (800) 626-2000
	Hubbell / Bryant 1222 Series	Milford, CT (800) 288-6000
	Leviton Manufacturing Co "Lev-Spec" 1222-2I Series	Melville, NY (800) 323-8920
	Pass & Seymour / Legrand 20AC2 Series	West Hartford, CT (877) 295-3472
	Accepted equal	
Wall Switches 3-Way	Arrow-Hart / Eaton 1993 Series	Beachwood, OH (216) 523-5000
,	General Electric GE5953-G Series	Fairfield, CT (800) 626-2000
	Hubbell / Bryant 1223 Series	Milford, CT (800) 288-6000
	Leviton Manufacturing Co "Lev-Spec" 1223-2I Series	Melville, NY (800) 323-8920
	Pass & Seymour / Legrand 20AC3 Series	West Hartford, CT (877) 295-3472
	Accepted equal	
Wall Switches SPST	Arrow-Hart / Eaton 1991-L Series	Beachwood, OH (216) 523-5000
Key Switches	General Electric GE5951-OLG Series	Fairfield, CT (800) 626-2000
,	Hubbell / Bryant 1221L Series	Milford, CT (800) 288-6000
	Leviton Manufacturing Co "Lev-Spec" 1222-2IL Series	Melville, NY (800) 323-8920
	Pass & Seymour / Legrand 20AC1L Series	West Hartford, CT (877) 295-3472
	Accepted equal	
Momentary Contact	Arrow-Hart / Eaton 1995 Series	Beachwood, OH (216) 523-5000
Switches 20A	General Electric GE5935-G Series	Fairfield, CT (800) 626-2000
120/277VAC	Hubbell / Bryant 1557 Series	Milford, CT (800) 288-6000
	Leviton Manufacturing Co "Lev-Spec" 1257-I Series	Melville, NY (800) 323-8920
	Pass & Seymour / Legrand 1250 Series	West Hartford, CT (877) 295-3472
	Accepted equal	(, , , , , , , , , , , , , , , , , , ,
	SWITCH PLATES	
Switch Plates	Carlon / Lamson & Session Co "#E98TSCN-CAR"	Cleveland, OH (800) 346-2646
	Kyle Switch Plates	Livermore, CA (800) 551-5953
	Accepted equal	, , ,
Switch Plates -	Appleton / Emerson "FSK-1VS"	Rosemont, IL (800) 621-1506
Padlockable	Crouse Hinds / Eaton "DS185"	Syracuse, NY (866) 764-5454
	Accepted equal	
Switch-Rated Plugs and	Meltric Corporation "Decontactor Series"	Franklin, WI (414) 433-2700
Receptacles	Accepted equal	
Switch Plates – Outdoor	Appleton / Emerson "FSK-1VTS" or "FSK-1VS"	Rosemont, IL (800) 621-1506
Weatherproof (WP)	Crouse Hinds / Eaton "DS-181" or "DS185"	Syracuse, NY (866) 764-5454
. , ,	Hubbell / Bryant 7420 Series	Milford, CT (800) 288-6000
	Accepted equal	, - \ ,

B. Acceptable Manufacturers for other wiring devices include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION		
	PUSH BUTTONS, HAND SWITCHES, AND INDICATING LAMPS			
Push Buttons – Indoor	Allen-Bradley / Rockwell Automation Bulletin 800H	Milwaukee, WI (414) 382-2000		
Locations	Schneider Electric Square D Class 9001 Type K	Andover, MA (888) 778-2733		
	Accepted equal			
Push Buttons –	Allen-Bradley / Rockwell Automation Bulletin 800H	Milwaukee, WI (414) 382-2000		
Outdoor and Damp	Schneider Electric Square D Class 9001 Type SK	Andover, MA (888) 778-2733		
Locations	Accepted equal			
Selector Switches	Schneider Electric Square D Class 9001 Type K	Andover, MA (888) 778-2733		
	Accepted equal			
Indicating Lights 120V	Allen-Bradley / Rockwell Automation Type PSB120	Milwaukee, WI (414) 382-2000		
	General Electric "#CR104PLT22"	Fairfield, CT (800) 626-2000		
	Schneider Electric Square D Class 9001 Type K	Andover, MA (888) 778-2733		
	Accepted equal			

ITEM	MANUFACTURER	MANUFACTURER LOCATION	
	RELAYS		
Control Relays 24V DPDT	Allen-Bradley / Rockwell Automation 700-HA32Z24 Relay 700 HN 125, 10A, 300V Relay Base	Milwaukee, WI (414) 382-2000	
	Accepted equal		
Control Relays 24V TPDT	Allen-Bradley / Rockwell Automation 700-HA33Z24 Relay 700-HN126, 10A, 300V Relay Base	Milwaukee, WI (414) 382-2000	
	Accepted equal		
Timing Control Relays 24V DPDT	Allen-Bradley / Rockwell Automation 700-HR52TZ24 Relay 700 HN 101, 10A, 300V Relay Base	Milwaukee, WI (414) 382-2000	
	700-HN131 Retainer Clip Accepted equal		
Control Relays 120V DPDT	Allen-Bradley / Rockwell Automation 700-HA32A1 Relay 700 HN125, 10A, 300V Relay Base	Milwaukee, WI (414) 382-2000	
5.5.	Schneider Electric Square D Class 8501 Type KP NR51	Andover, MA (888) 778-2733	
0 (10) (00)	Accepted equal	N	
Control Relays 120V TPDT	Allen-Bradley / Rockwell Automation 700-HA33A1 Relay 700-HN126, 10A, 300V Relay Base	Milwaukee, WI (414) 382-2000	
Timing Control Delays	Accepted equal	Milwayles W/I (444) 202 2000	
Timing Control Relays 120V	Allen-Bradley / Rockwell Automation 700-HR52TA17 Relay 700-HN126, 10A, 300V Relay Base 700-HN131 Retainer Clip	Milwaukee, WI (414) 382-2000	
	Schneider Electric Square D Class 9050 Type JCK with socket	Andover, MA (888) 778-2733	
	Accepted equal		
Intrusion Switches	Refer to Section 28 31 00		
Time-of-Use Override Switches	Eaton Cutler-Hammer 1025016H Switch 2 NO 10250T2 Contact Block 10250T15112H501 #501CH Key	Cleveland, OH (800) 386-1911	
	No exceptions		
Intrinsically Safe Barrier 24VDC	Ingram Micro / HNA Two Channel Relay with Intrinsically Safe Inputs, "ISR2-24V-10K"	Irvine, CA (714) 566-1000	
Contacts and Relays	No exceptions		
Intrinsically Safe	Warrick / Gems Sensors, Inc Series 27A1DO	Plainville, CT (855) 877-9666	
Barrier 120VAC Contacts and Relays	No exceptions		
	TERMINAL BLOCKS		
Control Wiring	Phoenix Contact USK-4 or USK-10 with mounting rack	Middletown, PA (800) 888-7388	
Terminal Blocks 120V DIN Rail Mounted	No exceptions		
Control Wiring Terminal Blocks DIN	Phoenix Contact UK5N (for power and general terminations)	Middletown, PA (800) 888-7388	
Rail Mounted	Phoenix Contact UKK 5TG (for discrete I/O terminations)	Middletown, PA (800) 888-7388	
	Phoenix Contact DOKD 1.5TG (for analog terminations)	Middletown, PA (800) 888-7388	
	Phoenix Contact ST-SILED 24-UK 4 (for fuse-plug terminations with indicator)	Middletown, PA (800) 888-7388	
	Phoenix Contact USLKG 5 (for ground terminations) No exceptions	Middletown, PA (800) 888-7388	
Terminal Blocks 600V	Electrovert / Wieland	Oakville, ON (905) 829-8414	
TOTTITION DIOCKS OUUV	Ideal Industries, Inc.	Sycamore, IL (815) 895-5181	
	Weidmuller USA	Richmond, VA (800) 849-9343	
	Accepted equal	1	

2.2 <u>Materials</u>

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Materials for basic wiring devices shall be:

ITEM	MATERIAL	SPECIFICATION

ITEM	MATERIAL	SPECIFICATION
Receptacle Bases	Polycarbonate	High-strength
	Color	Brown
Switch Plate Type	varies	Plate rocker switch cover
Mounting Hardware	Mounting Holes	Countersunk
-	Mounting Screws	Oval-head stainless steel screws of color matching plate
Device Plates for	General	Plates shall fit snugly to box to which they are mounted.
Receptacles and		On surface-mounted boxes, plates shall not extend beyond sides of box
Switches		unless plates are free of sharp corners or edges.
	Plate Type	Refer to table below
	Location	Plate Type
	Interior	Stainless Steel (SS)
	Office	Plastic (P)
	Exterior (WP	Weatherproof (WP)
	Designation)	
	Flush-Mounted	Metal (M)
	Boxes	
	Surface-Mounted	Cast Metal (CM)
	Cast Metal Boxes	
	Surface-Mounted	Metal (M)
	Sheet Metal Boxes	
	Corrosive or Wet	Polycarbonate
	Areas or Areas	
	Subject to	
DESERTACIES	Hosedown	DOGUNEN OR WET AREAS OR AREAS SUR LEGT TO HOSER SWILL
	1	RROSIVE" OR WET AREAS OR AREAS SUBJECT TO HOSEDOWN
Receptacle Cover	Polycarbonate	Individually gasketed
Plates – "Corrosive"	Color	Brown
or Wet Areas or		
Areas Subject to Hosedown		
TIOSECOWII	WEATHEDDDOOE	(WP) PLATES (Use for outdoor applications)
Receptacle Plates	Cast Metal or	Provide soft-gasketed "while-in-use" cover plates ≥ 0.040" thick
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Stainless Steel	Provide individual spring-loaded cap over each receptacle opening.
	Otali licos otoci	Stainless steel springs shall hold caps closed when receptacle is not in
		use.
Switch Plates	Cast Metal or	Provide gasketed plates ≥ 0.040" thick
	Stainless Steel	Provide provisions for padlocking switches "ON" and "OFF"
		Incorporate external operator for internal switch
	RAIS	ED SHEET METAL (SM) PLATES
Device Plate	Galvanized Steel	½"-high device plate designed for 1-piece drawn type sheet steel box
		EPTACLE COVER AND SWITCH PLATES
Metal (M) Plates	General	For surface-mounted outlet boxes, use galvanized or stainless steel plate
, ,		material compatible with box material to prevent galvanic corrosion of
		plate or box.
		For flush-mounted outlet boxes use stainless steel plate
	Stainless Steel	SAE Type 302 where weatherproof plates not required
		#430 Satin finish
		Provide gasketed plates ≥ 0.040" thick
	Galvanized	Provide gasketed plates ≥ 0.040" thick
	PVC-Coated Steel	Provide gasketed plates ≥ 0.040" thick
	Finish	Satin Stainless Steel
0 (11 (1/2))	0 111 11 11 1	Smooth exterior
Cast Metal (CM)	Cast Malleable Iron	Provide gasketed plates ≥ 0.040" thick
Plates	Finish	PVC-Coated Steel
		Smooth exterior
Plastic (P) Plates	Polycarbonate	Specification grade, high-strength, 1-piece
		Provide ≥ 0.10" thick, noncombustible, thermosetting material
	Nylon	Specification grade, high-strength, 1-piece
		Provide ≥ 0.10" thick, noncombustible, thermosetting material

ITEM	MATERIAL	SPECIFICATION
	Color	Brown
	Finish	Smooth exterior
Engraved Lettering	Size and Filler	1/8" black filler
		Nameplate shall conform to Section 26 05 10 except for lettering size.
	Text	Provide with designated lettering where device titles are shown
		Engraved or etched cover plates shall show equipment or area served for pilot switches, control circuit switches, 3-gang or larger gang switches, and switches from which equipment controlled cannot be readily seen. Provide separate nameplate mounted above receptacle for receptacles without cover plates or where engraving or etching is impractical. Provide nameplates or equivalent markings on switch enclosures to show "ON" and "OFF" positions of each switch. "ON" and "OFF" for 3-way or 4-way switches is not acceptable.

C. Materials for other wiring devices shall be:

materialie ter etiter mining de ritere entantiser		
ITEM	MATERIAL	SPECIFICATION
Push Button	Glass Polyester	Individually gasketed
Enclosures	Stainless Steel	SAE Type 430 with satin finish
		Individually gasketed
Terminal Blocks	Molded Plastic	
120V Control Circuits		

D. Unless otherwise shown, the following electrical design criteria are required for equipment specified in this section:

ITEM	DESCRIPTION	
Electrical Work	NEC Article 505 Classification	Nonhazardous
Enclosures – Indoor Dry Locations	NEMA 250 Enclosure Rating	NEMA 12 – Industrial Use
Enclosures – Indoor Damp Locations	NEMA 250 Enclosure Rating	NEMA 12 – Industrial Use
Enclosures – Outdoor or Wet Locations	NEMA 250 Enclosure Rating	NEMA 4X – Watertight, Corrosion-Resistant, Stainless steel
Enclosures	Construction	Lockable With powdercoat epoxy finish on steel surfaces Color ANSI 49 gray
	IEC 60529 Enclosure Rating for Underground Equipment	IP 65 water jet

E. The following product design criteria, options and accessories are required for basic wiring devices:

ITEM		DESCRIPTION
Receptacles	Single and Duplex	Conform to NEMA WD 1 and Fed Spec W-C-596
·	Indoor Receptacles	Conform to NEC Article 406
		Molded composition encased specification grade receptacles fitting within standard size outlet box
		Duplex receptacles for 120VAC – 1 phase 3-wire circuit to be rated
		125VAC, 15A NEMA Configuration 5-15R / 20A NEMA Configuration 5-
		20R
		2-pole 3-wire parallel-blade grounding type with insulated mounting yoke,
		Side-wired with binding screw-type terminals suitable for #10AWG wires
		Provide duplex receptacles except where single receptacles are called out
	Duplex Outdoor	Conform to NEMA WD 1 and Fed Spec W-C-596
	Weatherproof	Conform to NEC Article 406
	Receptacles	Mount in cast metal box with gasketed weatherproof plate.
		Molded composition encased specification grade receptacles fitting within standard size outlet box
		Duplex receptacles for 120VAC – 1 phase 3-wire circuit to be rated

ITEM	DESCRIPTION	
		125VAC, 20A NEMA Configuration 5-20R 2-pole 3-wire grounding type with insulated mounting yoke, Side-wired with binding screw-type terminals suitable for #10AWG wires
	Ground Fault Interrupter (GFI) Duplex Receptacles	Conform to NEC Article 406 Conform to UL943, Class A Molded composition encased specification grade receptacles fitting within standard size outlet box and accepting standard device plates. Duplex receptacles for 120VAC – 1 phase 3-wire circuit to be rated 125VAC, 20A NEMA Configuration 5-20R UL Class A sensitivity - Trip at 5 milliamps after 0.025 seconds Rated and capable of interrupting 1000A without damage Provide #12AWG copper TW-insulated pigtails Parallel-blade grounding type for general-duty applications. Provide front-mount test feature for periodic testing of GFCI circuit Use standard model where ground fault protection is required at individual location. Use feed-thru model where ground fault protection is specified for "downstream" conventional receptacles.
	Welding Receptacles	Surface-mount with pin-and-sleeve-type connectors sized as shown.
	Corrosion-Resistant Receptacles	Provide in areas designated "Corrosive" on Plans
	Special-Purpose Receptacles	Provide receptacles of type, rating, and number of poles shown or required for anticipated purpose. Furnish matching plugs with cord-grip features for each special purpose receptacle.
Wall Switches	General	Conform to NEMA WD 1 and Fed Spec W-S-896E Conform to NEC Article 404 Molded specification grade for flush device boxes or surface-mount FD cast outlet boxes Totally enclose in composition case with insulated mounting yoke and side-wired, binding screw-type terminals. Single pole, 2-pole, 3-way and 4-way as shown Capable of control of 100% tungsten filament and fluorescent lamp loads.
	120VAC or 277VAC Lighting Switches Weatherproof	20A rating 120/277VAC Plate-rocker type Mount in cast metal box with gasketed weatherproof device plate.
	Switches	·
	Switches with Pilot Lights	Provide 125VAC neon light with red jewel or lighted toggle lit when switch is ON
Switch-Rated Plugs and Receptacles	Design	Conform to UL 2682

F. The following product design criteria, options and accessories are required for other wiring devices:

ITEM		DESCRIPTION	
Push Buttons	Туре	Conform to NEMA ICS2 Provide contacts with NEMA designation rating A600 Heavy-duty oil-tight	
	Push-Buttons	30mm diameter round ON or START pushbuttons colored black OFF or STOP pushbuttons colored red	
	Enclosure: Nonhazardous Indoor Dry Locations, including MCC's, control panels, and control stations	NEMA 12 to match panel in which mounted	
	Enclosure:	NEMA 4X – Watertight, Corrosion-Resistant,	

ITEM		Di	ESCRIPTION		
	Nonhazardous Outdoor or Wet Locations	SAE Type 316 stainless steel to match panel in which mounted Provide required special gasketing to make complete station watertight			
	Nameplate	Provide extra-large laminated plastic nameplate or legend plate on enclosure front conforming to Section 26 05 10, showing function			
	Lockout Provisions	Provide for locking pushbuttons in OFF position where lockout provisions are shown.			
Indicating (Pilot) Lights	Туре	Conform to NEMA ICS2 Heavy-duty of same type and rating High-visibility LED type long-life (≥20,000 hours) Replaceable from panel front Color caps shall be interchangeable			
	Lamps	120VAC Indicating lights sha	ll be push-to-test typ	e	
	Lens Color	As shown Valve Actuators	Valve Closed	RED	
			Valve Open Intermediate Position	GREEN both RED and GREEN	
			Valve Moving	both RED and GREEN flashing	
	Enclosure: Nonhazardous Indoor Dry Locations, including MCC's, control panels, and control stations	NEMA 12 to match	panel in which moun	ted	
	Enclosure: Nonhazardous Outdoor or Wet Locations	SAE Type 316 stair		tant, anel in which mounted ake complete station watertight	
	Nameplate			meplate or legend plate on i 05 10, showing function	
Selector Switches	Туре	Conform to NEMA I Heavy-duty	CS2		
	Key-operated Switches	Key switches alike Coordinate key type	with Owner.		
	Operating Levers Enclosure: Nonhazardous Indoor Dry Locations, including MCC's, control panels, and control stations	Standard NEMA 4/13 Waterti	ght-Oiltight.		
	Enclosure: Nonhazardous Outdoor or Wet Locations	SAE Type 316 stair Provide required sp	ecial gasketing to ma	anel in which mounted ake complete station watertight	
	Nameplate	conforming to Secti	on 26 05 10, showing		
Relay Sockets	Туре	Terminal screws of	l and related hardwa "pressure screw" type		
Control Relays	Rating Type	Rated for 5A Conform to NEMA I Indicating type	CS2		
			control type with pilot	light and 1 spare contact	

ITEM		DESCRIPTION
	NEMA Class	NEMA Class A300 (300VAC, rated for 10A inductive load continuous, 7200VA make, 720VA break)
	Voltage	24VDC or 120VAC coils as shown.
		Number of poles and pole arrangement as shown.
		Contacts rated for circuit application shown
	Contacts	Multiple-contact, field-convertible plug-in type with dust cover and
		sockets. If additional contacts are required, they shall be ganged.
	Time Delay Relays	Magnetic type with socket
	, ,	Timer attachment adjustable over range shown
	Latching	Magnetic type with mechanical latch attachment and unlatching coil and
	(Mechanically-Held)	coil clearing contacts.
	Relays or Thermal-	Use attachment allowing easy latching and unlatching.
T : 101 1	Detector Relays	
Terminal Blocks	Design	UL Listed CSA certified
600VAC and less for 120VAC Control		Dead-front barrier type
Circuits	Location	Size to allow insertion of necessary wire sizes and types Provide for termination of control circuits entering or leaving equipment
Olicuits	Location	panels or boxes
	Rating	25A at 600VAC
	Yoke	Provide yoke to guide wire strands into terminal
		Construct of high-strength, high-conductivity metal
	Current Bar	Shall provide dependable vibration-proof connection.
		Shall provide direct contact with wire between compression screw and
		yoke.
		Construct of high-strength, high-conductivity metal.
	Terminals	DIN rail-mounted screw-clamp compression box lug type allowing
		connection of wire with no special preparation other than stripping. Provide terminals constructed so jumpers may be installed with no loss of
		space on terminal or rail.
		Construct of high-strength, high-conductivity metal
	Marking Strips	Secure to molded sections.
	l	Mark wire numbers or circuit identifications with pre-printed tags or
		permanent marking fluid
	Spare Terminals	Provide blocks with 25% spare termination points for Owner's use
		following completion of installation
Intrusion Override	Switch	2-Position Key Operator, key removal left and right positions
Switches	Contact Block	1 NC, 1 NO
Time-of-Use Override	Switch	2-Position Key Operator, key removal left position only
Switches	Contact Block	2 NO
Intrinsically Safe		Two Channel Relay with intrinsically safe inputs
Barrier 24VDC Contacts and Relays		
Intrinsically Safe		Required
Barrier 120VDC		- Noquilou
Contacts and Relays		

PART 3 - EXECUTION

3.1 <u>Preparation</u>

- A. Make field measurements needed to install wiring devices before submitting Shop Drawings or ordering.
 - 1. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Examine areas and conditions under which Work of this section will be performed.
 - 1. Correct conditions detrimental to timely and proper completion of Work.

3.2 Installation

- A. Refer to Section 01 73 00 for basic execution and installation requirements.
- B. Furnish and install wiring devices at locations shown on Plans and Submittals.
- C. Conform to the following installation standards:
 - 1. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 2. Other applicable OSHA and Cal OSHA regulations
 - 3. California Electrical Code Article 404 "Switches"
 - 4. California Electrical Code Article 406 "Receptacles, Cord Connectors, and Attachment Plugs"
 - 5. Other applicable building, fire, and electrical code requirements
 - 6. Manufacturer's installation and warranty requirements
- D. Refer variances between above documents and Contract Documents to Owner's Representative.
- E. Install wiring devices to tolerances recommended by Manufacturer.
 - 1. Unless otherwise shown, install wiring devices true and level using precision gauges and levels.
- F. Mount devices as follows:
 - 1. Secure wiring devices, as shown, avoiding interference with other equipment.
 - 2. Secure nameplates using screws, bolts, or rivets centered under or on device.

3. Mount wiring devices as follows:

DEVICE	MOUNTING DISTANCE	FROM/TO	NOTES					
	SWITCHES							
Wall Switches	48"	Finish floor or grade to center	Set for switch operation in vertical position unless otherwise shown.					
Safety Switches	54"	Finish floor to center of operating handle						
Separately- Mounted Motor Starter Switches	54"	Finish floor to center of operating handle						
Push-Button or Selector Switch Control Station	48"	Finish floor or grade to center						
RECEPTACLES								
Outdoor	18"	Finish floor or grade to center of outlet	Set duplex receptacles vertically unless otherwise shown					
Indoor Architecturally Finished Areas	18"	Finish floor or grade to center of outlet	Mount with grounding slots down except where horizontal mounting is required, in which case mount with neutral slot down					
Indoor Non- Architecturally Finished Areas	36"	Finish floor or grade to center of outlet						
	PANELBOARDS							
Panelboards	72"	Finish floor to top of panelboard						

- 4. Do not mount devices outside limits stipulated in California Building Code §1136A
- 5. Mount weatherproof receptacles with hinge for protective cover above (not at side or below) receptacle opening.
- 6. Locate special-purpose receptacles where shown, installing and mounting per Manufacturer's Installation Instructions and applicable codes.
- 7. Mount multi-outlet surface raceway systems where shown in accordance with Manufacturer's Installation Instructions.
- G. Ground devices, including switches and receptacles in accordance with NEC Article 250.
 - 1. Ground switches and metal plates through switch mounting yoke, outlet box, and raceway system.

- 2. Ground flush receptacles and metal plates through positive ground connection to outlet box and grounding system.
- 3. Provide bonding jumper between grounded outlet box and receptacle ground terminal.

 a. Do not rely on yoke or screw contact for grounding.
- 4. Maintain ground to each receptacle by spring-loaded grounding contact to mounting screw, or by grounding jumper, both making positive connection to outlet box and grounding system.
- H. Mount device plates as follows:
 - 1. Secure device plates to appropriate switch or receptacle.
 - 2. Install to alignment tolerance of ± 1/16"
 - 3. Do not use sectional type device plates.
 - 4. Install device plates over flush-mounted boxes so all 4 edges contact finished wall surface without use of mats, plaster or spackle fillings, or similar materials.

3.3 Field Quality Control

A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Wiring	Installation	Visual inspection of finished installation	1 inspection	Owner	Owner
Devices	Switch Operation	Operate each switch and verify load turns on and off.	1 test each switch	Contractor	Contractor
	Receptacles	Test with circuit tester checking voltage, polarity and grounded conditions.	1 test each receptacle	Contractor	Contractor
	GFI Receptacles	Test with circuits energized using portable GFI receptacle tester capable of circulationg 7.5 mA current between "hot" line and ground when plugged in to produce tripping of receptacle	2 tests each GFI receptacle	Contractor	Contractor
	Ground Fault Protective Equipment	 NEC 230.95C, Use 3rd-party tester qualified for such testing. Submit written report of test. Include copy of Manufacturer's instructions for test Include statement service grounding connections are properly installed for ground fault system. Include statement neutral conductors in distribution system have been tested and found to be ungrounded Include description of testing method. Include statement ground fault equipment functioned properly when tested. Document actual settings and trip times. Provide label on panel above device with certification and values. Record current pickup level and time-delay settings to which equipment was finally adjusted. Measure and record relay pickup current and relay time-delay at 2 values above pickup. Test for correct system operation at 57% rated voltage. If relay pickup current is not within 5% of Manufacturer's calibration marks or fixed setting or relay timing does not conform with Manufacturer's published time-current 	1 test before energizing	Contractor	Contractor

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
		characteristic curves, repair or replace equipment and repeat test.			
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed Literature	1 test	Owner	Contractor

3.4 **Spare Parts**

A. Furnish the following spare parts:

QUANTITY	PART
2	Each type control relay

END OF SECTION

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SECTION 26 28 00

LOW-VOLTAGE CIRCUIT-PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 Work Included

- A. Materials, testing, and installation of circuit breakers, fuses, and other circuit-protective devices.
- B. Refer to the following sections for Work not covered herein.
 - 1. Section 26 08 13 for requirements for Short-Circuit and Coordination Report
 - 2. Section 26 24 13 for disconnect switches.

1.2 Related Work

- A. Section 01 10 01: Summary of Work and Sequence of Construction
- B. Section 01 22 00: Unit Prices
- C. Section 01 33 00: Submittal Procedures
- D. Section 01 40 00: Quality Requirements
- E. Section 01 61 00: Common Product Requirements
- F. Section 01 65 00: Product Delivery Requirements
- G. Section 01 66 00: Product Storage and Handling Requirements
- H. Section 01 73 00: Execution
- I. Section 26 05 10: Common Work Results for Electrical
- J. Section 26 05 19: Low-Voltage Electrical Power Conductors and Cables
- K. Section 26 05 26: Grounding and Bonding for Electrical Systems
- L. Section 26 08 13: Short-Circuit and Coordination Report
- M. Section 26 24 13: Switchboards
- N. Section 26 24 16: Panelboards
- O. Section 26 27 26: Wiring Devices

1.3 System Description

A. Furnish and install wiring devices including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building and electrical codes and standards.

1.4 Quality Assurance

- A. Use adequate number of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Fuses and Circuit-Breakers	UL Listing	UL Standards	All wiring devices	Contractor	Contractor

1.5 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - 1. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 2. California Building Code (CBC)
 - 3. California Electrical Code (CEC)
 - 4. California Fire Code (CFC)
 - 5. California Mechanical Code (CMC)
 - 6. NEMA/ANSI 250 Enclosures for Electrical Equipment

- 7. NEMA AB1 Molded Case Circuit Breakers
- 8. NEMA AB3 Molded Case Circuit Breakers and their Application
- 9. NEMA ICS 2 Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts
- 10. NETA ATS Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems
- 11. NFPA 70 National Electric Code (NEC)
- 12. UL 489 Branch Circuit and Service Circuit Breakers
- 13. UL 943 Ground Fault Circuit Interrupters

1.6 **Submittals**

A. Furnish the following submittals.

SUBMITTAL	SUBMITTAL DESCRIPTION				
	MANUFACTURER'S LITERATURE				
Product Data	Submit data sheets on major components including:				
	Circuit breaker and fuse information.				
	Circuit breaker time-current characteristics.				
Material List	Submit material list for each type of fuse or breaker.				
	Submit material list for each additional type of wiring device listed herein.				
	Indicate type, voltage rating, continuous current rating, conduit entry restrictions,				
	enclosure type, dimensions, material, color, and Manufacturer.				
QUALITY ASSURANCE AND CONTROL SUBMITTALS					
Certificate of Compliance Submit evidence of UL listing					
Contractor's Certification	Contractor shall certify in writing:				
	Circuit breaker settings have been adjusted per field requirements				
	Power fuses have been selected and installed per field requirements				
3. Submit certified test results from circuit-breaker setting adjustment					
CLOSEOUT SUBMITTALS					
Warranty	Furnish 1-year warranty from date of final acceptance				

B. Refer to Section 01 33 00 for definition of requirements for Product Data, and Certificates of Compliance.

1.7 Delivery, Storage and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Strictly follow Manufacturer's instructions and warranty requirements for delivery, storage and handling of wiring devices.

1.8 Project Site Conditions

A. Refer to Section 01 10 01 for full list of project site conditions.

1.9 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for low-voltage circuit-protective devices.

PART 2 - PRODUCTS

2.1 <u>Acceptable Manufacturers</u>

A. Acceptable Manufacturers for overcurrent devices include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Panel Circuit Breakers	Eaton Cutler Hammer	Cleveland, OH (800) 386-1911
	General Electric Company	Fairfield, CT (800) 626-2000
	Schneider Electric Square D Class 611 J-Frame	Andover, MA (888) 778-2733
	Accepted equal	
Switchboard Main	Eaton Cutler Hammer	Cleveland, OH (800) 386-1911
Circuit Breakers	General Electric Company	Fairfield, CT (800) 626-2000
	Schneider Electric Square D Type FY, FA, or KA	Andover, MA (888) 778-2733
Accepted equal		
Switchboard Feeder	ritchboard Feeder Eaton Cutler Hammer	
Circuit Breakers	General Electric Company	Fairfield, CT (800) 626-2000

ITEM	MANUFACTURER	MANUFACTURER LOCATION
	Schneider Electric Square D Micrologic Type LE	Andover, MA (888) 778-2733
	Accepted equal	
Fuses for Motor and	Eaton Bussman Type LPN-RK	Cleveland, OH (800) 386-1911
Transformer Circuits	Ferraz Shawmut / Gross Automation Type A2D-R	Brookfield, WI (877) 268-3700
≤250VAC	Accepted equal	
Fuses for Motor and	Eaton Bussman Type LPS-RK	Cleveland, OH (800) 386-1911
Transformer Circuits	Ferraz Shawmut / Gross Automation Type A6D-R	Brookfield, WI (877) 268-3700
≤600VAC	Accepted equal	
Fuses for Motor and	Eaton Bussman Type LPN-RK	Cleveland, OH (800) 386-1911
Transformer Circuits	Ferraz Shawmut / Gross Automation Type A2D-R	Brookfield, WI (877) 268-3700
250VAC and less	No exceptions	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Materials for low-voltage circuit-protective devices shall be:

ITEM	MATERIAL	SPECIFICATION

C. Unless otherwise shown, the following electrical design criteria are required for equipment specified in this section:

ITEM		DESCRIPTION
Electrical Work	NEC Article 505 Classification	Nonhazardous
Enclosures – Indoor Dry Locations	NEMA 250 Enclosure Rating	NEMA 12 – Industrial Use
Enclosures – Indoor Damp Locations	NEMA 250 Enclosure Rating	NEMA 12 – Industrial Use
Enclosures – Outdoor or Wet Locations	NEMA 250 Enclosure Rating	NEMA 4X – Watertight, Corrosion-Resistant, Stainless steel
Enclosures	Construction	Lockable With powdercoat epoxy finish on steel surfaces Color ANSI 49 gray
	IEC 60529 Enclosure Rating for Underground Equipment	IP 65 water jet

D. The following product design criteria, options and accessories are required for overcurrent protection:

ITEM		DESCRIPTION
Disconnect Switch		Refer to Section 26 24 13
Switchboard Main	Туре	Molded case or Insulated case type
Service Circuit		Conform to NEMA AB1
Breaker 460VAC		Fixed mounting
(Use with Frames		UL-listed and labeled
≥1200A)	Trip Rating	As shown
		Minimum interrupting rating ≥42,000A RMS symmetrical at 460VAC
	Trip Characteristic	Electrically operated with solid state microprocessor trip device with:
		adjustable long-time pickup
		2. adjustable long-term delay
		adjustable short-term pickup
		4. adjustable short-term delay
		5. adjustable instantaneous pickup with off option
		6. fixed, high-set instantaneous (15X) and stored-energy close and trip mechanism.
		Indicate automatic tripping by handle position between manual OFF and
		ON position
	Number of Poles	As shown

ITEM		DESCRIPTION
		Multipole design so overload on 1 pole triggers all poles to open
	Frame Sizes	As shown
	Location	Mount individual circuit breakers in MCC enclosure and service
		equipment
	Ground Fault	Provide integral ground-fault protection with adjustable time delay and trip
	Protection	settings.
	Disconnect Handles	Show ON/OFF and TRIPPED positions of operating handle
		Padlockable in OFF position
		Interlock enclosure and circuit breaker shall prevent opening cover with breaker in ON position
	Terminals	Suitable for use with 75°C wire at full NEC 75°C ampacity.
	Design	Multipole design so overload on 1 pole triggers all poles to open
Switchboard Main Service Circuit Breaker 460VAC	Туре	UL-listed and labeled Molded case type Conform to NEMA AB1 Not influenced by ambient temperature range of 0°F-122°F Do not use handle ties or nails in lieu of multiple breakers.
		Multiple circuit breakers shall be common-trip type
	Trip Rating	As shown. Show trip rating on operating handle. Minimum interrupting rating ≥42,000A RMS symmetrical at 460VAC
	Trip Characteristic	Quick-make, Quick-break toggle mechanism on manual and automatic operation Thermal-magnetic Inverse time-limit overload Trip-free operation on overload or short circuit Provide separate ON/OFF and TRIPPED handle positions to Indicate automatic tripping
	Number of Poles	As shown Multipole design so overload on 1 pole triggers all poles to open
	Frame Sizes	As shown Show frame size on breaker.
	Location	Mount individual circuit breakers in MCC enclosure and service equipment
	Disconnect Handles	Provide ON/OFF and TRIPPED positions on operating handle
		Padlockable in OFF position
		Interlock enclosure and circuit breaker shall prevent opening cover with breaker in ON position
	Terminals	Suitable for use with 75°C wire at full NEC 75°C ampacity.
	Design	Multipole design so overload on 1 pole triggers all poles to open
Switchboard Feeder Circuit Breakers 460VAC	Туре	UL-listed and labeled Molded-case indicating Type Conform to NEMA AB1 Do not use handle ties or nails in lieu of multiple breakers. Multiple circuit breakers shall be common-trip type
	Trip Rating	As shown Minimum interrupting rating ≥42,000A RMS symmetrical at 460VAC
	Trip Characteristic	Quick-make, Quick-break toggle mechanism on manual and automatic operation Thermal-magnetic Inverse time-limit overload Trip-free operation on overload or short circuit Provide separate ON/OFF and TRIPPED handle positions to Indicate automatic tripping
	Number of Poles	As shown Multipole design so overload on 1 pole triggers all poles to open
	Frame Sizes	As shown
	Location	Mount individual circuit breakers in MCC enclosure and service equipment

ITEM	DESCRIPTION		
	Disconnect Handles	Show ON/OFF and TRIPPED positions of operating handle	
		Padlockable in OFF position	
		Interlock enclosure and circuit breaker shall prevent opening cover with	
		breaker in ON position	
	Terminals	Suitable for use with 75°C wire at full NEC 75°C ampacity.	
	Design	Multipole design so overload on 1 pole triggers all poles to open	
	Future Expansion	Provide space for future breakers as shown.	
Panelboard Circuit	Туре	UL-listed molded-case indicating type.	
Breakers – Single-		Noninterchangeable per NEC	
Pole 120VAC		Full module size bolt-on "miniature" type for main and branch circuit	
		breakers	
		Do not install 2 poles in 1 module	
		Do not use handle ties or nails in lieu of multiple breakers.	
		Do not use tandem or dual circuit breakers in normal single pole spaces	
		Multiple circuit breakers shall be common-trip type	
	Trip Rating	As shown	
		Minimum Single-pole, 120VAC, 20A rating where not otherwise shown	
		Mark breakers with ampere trip rating	
		Instantaneous 10kA short-circuit protection on poles	
	Trip Characteristic	Quick-make, Quick-break toggle mechanism	
		Thermal-magnetic	
	N	Inverse time-limit overload	
	Number of Poles	As shown	
	Frame Sizes	As shown	
	Location	Mount in panelboard	
	Breaker Handles	Provide single operating handle padlockable in OFF position	
		Indicate automatic tripping by handle position separate from manual OFF	
		·	
	Future Evenneign		
Ground Fault	Future Expansion		
Olicuit Dieakers			
Fuses 600VAC and	Type		
	1,700	· ·	
2000 0 000/1			
Fuses 250VAC and	Type		
	. , , , ,	,	
==== • ••••		Provide features rejecting Class H fuses	
Ground Fault Interrupter (GFI) Circuit Breakers Fuses 600VAC and Less 0-600A Fuses 250VAC and Less 0-600A	Future Expansion Type Type	and ON position Furnish breaker handles that are trip-free on overloads Furnish handle lock device on breakers where shown to prevent manual opening of selected breakers. Provide space for future breakers as shown. Where shown or required by NEC, provide unit containing conventional thermal magnetic trip and ground-fault sensor. Provide push-to-test button UL Class A sensitivity - Trip at 5 milliamps after 0.025 seconds Ground fault sensor shall have same rating as circuit breaker 0-600A UL Class RK-1 with time delay Shall fit mountings specified with switches Provide features rejecting Class H fuses 0-600A UL Class RK-1 with time delay Shall fit mountings specified with switches	

PART 3 - EXECUTION

3.1 <u>Preparation</u>

- A. Make field measurements needed to install wiring devices before submitting shop drawings or ordering.
 - 1. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Examine areas and conditions under which Work of this section will be performed.
 - 1. Correct conditions detrimental to timely and proper completion of Work.

3.2 Installation

- A. Refer to Section 01 73 00 for basic execution and installation requirements.
- B. Furnish and install circuit-protective devices at locations shown on Plans and Submittals.

- C. The following installation standards shall be followed:
 - 1. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 2. Other applicable OSHA and Cal OSHA regulations
 - 3. California Electrical Code Article 240 "Overcurrent Protection"
 - 4. NETA (National Electrical Testing Association) ATS standards
 - a. NETA ATS 7.6.1.1 for low-voltage molded-case circuit breaker tests.
 - b. NETA ATS 7.6.1.2 for low voltage power circuit breaker inspections and tests.
 - 5. Other applicable building, fire, and electrical code requirements
 - 6. Manufacturer's installation and warranty requirements
- D. Refer variances between above documents and Contract Documents to Owner's Representative.
- E. Install circuit-protective devices to tolerances recommended by Manufacturer.
 - 1. Unless otherwise shown, install wiring devices true and level using precision gauges and levels.

3.3 **Field Quality Control**

A. Field testing shall conform to NETA ATS and include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Circuit	Installation	Visual inspection of finished installation	1 inspection	Owner	Owner
Breakers		Compare nameplate data with Contract Documents	1 inspection	Contractor	Contractor
		Inspect physical and mechanical condition and cleanliness	1 inspection	Contractor	Contractor
		Inspect anchorage and alignment	1 inspection	Contractor	Contractor
		Inspect connections for high resistance	1 inspection	Contractor	Contractor
		Inspect compression-applied connections for correct cable match and indentation	1 inspection	Contractor	Contractor
		Inspect and test per NETA ATS 7.6.1	1 inspection	Contractor	Contractor
	High Resistance	Test connections for high resistance using low resistance ohmmeter	1 test each phase of each circuit	Contractor	Contractor
		Measure insulation-resistance on each pole phase-to-phase and phase-to-ground with circuit breaker closed and across each open pole.	1 test each phase of each circuit	Contractor	Contractor
		Measure contact/pole resistance.	1 test each contact/pole	Contractor	Contractor
		Perform insulation resistance tests on control wiring,	1 inspection	Contractor	Contractor
	Circuit Breaker Settings	Factory-authorized representative of circuit breaker Manufacturer shall field adjust circuit breakers specified with adjustable time or pick-up settings for ground current, instantaneous overcurrent, short-time overcurrent, and longtime overcurrent.	All circuit breakers	Contractor	Contractor
		Perform adjustments for final time and pickup setting per coordination study.	All circuit breakers	Contractor	Contractor
		Determine long-time pickup and delay by primary current injection.	All circuit breakers	Contractor	Contractor
		Determine short-time pickup and delay by primary current injection at final settings.(except circuit breakers with <150-amp frames) Where short-time or instantaneous settings on large-frame breakers are beyond current capability of field testing, perform primary injection tests at reduced currents combined with	All circuit breakers	Contractor	Contractor

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
		secondary injection calibration test of trip unit at final setting.			
		Determine ground fault pickup and delay by primary current injection at final settings	All circuit breakers	Contractor	Contractor
		Determine instantaneous pickup by primary current injection		Contractor	Contractor
	Determine shunt trip devices minimum tripping voltages		All shunt-trip devices	Contractor	Contractor
		Record as-left settings	All circuit breakers	Contractor	Contractor
	Operation	Operate each circuit breaker at least 3 times, verifying smooth and satisfactory operation each time.	Each circuit and each phase of each motor	Contractor	Contractor
		Verify correct operation of auxiliary functions	1 inspection	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed Literature	1 test	Owner	Contractor

3.4 **Spare Parts**

A. Furnish the following spare parts:

QUANTITY	PART	
6	Spare fuses for each type and current rating installed.	

END OF SECTION

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SECTION 26 24 13

SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 Work Included

A. Materials, testing, and installation of surge protection modules.

1.2 Related Work

- A. Section 01 10 01: Summary of Work and Sequence of Construction
- B. Section 01 22 00: Unit Prices
- C. Section 01 33 00: Submittal Procedures
- D. Section 01 40 00: Quality Requirements
- E. Section 01 61 00: Common Product Requirements
- F. Section 01 65 00: Product Delivery Requirements
- G. Section 01 66 00: Product Storage and Handling Requirements
- H. Section 01 73 00: Execution
- I. Section 09 90 00: Painting and Coating
- J. Section 26 05 10: Common Work Results for Electrical
- K. Section 26 05 19: Low-Voltage Electrical Power Conductors and Cables
- L. Section 26 05 26: Grounding and Bonding for Electrical Systems
- M. Section 26 05 33: Raceway and Boxes for Electrical Systems
- N. Section 26 05 47: Cabinets and Enclosures
- O. Section 26 08 00: Commissioning of Electrical Systems
- P. Section 26 24 13: Switchboards
- Q. Section 26 28 00: Low-Voltage Circuit-Protective Devices
- R. Section 26 29 14: Low-Voltage Motor Control Centers

1.3 System Description

A. Furnish and install complete operating surge protective system including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.

1.4 Quality Assurance

- A. Use adequate number of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Surge protective devices shall bear UL Label.
- C. Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Surge	Functionality and	Manufacturer's Standard Testing	1 each unit	Contractor	Contractor
Protective	Compliance with	Procedure			
Devices	Listed Standards				

1.5 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 2. California Building Code (CBC)
 - 3. California Electrical Code (CEC)
 - 4. California Fire Code (CFC)

- 5. EUSERC Electric Utility Service Equipment Requirements Committee requirements
- 6. IEEE/ANSI C62.41 Guide on Surge Voltages in AC Power Circuits Rated up to 600V
- 7. NEMA/ANSI 250 Enclosures for Electrical Equipment
- 8. NFPA 70 National Electric Code (NEC)
- 9. UL 1449 Standard for Safety, Transient Voltage Surge Suppressors

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION			
	DRAWINGS	•		
Shop Drawings	Submit for surge protective devices under electrically controlled equipment Shop Drawing requirements.			
	Submit ratings and characteristics including			
	Fault current withstand ratings,			
	2. Enclosure type			
	3. Enclosure rating			
	4. Conduit entry restrictions			
	5. List of accessories if any			
	Submit outline and dimensional drawings			
	MANUFACTURER'S LITERATURE			
Product Data	Submit per Product Data requirements.			
	Submit data sheets on surge protection module			
Installation Instructions	Submit per Installation Instruction requirements.			
	Include general description for reading nameplate data, serial numbers, UL			
	markings and short-circuit ratings.			
	Describe installation procedures			
	Describe initial maintenance and trouble-shooting procedures.			
	QUALITY ASSURANCE AND CONTROL SUBMITTALS			
Test Record Transcripts	Test per Manufacturer's standard			
	Submit transcripts for factory tests per Test Record Transcript requirements.			
	CLOSEOUT SUBMITTALS			
O & M Instructions Submit per Operation and Maintenance Instruction requirements				
	Include name and phone number of local distributor for spare parts.			
Warranty	Furnish 1-year warranty from date of final acceptance			

B. Refer to Section 01 33 00 for definition of requirements for Shop Drawings, Product Data, Installation Instructions, and O&M instructions.

1.7 Delivery, Storage, and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Strictly follow Manufacturer's instructions and warranty requirements for delivery, storage, and handling of surge protective devices.

1.8 Project Site Conditions

A. Refer to Section 01 10 01 for full list of project site conditions.

1.9 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for surge protective devices.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Surge Protection Device	Leviton Manufacturing Co "74000" Series	Melville, NY (800) 323-8920
	Accepted equal	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Surge protective devices shall fit within space limitation shown on Plans.

C. Materials for surge protection devices shall be:

ITEM MATERIAL		SPECIFICATION	
Enclosures	Sheet Steel	12 gauge	

D. The following product design criteria, options and accessories are required for surge protection:

protection.	1	224212	
ITEM		DESCRIPT	TION
Lightning and Surge	Design	Listed per UL1449	
Protection		Conform to ANSI/IEEE C62.41 Category C3 environments	
		High-speed, high-current so	olid-state surge suppression device
		Provide continuous bi-polar	bi-directional non-interrupting protection.
	Location	Provide on incoming service	e connection as shown on single-line diagram
		Install on switchboard exter	ior in separate enclosure
	Enclosure	NEMA 12 for indoor panels	
	Color	ANSI 61 light grey	
	Construction	Modular with individual repla	aceable suppression modules.
	Disconnect	Provide integral 30A discon	
	Automatic Reset	Provide automatic reset capability with no degradation of protection	
		capabilities.	
	Characteristics	Voltage Suppression	1200VAC RMS L-G
		Rating	
		Nominal Operating	480/277VAC, 3Ф, 4W
		Voltage	
		Nominal Discharge	10,000A
		Current	
		Maximum Surge Current	320kA per phase
	Features	POWER-ON indicating light	
		Suppressor operational indication	
		Remote status-indicating relay contacts	
	Finish	<u> </u>	ated with ANSI 61 gray paint finish
	Nameplate	Refer to Section 26 05 10.	
	'	Provide nameplate on front	of enclosure,

E. The following electrical design criteria are required for equipment specified in this section:

ITEM		DESCRIPTION
Electrical Work	NEC Article 505	Nonhazardous
	Classification	
Enclosures – Indoor	NEMA 250	NEMA 12 – Industrial Use
Dry Locations	Enclosure Rating	
Enclosures – Indoor	NEMA 250	NEMA 12 – Industrial Use
Damp Locations	Enclosure Rating	
Enclosures – Outdoor	NEMA 250	NEMA 4X – Watertight, Corrosion-Resistant, Stainless steel
or Wet Locations	Enclosure Rating	
All Enclosures	Construction	Lockable
		With powdercoat epoxy finish on steel surfaces
	IEC 60529	IP 65 water jet
	Enclosure Rating	
	for Underground	
	Equipment	
Power Supply	Motor Circuit	460VAC – 3Φ – 60Hz
	Lighting Circuit	120VAC – 1Φ – 60Hz

PART 3 - EXECUTION

3.1 <u>Preparation</u>

- A. Make field measurements needed to install surge protective devices before submitting Shop Drawings or ordering.
 - 1. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Examine areas and conditions under which Work of this section will be performed.
 - 1. Correct conditions detrimental to timely and proper completion of Work.

1. <u>Installation</u>

- B. Refer to Sections 01 73 00 and 01 73 24 for basic execution and installation requirements.
- C. Furnish and install surge protective devices at locations shown on Plans and Submittals.
- D. The following installation standards shall be followed:
 - 1. California Administrative Code (CCR) Title 8 §5 Division of Industrial Safety, State of California Cal-OSHA Low Voltage Electrical Safety Orders
 - 2. Other applicable OSHA and Cal OSHA regulations
 - 3. California Electrical Code Article 285 "Surge Protective Devices (SPD's 1kV or Less"
 - 4. Other applicable building, fire, and electrical code requirements
 - 5. Manufacturer's installation and warranty requirements
- E. Refer variances between above documents and Contract Documents to Owner's Representative.
- F. Install surge protective devices to tolerances recommended by Manufacturer.
 - 1. Unless otherwise shown, install surge protective devices true, plumb, and level using precision gauges and levels.

3.2 Field Quality Control

A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Surge Protective	Installation & Leakage	Visual inspection of finished installation	1 inspection	Owner	Owner
Devices	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Owner	Contractor

END OF SECTION

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SECTION 31 05 00 – COMMON WORK RESULTS FOR EARTHWORK

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. The General Conditions apply to all work of this specification, which shall be done as shown on the plans, and as specified, and shall be properly coordinated with work in other Specifications.
- B. The DRAWINGS and these specifications are complementary to each other; what is called for by one shall be as binding as if called for by both. If there is any conflict between what is shown on the DRAWINGS and what is written in the specifications, the details described on the DRAWINGS shall take precedence and the CONTRACTOR shall communicate the conflicts to the ENGINEER in a timely manner.

C. Safety

- 1. The CONTRACTOR shall be familiar with, and shall at all times conform to, the regulations of the "OSHA General Industry Occupational Safety and Health Standards," "OSHA Safety and Health Regulations for Construction," and other applicable state and municipal standards and regulations.
- 2. The CONTRACTOR shall be familiar with, and shall at all times conform to California Code of Regulations, Title 8, Chapter 4, Subchapter 4 —Construction Safety Orders.

1.02 REFERENCED SECTIONS – NONE

1.03 CITED STANDARDS

- A. All earthwork specifications shall conform to the requirements of the following standard specifications, of the latest revisions, as applicable:
 - 1. State of California Standard Specifications, Issued by: Department of Transportation, 2010.

1.04 NOTED RESTRICTIONS – NONE

1.05 QUALITY CONTROL

- A. Quality Control: The CONTRACTOR shall provide proper quality control measures to assure compliance with specified requirements.
- B. The OWNER will engage the services of an approved independent soils testing laboratory to perform tests as necessary to demonstrate compliance with these specifications.

C. Tolerances:

- 1. Construct finished surfaces to plus or minus 2 inches of the elevations indicated.
- 2. Complete embankment slopes to plus or minus 6 inches of the slope line indicated.
- 3. Maintain the moisture content of fill material as it is being placed within plus or minus three percent of the recommended moisture content of the material.

- 4. Maintain existing overall site drainage slope.
- 5. Maintain a minimum slope of 5" per 10 feet in the first 10 feet around structures.

1.06 ANTIPOLLUTION MEASURES

- A. The CONTRACTOR shall conduct his activities and shall program his operations in such a manner as to minimize stream pollution from erosion of cleared soil surfaces and freshly excavated or backfilled material during periods of surface water runoff.
- B. The CONTRACTOR shall reduce the area and duration of exposure of all erodible soils by the greatest extent practicable, and to that end hydro-mulching, reseeding and other specified surface restoration shall be required to closely follow backfilling and final grading operations.
- C. Where the ENGINEER so directs in the field, sediment traps and other means to retard runoff rates shall be installed. Similar holding basins or other sediment traps arrangements shall also be required to be installed at the discharge of dewatering pumps.
- D. The CONTRACTOR shall provide noise and dust abatement as necessary to minimize impact on surrounding areas.

END OF SECTION

SECTION 31 11 00 - CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This sections describes how the General Construction CONTRACTOR shall furnish complete all materials necessary to perform work related to all clearing, grubbing, scalping, removing of trees and stumps, and removing of all vegetation and construction debris from the limits shown on the DRAWINGS.
- B. The method of clearing, including the use of bulldozers, shall be at the option of the CONTRACTOR. However, he or she will not be permitted to cover up brush and similar debris with earth. All work under this heading shall be done sufficiently ahead of topsoil removal and excavation so as not to interfere with those operations. The CONTRACTOR shall remove stumps and large roots and refill the depression with suitable compacted earth fill where necessary to bring the grade back to its original elevation or final grade.

1.02 REFERENCED SECTIONS – NONE

1.03 CITED STANDARDS

A. All clearing and grubbing shall conform to federal, state and local codes and standards.

1.04 NOTED RESTRICTIONS

- A. The CONTRACTOR shall protect survey markers and monuments, existing improvements, and adjacent properties from removal and damage.
- B. Protect existing utilities indicated or made known.
- C. The CONTRACTOR shall notify all utilities of the intent to begin work at the site and shall locate all such utilities, including storm water drainage piping prior to commencing work.
- D. The CONTRACTOR shall give written notices to utility companies and municipal departments requesting discontinuance of services to areas that will be affected by the site clearing and grubbing work.
- E. Protection of persons and property:
 - 1. Barricade open depressions and holes occurring as part of this work, and post warning lights on property adjacent to or within public access.
 - 2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
 - 3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by operations under this section.

- F. No burning or burying of brush, roots, stumps, etc. shall be permitted at the site. Such materials shall be disposed off-site in a safe, acceptable manner, in accordance with applicable laws and ordinances and as prescribed by authorities having jurisdiction.
- G. All vegetation and objects not designated for removal shall be protected.

H. Protection of Existing Trees

- 1. The CONTRACTOR shall protect existing trees, shrubbery, and other vegetation that is to remain in place against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Temporary fences, barricades or guards are to be provided as required to protect trees and vegetation to be left standing.
- 2. Trees and other vegetation to remain within limits of contract work shall be watered as required to maintain their health during course of construction operations.
- 3. Protection shall be provided for roots over 1-½" diameter cut during construction operations. Coat cut faces with a wound paint formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
- 4. The CONTRACTOR shall repair or replace trees and vegetation that will remain, which are damaged by construction operations, in a manner acceptable to the ENGINEER, and property OWNER if work is performed on private property. The ENGINEER may employ an Arborist to repair damages to trees and shrubs at the CONTRACTOR's expense when deemed necessary.
- I. Depressions caused by clearing and grubbing operations shall be filled with suitable soil material, unless further excavation or earthwork is indicated. Fill material shall be placed in horizontal layers not exceeding 6" loose depth, and thoroughly compacted to a 90% modified proctor density equal to or better than the adjacent original ground.
- J. Use means necessary to prevent dust from becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.
- K. Maintain access to the site at all times.

1.05 QUALITY CONTROL

A. The CONTRACTOR shall use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. The CONTRACTOR shall furnish all materials, tools, equipment, facilities, and services as required to complete the work described herein.

B. Fill material required for depressions created through clearing and grubbing shall be clean, dry earthen material common to the site. The material shall not contain rocks or lumps larger than 5 inches in greatest dimension, with no more than 15 percent by weight larger than 3 inches.

PART 3 - EXECUTION

3.01 PREPARATION

- A. The CONTRACTOR shall notify all utilities of the intent to begin work at the site and shall locate and mark all underground utilities, including storm water drainage piping prior to commencing work.
- B. The CONTRACTOR shall obtain all necessary permits prior to commencing work.
- C. Protection of landscape features to be preserved shall be by fencing, barricades, or wrapping as required by the ENGINEER.

3.02 CLEARING AND GRUBBING

- A. The CONTRACTOR shall remove trees, including stumps and roots, shrubs, grass, flowers and any other vegetation interfering with installation of new construction. The CONTRACTOR shall carefully and cleanly cut roots and branches of trees that will remain where such roots and branches obstruct new construction.
- B. Grubbing shall consist of the removal and disposal of stumps, roots, root mats and other debris to a depth of not less than 18 inches below existing ground elevation.
- C. The CONTRACTOR shall remove existing footers and foundations within the work site area that will interfere with excavation and construction activities. Such structures shall be removed to a minimum depth of 24". Such materials of construction shall not be used for backfill and shall be properly disposed offsite.
- D. In locations to be seeded, the CONTRACTOR shall remove stumps at least 6 inches (150 mm) below ground surface. In unseeded areas to be rounded at the top of backslopes, stumps shall be cut flush with or below the surface of the final slope line.
- E. The CONTRACTOR may leave undisturbed stumps and roots, and nonperishable solid objects 6 inches (150 mm) above the existing ground surface in the plan embankment construction locations where the embankment height is greater than 9 feet (3 m) from the subgrade elevation and when the existing side slope is 8:1 or flatter.
- F. If existing pipelines are constructed throughout the site to be cleared, a minimum of such areas shall be disturbed.
- G. Except in areas to be excavated, backfill stump holes and other holes created by removing obstructions with Item 2.03B embankment material. Place and compact according to Item 2.01B.
- H. The CONTRACTOR shall remove low hanging, unsound, or unsightly branches on trees or shrubs designated to remain. The CONTRACTOR shall trim branches of trees extending over a roadbed to provide a clear height of 20 feet (6 m) above the roadbed surface. Cut off branches

neatly and close to the tree boles. Remove other branches as necessary to present a balanced appearance. Treat scars resulting from tree branch removal with a heavy coat of an approved asphaltic tree paint.

3.03 CONSERVATION OF TOPSOIL AND EXISTING LANDSCAPING/GROUNDCOVER

- A. After the area has been cleared of vegetation, strip the existing topsoil to the depth necessary to provide at least 6-inch depth of topsoil in areas shown on the DRAWINGS to be turfed or planted, without contamination with subsoils.
- B. Stockpile in an area clear of new construction.
- C. Maintain the stockpile in a manner which will not obstruct the natural flow of drainage.
 - 1. Maintain stockpile free from debris and trash.
 - 2. Keep the topsoil damp to prevent dust and drying out.
- D. Disturbed vegetation shall be replaced in kind approved by the OWNER.

3.04 CLEANUP

- A. The CONTRACTOR shall dispose of debris contaminated with garbage, solid waste, or hazardous waste or material according to other contract items.
- B. Salvageable Material
 - 1. Any material, resulting from clearing operations on private property not desired by the property OWNER shall become property of the CONTRACTOR and shall be properly disposed of by the CONTRACTOR off site at no additional cost to the OWNER. Weather permitting, the CONTRACTOR shall remove and dispose of all waste material weekly.

END OF SECTION

SECTION 31 22 13 – ROUGH GRADING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This Section defines the requirements for earthwork and shall include, but not be limited to, providing labor, materials, equipment, and supplies necessary to perform.
 - 1. Grading of the existing subgrade surface; and,
 - 2. Fill and grading of the proposed subgrade/structural fill material.

B. Definitions

- 1. <u>Structural Fill</u>. Clean and dry fill material removed from site excavation suitable for use in backfilling and compaction.
- 2. <u>Unsuitable Fill</u>. Material which, because of chemical contamination or structural characteristics, is judged to be unsuitable for use as structural fill at the site.
- 3. <u>Topsoil</u>. Topsoil is the top layer of soil from vegetative cover areas which is suitable for plant growth.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS

A. Site Investigations

1. The CONTRACTOR shall carefully examine the site, test the soils, and make inspections necessary in order to construct the earthwork as indicated by the DRAWINGS. The CONTRACTOR shall satisfy himself as to the nature and physical properties of the soils, the condition of the existing ground surface, and the character of equipment and facilities needed prior to and during execution of the work. Inaccuracies or discrepancies between the actual field conditions and the DRAWINGS, or between the DRAWINGS and Specifications, shall be brought to the attention of the ENGINEER in order to clarify the exact nature of the work to be performed.

1.05 QUALITY CONTROL

- A. It shall be the CONTRACTOR's responsibility to maintain adequate safety measures and working conditions and to take measures necessary during the performance of the work to protect the entire project area and adjacent properties which would be affected by this work from storm damage, flood hazard, caving of trenches and embankments, and sloughing of material until final acceptance by the ENGINEER.
- B. The CONTRACTOR shall account in the construction Schedule for delays caused by weather, including time for dewatering, drying-moisture conditioning, and sample testing.

1.06 SUBMITTALS

- A. CONTRACTOR submittals required under this Section shall be made (1) only if off-site imported fills are provided by the CONTRACTOR and (2) in accordance with requirements set forth in the Specifications unless stated otherwise. Submittals under this Specification include, but are not limited to, test results for fill material, together with other information, to be submitted at least seven days before scheduled delivery of the material, as detailed in this Section.
- B. CONTRACTOR shall provide compaction testing results to OWNER or its representative or Designate.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Structural fill material for use at the site shall be subject to approval by the ENGINEER. Structural fill material shall not contain rocks or lumps larger than 5 inches in greatest dimension, with no more than 15 percent by weight larger than 3 inches. The CONTRACTOR shall provide equipment and manpower to obtain representative samples from the identified borrow sources 10 days prior to material use. Testing of structural fill samples will be performed in accordance with the applicable standards. The CONTRACTOR shall compact and moisture condition (including discing of the material to provide a homogeneous soil and moisture mix) the structural fill to achieve at least 95 percent of its standard Proctor maximum dry density.

2.02 EQUIPMENT

- A. Use compaction equipment to achieve the required minimum soil dry density within the range of acceptable moisture contents.
- B. Use hand compaction equipment such as walk-behind pad-foot compactors, hand tampers, or vibratory plate compactors for compaction in areas inaccessible to large compaction equipment.
- C. Use water tank trucks, pressure distributors, or other equipment designed to apply water uniformly and in controlled quantities to variable surface widths to provide the required in-place moisture content.
- D. Use miscellaneous equipment such as scarifiers, disks, spring tooth or spike tooth harrows, earth hauling equipment, and other equipment, as necessary for earthwork construction.

PART 3 - EXECUTION

3.01 GENERAL

A. Before beginning backfilling, foreign material, including surface water and loose organic material shall be removed from the space to be backfilled and the area to be backfilled shall be inspected and approved by the ENGINEER. If deemed necessary, the existing area will be compacted prior to placement of the backfill. Backfill materials shall be placed "in-the-dry" on subgrades acceptable to the ENGINEER. A 2-foot maximum bridge lift will be permitted in the trough areas in Landfill 3.

B. The CONTRACTOR shall prepare and proof-roll the subgrade as described within the CQA Plan and within this Specification.

3.02 GRADING

- A. Grade designated areas to the subgrade elevations and excavation limits indicated on the Project DRAWINGS. Stockpile excavated material in designated areas only. Prepare the subgrade in accordance with this Section.
- B. Do not remove soil or waste material from the site or dispose of soil or waste material included in this Contract except as indicated in these Specifications, on the DRAWINGS or as approved in writing by the ENGINEER.

3.03 STOCKPILING

- A. Stockpile required soils at the areas indicated on the Project DRAWINGS or as directed by the ENGINEER.
- B. Construct stockpiles no steeper than 3H:1V (horizontal to vertical ratio), grade to drain, seal by tracking perpendicular to the slope contours with a dozer, and dress daily during periods when fill is taken from the stockpile. Install erosion and sediment control measures around stockpile areas.

3.04 SUBGRADE PREPARATION

- A. Subgrade surface shall be relatively free of debris, foreign objects, loose organics, and other deleterious materials.
- B. In areas of subgrade preparation where soft soils are encountered, remove and replace the soil to a minimum depth of 1 foot below the proposed subgrade elevation. Fill the area with structural fill in accordance with the requirements of this Section. Compact the fill material to at least 95 percent standard Proctor maximum dry density and within an appropriate moisture range based on laboratory test data (ASTM D 698).
- C. In excavations or other areas where water accumulates, implement measures to remove the water in accordance with this Section. Maintain the subgrade surface free of standing water and firm. Maintain dewatered areas in this condition until overlying construction is complete. Surface water that comes into contact with exposed waste shall be contained and disposed of.

3.05 FILL

- A. Place fill material on surfaces which are relatively free of debris, branches, vegetation, mud, ice, or other deleterious material as approved by the ENGINEER.
- B. Place structural fill material in compacted lifts with a thickness of 8 inches (maximum). Place low permeable soil in compacted lifts with a thickness of 6 inches (maximum). In areas where compaction is to be performed using hand-operated equipment, place the fill material in loose lifts with a loose thickness of 4 inches ±1 inch. Place low permeable soil material in compacted lifts with a thickness of 6 inches (maximum).
- C. Remove rock and soil clod particles not conforming with Paragraph 2.01 of this specification.

- D. Prior to placing a succeeding lift of material over a previously compacted lift, thoroughly scarify the previous lift to a depth of 2 inches by discing, raking, or tracking with a dozer. Moisture condition the preceding lift in accordance with this Section if the moisture content of the surface of the preceding lift is not within the range of acceptable moisture contents for the fill.
- E. Reduce clod size by discing, raking, or tracking with a dozer or other means to achieve the required maximum soil clod size as defined in Paragraph 2.01 of this specification.
- F. Structural fill material in each lift shall be compacted to at least 95 percent of its standard Proctor maximum dry density and within a moisture content range determined by the ENGINEER based on testing results (ASTM D 698).
- G. Low permeable soil material in each lift shall be compacted to at least 95 percent of its standard Proctor maximum dry density and within a moisture content range determined by the ENGINEER based on testing results (ASTM D 698). Samples of low permeable soil material will be remolded by the ENGINEER defined soils laboratory to define an Acceptable Permeability Zone (APZ) which will be used to qualify field nuclear density test results and the acceptance criteria to achieve a permeability of 1 × 10⁻⁵ cm/sec or less for each material type and source.
- H. Do not compact fill material at temperatures below 32°F, unless otherwise authorized in writing by the Supervising CONTRACTOR.
- I. Do not place fill during periods of precipitation. Placement may occur during periods of misting or drizzle, if authorized by the ENGINEER.

3.06 CARE OF DRAINAGE WATER

- A. Grading shall be performed as shown on the DRAWINGS to prevent surface water from flowing into excavations or off-site.
- B. The CONTRACTOR shall place silt fences as needed to control sediment runoff.

3.07 CLEAN UP

- A. Upon completion of work in this Section, rubbish and debris shall be removed from the site. Construction equipment and implements of service shall be removed and the entire area involved shall be left in a neat, clean, and acceptable condition.
- B. Excavated materials which are determined to be unsuitable for use as fill, or excavated material that is in excess of that required to be used for fill, shall be disposed of in the Industrial Landfill or in a manner approved by the ENGINEER at the CONTRACTOR's expense.

3.08 EROSION CONTROL

A. The CONTRACTOR shall prevent erosion of exposed areas and newly deposited fill soil. The CONTRACTOR shall follow applicable federal and state regulations and these Specifications for erosion and sedimentation control.

END OF SECTION

SECTION 31 22 19 – FINISH GRADING

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. Upon completion of the installation of structures and paved or graveled areas, the remaining disturbed area shall be final graded.
- 1.02 REFERENCED SECTIONS
 - A. Related Sections are listed below:
 - 1. SECTION 31 23 23 FILL
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. The final grade shall, in general, slope away from the structures and paved or gravel areas and toward natural drainage areas.
 - B. The grading shall allow approximately 6 inches of curb exposure at the equipment pad and all other concrete structures shall have a minimum exposure of 2 inches.
 - C. Backfilled areas including trenches, paved or graveled areas, and around foundations, shall be compact filled as per the requirements in **Section 31 23 23**.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

FINISH GRADING 31 22 19 - 1

SECTION 31 23 00 -EXCAVATION AND FILL

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes materials, testing and installation for trench excavation, backfill, and compaction of piping, conduit, manholes and vaults.

1.02 REFERENCE STANDARDS

- A. The publications listed below form part of this specification to the extent referenced and are referred to in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for.
 - 1. ASTM C 131 Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
 - 2. ASTM C 150 Portland Cement
 - 3. ASTM D 75 Practice for Sampling Aggregates
 - 4. ASTM D 1556 Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
 - 5. ASTM D 1557 Test Method for Moisture-Density Relations of Soils Using a Modified Effort
 - 6. ASTM D 2419 Test Method for Sand Equivalent Values of Soil and Fine Aggregate
 - 7. ASTM D 2922 Test Method for Density of Soil in Place by Nuclear Methods (Shallow Depth)
 - 8. ASTM D 3017 Test Method for Water Content of Soil and Rock in Place by Nuclear Methods
 - 9. ASTM D 3776 Test Method for Mass Per Unit Area (Weight) of Woven Fabric
 - 10. ASTM D 4253 Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Plate
 - 11. ASTM D 4254 Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
 - 12. ASTM D 4632 Test Method for Grab Breaking Load and Elongation of Geotextiles
 - 13. ASTM D 4751 Test Method for Determining the Apparent Opening Size of a Geotextile
 - 14. CAL-OSHA Title 8 General Industry Safety Orders

1.03 RELATED WORK

- A. Plans
- B. Standard Drawings

C. Standard Specifications 01 00 00, 01 04 50, 01 32 16, 01 33 00, 02 41 13.13, 03 30 00, 03 15 16, 09 90 00, 09 96 71, 21 50 10, 23 00 00, 23 26 13, 23 31 19.13, 23 91 10, 23 91 19, 23 92 13, 23 92 17, 23 93 10, 23 93 17, 23 94 05, 23 95 13, 31 23 00, 31 23 19, 32 16 13, 33 02 22

1.04 GEOTECHNICAL TESTING

- A. TVMWD shall engage the services of a geotechnical engineering firm or individual licensed in the State of California to monitor soil conditions during earthwork, trenching, bedding, backfill and compaction operations if any, other backfill material than 1 sack cement slurry is used. Sampling and testing procedures shall be performed in accordance with the Reference Standards and as follows:
 - 1. The soils technician shall be present at the site during all backfill and compaction operations. Failure to have the soils technician present will subject such operations to rejection.
 - 2. Density and optimum moisture content of soil shall be determined by the use of the sand cone method, ASTM D 1556, or nuclear density gauge method, ASTM D 2922 & D 3017. Since the composition of the pipe and the walls of the trench have an effect on the nuclear density gauge output, a minimum of 25% of the density and optimum moisture tests shall be made using the sand cone method.
 - 3. Determine laboratory moisture-density relations of existing soil by ASTM D 1557, Method C and/or D (formerly ASTM D 4253 and ASTM D 4254).
 - 4. Determine the relative density of cohesionless soils by ASTM D 1557, Method C and/or D (formerly ASTM D 4253 and ASTM D 4254).
 - 5. Sample backfill material by ASTM D 75.
 - 6. Express "relative compaction" as a percentage of the ratio of the in-place dry density to the laboratory maximum dry density.
- B. Costs for initial compaction testing of a subject location shall be paid for by TVMWD, all failed compaction tests shall be performed again and paid for by the Contractor.
- C. A report of all soils tests performed shall be stamped and signed by the soils firm or individual and shall be submitted prior to the filing of the Notice of Completion by the City. The report shall document the sampling and testing of materials, the location and results of all tests performed, and shall certify that materials and work are in compliance with this specification.

1.05 PIPE ZONE

A. The pipe zone includes the full width of the trench from 6" below the bottom of the pipe to 12" above the top of the pipe and extends into manhole or vault excavations to the point of connection to or penetration of such structure.

1.06 TRENCH ZONE

A. The trench zone includes the portion of the trench from the top of the pipe zone to the bottom of the pavement zone in paved areas, or to the existing surface in unpaved areas, and extends into manhole or vault excavations above the pipe zone.

1.07 PAVEMENT ZONE

A. The pavement zone includes the concrete or asphalt concrete pavement and aggregate base section placed over the trench zone and extends into manhole or vault excavations above the trench zone.

1.08 PROTECTION OF EXISTING UTILITIES AND FACILITIES

A. The Contractor shall be responsible for the care and protection of all existing utilities, facilities and structures that may be encountered in or near the area of the work in accordance with **Sections 01 00 00 and 01 04 50**.

1.09 PROTECTION OF EXISTING LANDSCAPING

A. The Contractor shall be responsible for the protection of all trees, shrubs, fences, and other landscape items adjacent to or within the work area in accordance with **Section 01 00 00**.

1.10 ACCESS

A. The Contractor shall provide continuous, unobstructed access to all driveways, water valves, hydrants, or other property or facilities within or adjacent to the work areas.

1.11 SAFETY

- A. Protection of workers within trenches shall be as required by the California Labor Code.
- B. All excavations shall be performed in a safe manner and shall be protected and supported in accordance with CAL-OSHA regulations.
- C. Barriers and traffic delineators shall be placed in accordance with the requirements of the agency having jurisdiction.

1.12 EXCESS EXCAVATED MATERIAL

- A. The Contractor shall remove and legally dispose of all excess excavated material and demolition debris.
- B. It is the intent of these specifications that all surplus material shall be legally disposed of by the Contractor. Before acceptance of the work by City, the Contractor shall provide the City with written releases signed by all property owners with whom the Contractor has entered into agreements for disposing of excess excavated material, absolving the City from any liability connected therewith.

1.13 FILTER FABRIC

A. Filter fabric shall be used when excessively wet, soft, spongy, or similarly unstable material is encountered or in areas of suspected high groundwater in accordance with the soils technician's recommendation and the approval of the City Engineer.

1.14 CHANGES IN LINE AND GRADE

A. In the event obstructions not shown on the plans are encountered during the progress of the work, and which will require alterations to the plans, the City Engineer shall have the authority to change the plans and order the necessary deviation from the line and grade, in accordance with **Section 01 00 00**. The Contractor shall not deviate from the specified line and grade without prior written approval by the City Engineer.

1.15 HYDROSTATIC TESTING

A. Pre-testing of the piping system may be performed for the Contractor's convenience at any time. However, the final hydrostatic pressure test shall be as described in **Section 23 91 19**.

1.16 MEASUREMENT AND PAYMENT

- A. Measurement and payment for work in this section will be considered as subsiding obligation of the Contractor and the cost thereof shall be in the applicable items listed in the Bid Schedule.
- B. Payment for work in this section will be considered a subsiding obligation of the Contractor and the cost thereof shall be included in the applicable item listed in the Bid Schedule.

PART 2 - PRODUCTS

2.01 GENERAL

A. The Contractor shall furnish backfill material as specified below. All materials used in and above the pipe zone shall be capable of attaining the required relative density.

2.02 SAND MATERIAL FOR PIPE BEDDING - PIPE ZONE

A. Pipe bedding material shall comply with Section 200-1.5 Sand of the SSPWC and table 200-1.5.3 Sand Equivalent.

U.S. Standard	Percent Passing		
Sieve Size Weight	<u>By</u>		
3/8"	100		
No. 4	75 - 95		
No. 30	12 - 50		
No. 100	5-20		
No. 200	0 - 11		

2.03 BACKFILL – TRENCH ZONE

A. Backfill of trench zone shall be native material excavated from the utility trench and compacted to 95% relative compaction except backfill under curbs, cross gutter, crossing utilities, and sidewalks shall be one sack cement slurry.

2.04 TRENCH PLUGS

A. Trench plugs consisting of compacted Imported Granular Material or sand-cement slurry shall be installed on piping systems that are backfilled with crushed rock.

2.05 FILTER FABRIC

- A. Filter fabric shall be manufactured from polyester, nylon, or polypropylene. Material shall be of non-woven construction and shall meet the following requirements:
 - 1. Grab tensile strength (ASTM D 4632): 45.4kg (100 lbs) minimum for a 1" raveled strip
 - 2. Weight (ASTM D 3776): 4.5 oz./yd2
 - 3. Apparent opening size (ASTM D 4751): 0.006"

PART 3 - EXECUTION

3.01 CLEARING AND GRUBBING

- A. Areas where work is to be performed shall be cleared of all trees, shrubs, rubbish, and other objectionable material of any kind, which, if left in place, would interfere with the proper performance or completion of he contemplated work, would impair its subsequent use, or would form obstructions therein.
- B. Organic material from clearing and grubbing operations will not be incorporated in the trench backfill and shall be removed from the project site or retained and incorporated into the topsoil.

3.02 PAVEMENT, CURB, AND SIDEWALK REMOVAL

A. Bituminous or concrete pavements, curbs, and sidewalks shall be removed and replaced in accordance with the requirements of **Section 02 41 13.13**.

3.03 DEWATERING

- A. The Contractor shall provide and maintain at all times during construction ample means and devices to promptly remove and dispose of all water from any source entering excavations or other parts of the work.
- B. Dewatering shall be performed by methods that will ensure a dry excavation and preservation of the final lines and grades of the bottoms of excavations. Dewatering methods may include well points, sump points, suitable rock or gravel placed as pipe bedding for drainage and pumping, temporary pipelines, or other means, all subject to the approval of the City Engineer. The cost of all dewatering activities shall be borne by the Developer or Contractor.
- C. Sewer systems shall not be used as drains for dewatering trenches or excavations, nor for disposal of collected or accumulated groundwater, without the approval of the agency of jurisdiction.
- D. Concrete shall not be poured in water, nor shall water be allowed to rise around concrete or mortar until it has set at least four hours.
- E. Refer to **Section 31 23 19**.
- F. The Contractor is responsible for meeting all Federal, State, and local laws, rules and regulations regarding the treatment and disposal of water from dewatering operations at the construction site.

3.04 SHORING AND SHIELDING

- A. The Contractor's design and installation of shoring shall be consistent with the rules, orders, and regulations of CAL-OSHA.
- B. Excavations shall be shored, sheeted, and supported such that the walls of the excavation will not slide or settle and all existing improvements of any kind, either on public or private property, will be fully protected from damage.
- C. The sheeting and shoring shall be arranged so as not to place any stress on portions of the completed work until the general construction has proceeded far enough to provide ample strength.
- D. Care shall be exercised in the moving or removal of trench shields, sheeting, and shoring to prevent the caving or collapse of the excavation faces being supported.

3.05 CORRECTION OF OVER-EXCAVATION

A. Over excavations shall be corrected by backfilling with approved imported granular material or crushed rock, compacted to 90% relative compaction, as directed by the City Engineer.

3.06 FOUNDATION STABILIZATION

- A. When unsuitable soil materials are encountered, the unsuitable material shall be removed to the depth determined necessary in the field by the Soils Technician, and as acceptable to the City Engineer. The sub-grade shall be restored with compacted Imported Granular Material or crushed rock as recommended by the Soils Technician. Place the appropriate bedding or base material on this restored foundation.
- B. When rock encroachment is encountered, the rock shall be removed to a point below the intended trench or excavation sub-grade as determined necessary in the field by the Soils Technician, and as acceptable to the City Engineer. The sub-grade shall be restored with compacted Imported Granular Material as recommended by the Soils Technician. Place the appropriate bedding or base material on this restored foundation.
- C. When excessively wet, soft, spongy, or similarly unstable material is encountered at the surface upon which the bedding or base material is to be placed, the unsuitable material shall be removed to the depth determined necessary in the field by the Soils Technician, and as acceptable to the City Engineer. Restore the trench with crushed rock enclosed in filter fabric as directed by the City Engineer. Larger size rocks, up to 3", with appropriate gradation, may be used if recommended by the Soils Technician. Place the appropriate bedding or base material on this restored foundation.

3.07 TRENCH EXCAVATION AND PLACEMENT OF BEDDING

- A. Excavate the trench to the lines and grades shown on the drawings with allowance for 6" of pipe bedding material. The trench section shall be as shown on the Standard Drawings.
- B. The maximum length of open trench shall be 500' except by permission of the City. The distance is the collective length at any location, including open excavation and pipe laying, which has not been backfilled to the elevation of the surrounding grade.

- C. Trench walls shall be sloped or shored per the requirements of CAL-OSHA.
- D. The trench bottom shall be graded to provide a smooth, firm, and stable foundation that is free from rocks and other obstructions.
- E. Place the specified thickness of bedding material over the full width of the trench. Grade the top of the pipe base ahead of the pipe laying to provide a firm, uniform support along the full length of pipe.
- F. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint.
- G. Trenches for main pipelines and all appurtenances shall be backfilled with the materials and methods as specified for the Pipe Zone, Trench Zone and Pavement Zone.
- H. Trench widths shall be in accordance with the Standard Drawings.
- I. Trench depth shall be as required to install pipelines in accordance with the Approved Plans.

 Unless shown otherwise on the Approved Plans, the minimum depth of cover for pipelines shall be as follows:

Pipeline Type Minimum	Cover Required
Potable Water	36"
Recycled Water	48"
Sewer	60"

J. Final street sub-grade shall be established prior to the excavation of pipeline trenches. Minimum cover above pipe shall be 24" for hydrotesting.

3.08 MANHOLE AND VAULTS

- A. The Contractor shall prepare an excavation large enough to accommodate the structure and permit grouting of openings and backfilling operations. The walls of the excavation shall be sloped or shored per the requirements of CAL-OSHA.
- B. Manholes and vaults shall be placed at the location and elevation shown on the plans, on undisturbed soils and 6" of compacted crushed rock base.
- C. Manhole and vault excavations shall be backfilled with the materials and methods as specified for the Pipe Zone, Trench Zone and Pavement Zone.

3.09 COMPACTION REQUIREMENTS

- A. Compaction shall be accomplished by mechanical means. Consolidation by water settling methods such as jetting or flooding is prohibited.
- B. If the backfill fails to meet the specified relative compaction requirements; the backfill shall be reworked until the requirements are met. All necessary excavations for density tests shall be made as directed by the Soils Technician, and as acceptable to the City Engineer. The requirements of the Agency having jurisdiction shall prevail on all public roads.

- C. Compaction tests shall be performed at random depths, and at random intervals not to exceed 150', as directed by the Soils Technician or City Engineer.
- D. Relative compaction shall be determined by the impact or field compaction test made in accordance with ASTM D 1557 Procedure C.
- E. Unless otherwise shown on the drawings or otherwise described in the specifications for the particular type of pipe installed, relative compaction in pipe trenches shall be as follows:
 - 1. Pipe zone 90% relative compaction.
 - 2. Trench zone 90% relative compaction.
 - 3. Structural section in paved areas per agency requirements, 95% minimum.
 - 4. Imported Granular Material for over excavation or foundation stabilization 90% relative density.
- F. All excavations are subject to compaction tests.

3.10 TRENCH PLUGS

A. Trench plugs shall be installed at 60m (200') intervals along the entire length of piping systems. Trench plugs shall be 3m (10') in length and shall encompass the entire pipe zone. Additional trench plugs may be required as directed by the City Engineer.

3.11 PIPE ZONE BACKFILL

- A. Care shall be taken in placing the imported granular backfill material simultaneously around the main pipeline and appurtenance pipes so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe or on the sides of the pipe. Care shall be taken to place material simultaneously on both sides of the pipe to prevent lateral movement. This area shall be mechanically compacted to attain 90% relative density. Care shall be taken when compacting appurtenance laterals 2" and smaller to prevent the crushing or denting of the copper lateral. Additional lifts of 12" or less thickness may be required on 16" or larger diameter pipe to attain complete support of the haunch area. Soils tests may be taken on this layer of backfill.
- B. After the spring line backfill has been approved by the Soils Technician, backfill of the remainder of the Pipe Zone may proceed. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe.
- C. Place and compact the imported granular material at a maximum of 12" lifts. Compact all material placed in the Pipe Zone by mechanical methods. Sand cone tests shall be taken on this layer of backfill.
- D. The use of a backhoe-mounted compaction wheel is prohibited within the pipe zone to 12" above the top of the pipe.
- E. Under no circumstances shall consolidation by water settling or water-setting methods (i.e. jetting, diking, etc.) be permitted.

3.12 TRENCH ZONE BACKFILL

- A. After the Pipe Zone material has been placed, compacted, approved by the Soil Technician and accepted by the City Engineer, backfill in the Trench Zone may proceed.
- B. Compaction using vibratory equipment, tamping rollers, pneumatic tire rollers, or other mechanical tampers shall be performed with the type and size of equipment necessary to accomplish the work. The backfill shall be placed in horizontal layers of such depths as are considered proper for the type of compacting equipment being used in relation to the backfill material being placed. Each layer shall be evenly spread, properly moistened, and compacted to the specified relative density. The Contractor shall repair or replace any pipe, fitting, manhole, or structure damaged by the installation operations as directed by the City Engineer.

3.13 PAVEMENT ZONE BACKFILL AND RESTORATION

- A. After the Trench Zone material has been placed, compacted, approved by the Soil Technician, and accepted by the City Engineer; backfill in the Pavement Zone may proceed as necessary in accordance with the requirements of the agency having jurisdiction.
- B. Replace bituminous and concrete pavement, curbs, and sidewalks removed or damaged during construction in accordance with the requirements of the agency having jurisdiction.

END OF SECTION

SECTION 31 23 16 – EXCAVATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Under this section, the General Construction CONTRACTOR for this Contract shall furnish complete all materials, labor, and equipment necessary to perform work related to all excavation and backfill, as shown on the DRAWINGS or specified herein.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. The total length of excavated trench open at any one time should not be greater than the total length of pipeline/utility line that can be placed in the trench and backfilled in one working day.
 - B. The CONTRACTOR shall use underground Service Alert (USA) notifications and shall utilize an underground utility locating service.

1.05 QUALITY CONTROL

A. The CONTRACTOR is totally responsible for the design, purchase and installation of all construction aids. None of the structures or materials indicated on the DRAWINGS is intended for this use. (For example, if shoring is required for vertical excavation line(s) the design, purchase and installation of such shoring would be the CONTRACTOR's responsibility.)

B. Limits of Work

- 1. All work to be done is located as shown on the contract DRAWINGS. The CONTRACTOR shall confine his operations to designated areas of the sites shown on the DRAWINGS.
- 2. The CONTRACTOR shall occupy and cross only those portions of the site on which the actual work is located.

C. Antipollution Measures

1. The CONTRACTOR shall conduct his activities and shall program his trenching and restoration operations in such a manner as to minimize pollution from erosion of the freshly excavated or backfilled material during periods of excavation. The CONTRACTOR shall reduce the area and duration of exposure of all erodible soils by the greatest extent practicable. Where the ENGINEER so directs in the field, sediment traps and other means to retard runoff rates shall be installed. Similar holding basins or other sediment traps arrangements shall also be required to be installed at the discharge of dewatering pumps. Discretion shall be exercised in selecting the number and location of encroachments during construction both in and along watercourses such that a minimum of disturbance and erosion pollution result.

2. During all construction activities, the CONTRACTOR shall also, wherever possible, make every effort to minimize noises caused by his activities, especially in populated residential areas. Equipment shall be equipped with mufflers or silencers designed to operate with the least possible noise levels.

D. Rights-of-Way

- 1. The OWNER will obtain all rights-of-way, which the OWNER deems necessary for construction of the pipelines and the CONTRACTOR shall confine all construction activities within the limitations of same. The CONTRACTOR, however, shall make his own arrangements for office space, materials storage yards, sanitary facilities, any utility services which may be desired, and for ingress and egress over any private property or land which he desires to use for which the OWNER has obtained no right-of-way for construction, operation and/or maintenance.
- 2. The CONTRACTOR shall not use any vacant lot, or private land as a plant site, depository for materials, or spill site, or for any other purpose without the written authorization of the OWNER (or an authorized agent) of the land, a copy of which authorization shall be filed with the ENGINEER.

PART 2 - PRODUCTS

2.01 EXCAVATION FOR PIPELINES

- A. The depth of trench for pipelines shall be such that the pipe in its installed position shall comply with the line and grades as shown on the plans, or with the line and grades established by the ENGINEER in the field.
- B. The total length of excavated trench open at any one time should not be greater than the total length of pipeline/utility line that can be placed in the trench and backfilled in one working day. No more than 50 lineal feet of open trench should exist when pipeline/utility line installation ceases at the end of the workday.
- C. In excavation for pipelines made in open cut trenches where space permits, the sides of the trench from the ground surface to a depth not closer than 1 ft above the top of the pipe may be excavated to non-vertical and nonparallel planes. In no case shall the side walls of the trench in the pipe zone, defined as all that trench area below a point 12 inches above the top of the pipe in its installed position, be permitted to be other than vertical and parallel planes equidistant from the pipe centerline. The horizontal distance between the vertical planes shall be no greater than the outside diameter of the pipe plus 24 inches, nor less than the outside diameter of the pipe plus 12 inches.
- D. Where the available space does not permit and where existing or proposed above ground or underground structures may be endangered, the sides of the trench above the pipe zone shall be excavated to vertical and parallel planes. The horizontal distance between the vertical planes shall be no greater than necessary to permit construction of the pipe-line with all required sheeting, shoring and bracing in place.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Before beginning excavation or filling work, the topsoil (if any) from all areas to be affected shall be stripped to a depth of 6 inches and shall be properly stored and protected at a location approved by the ENGINEER. After completion of the major construction work, the topsoil shall then be replaced as the upper layer of backfill to a depth of no less than 6 inches so that the final grade shall be as required by the DRAWINGS. If additional topsoil over and above that salvaged from the site is required in order to maintain the 6-in. depth specified, the CONTRACTOR shall furnish and install same at no additional cost to the OWNER.
- B. The CONTRACTOR shall use underground Service Alert (USA) notifications and shall utilize an underground utility locating service.
- C. Concrete and/or other excavated surfacing materials shall be removed from the site and properly disposed at the CONTRACTOR's expense.
- D. Backfill around all structures and in all trenches shall be carried to the grade existing before the installation of the improvement unless otherwise indicated on the DRAWINGS or specified hereafter. Backfilling shall follow immediately after construction of the pipe and appurtenances and in no case shall there be a finished installed pipe left uncovered at the end of the work day.
- E. Each CONTRACTOR shall make personal examination of the sites in which the improvements are to be installed and determine for themselves the extent and character of any work that may be encountered. All work on the basic contract will be performed on an unclassified basis. Unclassified excavation includes the removal and disposal of material of any kind, natural or man-made, without exception.
- F. The CONTRACTOR shall provide adequate and suitable means of support to prevent failure of any excavation wall and to protect his personnel working in the excavation. The system of support shall be in accordance with current OSHA regulations.

3.02 INSTALLATION

- A. All open excavation in the construction area shall be adequately barricaded and posted with battery operated warning lights, signs, etc., as required by any local, State, or Federal regulations, or by any published policy by the OWNER, or in the absence of any such regulation, to the satisfaction of the ENGINEER.
- B. Should the CONTRACTOR's operations encounter foundations of new or existing structures, the CONTRACTOR shall perform excavation and backfill as per the pipe manufacturer's specifications.
- C. No excessively wet material will be permitted to be used as backfill. Suitable or selected backfill material shall be kept separated from the unsuitable types. If the CONTRACTOR allows suitable backfill material from his excavation to become excessively wet or mixed with unsuitable material, he shall not be allowed to use it as backfill material and he will be required to bring in material from an outside source at no additional cost to the OWNER.

- D. The ENGINEER may require that sheeting, shoring or bracing installed for excavation be left in place in order to protect adjacent facilities or structures. Where such is not required in these specifications or on the DRAWINGS, the CONTRACTOR will be reimbursed as stipulated in the General Conditions section of these specifications. All other sheeting may be salvaged when the removal of same will not present a hazard to the adjacent facilities or to the safety of the CONTRACTOR's personnel. The CONTRACTOR shall be fully responsible and liable for any improper or premature removal of sheeting, shoring or bracing and any and all personal or property damages resulting therefrom.
- E. All excavation materials not used in backfill or final grading operations shall be hauled to a specific site location as directed by the OWNER or ENGINEER at the CONTRACTOR's expense. The CONTRACTOR shall not dispose of such material offsite or on the site of the work without the permission of the OWNER.
- F. The CONTRACTOR shall prevent surface water and subsurface or groundwater from flowing into excavations and from flooding the project site. The CONTRACTOR shall not allow water to accumulate in excavations to prevent softening of foundation bottoms and undercutting of footings. The CONTRACTOR shall provide and maintain pumps, sumps, suction and discharge lines, and other dewater system components necessary to convey water away from excavations.

3.03 TESTING – NONE

END OF SECTION

SECTION 31 23 16.26 – ROCK REMOVAL

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Rock excavation includes every operation necessary for excavation of all materials of rock that cannot be excavated using standard methods within the designated lines of the trenches. It shall include hydraulic fracturing, drilling, loading, excavation, dewatering, bracing and shoring as required by safety regulations.
- B. Standard excavation methods are defined as those methods using track mounted excavators of sufficient size and power to excavate for the pipeline and structures in soils, cemented conglomerates, rock, fractured rock, and weathered rock that can be reasonably excavated.

1.02 EQUIPMENT

A. The CONTRACTOR shall have sufficient suitable equipment on site during the hydraulic fracturing, drilling, loading, and blasting to assure that the rock excavation can proceed in an orderly fashion. All equipment shall be suitable for the type of rock excavation required and shall be kept in good working condition during the work. All safety devices required for the operation of the specific equipment shall remain in place and functional during all use of the equipment.

1.03 USE OF EXPLOSIVES

A. Explosives are not permitted in the area of work.

END OF SECTION

ROCK REMOVAL 31 23 16.26 - 1

SECTION 31 23 19 – DEWATERING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section describes the general dewatering methods and equipment required to maintain a dewatered environment throughout the course of work.
- B. This section includes materials, installation, maintenance, operation, and removal of temporary dewatering systems for the control and disposal of surface and ground waters.

1.02 RELATED WORK

- A. Standard Drawings
- B. Standard Specifications 01 00 00, 01 04 50, 01 32 16, 01 33 00, 02 41 13.13, 03 30 00, 03 15 16, 09 90 00, 09 96 71, 21 50 10, 23 00 00, 23 26 13, 23 31 19.13, 23 91 10, 23 91 19, 23 92 13, 23 92 17, 23 93 10, 23 93 17, 23 94 05, 23 95 13, 31 23 00, 31 23 19, 32 16 13, 33 02 22

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. California Regional Water Quality Control Board General Waste Discharge Requirements for Groundwater Remediation and Dewatering Waste Discharges. Copies of the Waste Discharge Requirements may be obtained from the City.

1.04 SUBMITTALS

A. Shop Drawings which, at a minimum, indicate the proposed type of dewatering system; the arrangement, location, and depths of systems components; a complete description of equipment and instrumentation to be used, with installation, operation and maintenance procedures; and the methods of disposal of pumped water.

1.05 QUALITY CONTROL

A. The CONTRACTOR shall be responsible for keeping the excavation for which he is responsible dewatered throughout the course of the work, and failure of the CONTRACTOR to perform these tasks will not make the OWNER liable for any additional expenses incurred by the CONTRACTOR.

1.06 JOB CONDITIONS

- A. Methods of dewatering may include sump pumping, single or multiple stage well point systems, educator and ejector type systems, deep wells, and combinations thereof.
- B. Locate dewatering facilities where they shall not interfere with utilities and construction work to be performed by others.
- C. Modify dewatering procedures which cause, or threaten to cause, damage to new or existing facilities, so as to prevent further damage. Install settlement gauges, as necessary, to monitor

- settlement of critical structures or facilities adjacent to areas of dewatering. Control the rate of dewatering to avoid all objectionable settlement and subsidence.
- D. Comply with Regional Water Quality Control Board Waste Discharge requirements. Obtain authorization, as required, prior to discharge of groundwater, and comply with the sampling, testing, monitoring, and reporting requirements specified therein.

PART 2 - PRODUCTS

2.01 METHODS AND EQUIPMENT

- A. Dewatering methods shall be submitted to the ENGINEER for review and comment.
- B. The CONTRACTOR shall provide and maintain in operation suitable and adequate pumping or well-point equipment for completely dewatering any and all trench excavations in such a manner as to permit the successful installation of the proposed improvements. No pipe shall be permitted to be constructed in a trench in which water flows or is pooled.
- C. The CONTRACTOR shall take all necessary precautions to protect all construction, including partially installed piping, against flooding and/or floatation from hydrostatic uplift.
- D. All water pumped or drained from the construction site shall be directed to a sedimentation control device and properly disposed of by the CONTRACTOR in accordance with all regulations and requirements of all governing authorities, including erosion and sedimentation control activities. No storm or surface water shall be disposed of in new or existing sewer facilities.
- E. The dewatering of the excavation and trench shall be considered an integral part of the excavation work.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Perform dewatering in accordance with approved Shop Drawings. Keep the Engineer advised of any changes made to accommodate field conditions and, on completion of the dewatering system installation, revise and resubmit Shop Drawings as necessary to indicate the installed configuration.
- B. Organize dewatering operations to lower the groundwater level in excavations as required for prosecution of the work, and to provide a stable, dry subgrade for the prosecution of construction operations.
- C. Dispose of water in such a manner as to cause no injury or nuisance to public or private property, or be a menace to the public health. Dispose of the water in accordance with applicable regulatory agency requirements. Do not drain trench water through the pipeline under construction.
- D. The dewatering operation will be continuous, so that the excavated areas shall be kept free from water during construction, while concrete is setting and achieves full strength, and until backfill has been placed to a sufficient height to anchor the work against possible flotation.

- E. Prevent disposal of sediments from the soils to adjacent lands or waterways by employing necessary methods, including settling basins. Locate settling basins away from watercourses to prevent silt-bearing water from reaching the watercourse during flow regime.
- F. Where excavations may obstruct the natural flow of a watercourse, implement measures to control and dispose of the surface water that will not adversely affect water quality or beneficial uses of the watercourse. Divert watercourse flows around excavation areas by constructing barriers, temporary culverts, new channels or other appropriate means.
- G. Do not allow water containing mud, silt or other pollutants from aggregate washing or other construction activities to enter a watercourse or be placed in locations that may be subjected to high storm flows.

3.02 DRAINAGE

- A. Surface water shall be directed away from excavations and construction sites so as to prevent erosion and undermining of any nearby foundations. Diversion ditches, dikes, and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site and the area immediately surrounding the site and affecting operations at the site shall be continually and effectively drained.
- B. Grading shall be done as may be necessary to prevent surface water from flowing into the excavations, and any water accumulating therein shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized over-excavation shall be backfilled with granular fill material and compacted, at no additional cost to the OWNER.
- C. Groundwater flowing toward or into excavations or trenches shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction.
- D. Provide and maintain means and devices to remove and dispose of all water entering the trench excavation during the time the trench is being prepared for the pipe laying, during the laying of the pipe, and until the backfill at the pipe zone has been completed. These provisions shall apply during the noon hour as well as overnight. Dispose of the water in a manner to prevent damage to adjacent property. Do not drain trench water through the pipeline under construction. Do not allow groundwater to rise around the pipe.
- E. CONTRACTOR shall notify the OWNER 48 hours prior to commencement of dewatering. Methods employed shall be in conformance with the applicable discharge permits.

3.03 RECORDS

- A. Provide a daily record of the average flow rate. Provide water quality testing as required by the Regional Water Quality Control Board.
- B. Observe and record the elevation of the groundwater during the period that the dewatering system is in operation.

PART 4 - MEASUREMENT AND PAYMENT

Measurement and payment for work in this section will be considered as subsiding obligation of the Contractor and the cost thereof shall be in the applicable items listed in the Bid Schedule.

END OF SECTION

SECTION 31 23 23.23 – COMPACTION

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. The CONTRACTOR shall compact during backfill as per the specifications contained herein.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS
 - A. Testing for Compaction
 - 1. Determine the density of soil in place by the Sand Cone Method ASTM D1556, or Nuclear Gage Method ASTM D2922 and D3017.
 - 2. Determine laboratory moisture-density relations of soils by ASTM D1557.
 - 3. Determine the relative density of cohesionless soils by ASTM D4253 and D4254.
 - 4. Sample backfill materials by ASTM D75.
 - 5. Express "relative compaction" as the ratio, expressed as a percentage, of the in-place dry density to the laboratory maximum dry density.
 - 6. Compaction shall be deemed to comply with the specifications when no test falls below the specified relative compaction. The CONTRACTOR shall pay the costs of any retesting of work not conforming to the specifications.
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. The CONTRACTOR shall include all costs required for the compaction tests, including delivery of said certified results to the ENGINEER, in the total price bid for this Contract.
 - B. Subject to unsatisfactory test results not meeting specification compaction requirements, the ENGINEER reserves the right to order additional tests at no additional cost to the OWNER until satisfactory test results are reached in the affected areas.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

- 3.01 PREPARATION
 - A. Percentage of Maximum Density and Optimum Water Content Requirements
 - 1. Compact soil to not less than the following percentages of maximum dry density for soils which exhibit a well-defined moisture density relationship, determined in accordance with ASTM D 1557, and not less than the following percentages of relative density, determined in accordance with ANSI/ASTM D2049, for soils which will not exhibit a well-defined moisture-density relationship.

COMPACTION 31 23 23.23 - 1

B. For Structures

1. Compact the top 12 inches of subgrade and each layer of backfill or fill material at 90% maximum dry density at a moisture content that lies within 3% of the optimum moisture content or 90% relative density.

C. For Building Slabs and Steps

1. Compact the top 12 inches of subgrade and each layer of backfill or fill material at 90% maximum dry density at a moisture content that lies within 3% of the optimum moisture content or 90% relative density.

D. For Lawn or Unpaved Areas

1. Unless otherwise shown in DRAWINGS, compact the top 6 inches of subgrade and each layer of backfill or fill material at 90% maximum dry density at a moisture content that lies within 3% of the optimum moisture content.

E. For Walkways

1. Unless otherwise shown in the DRAWINGS, compact the top 6 inches of subgrade and each layer of backfill or fill material at 90% maximum dry density at a moisture content that lies within 3% of the optimum moisture content or 80% relative density.

F. For Roadways

1. Unless otherwise shown on the DRAWINGS, compact the top 12 inches of subgrade and each layer of backfill or fill material at 95% maximum dry density at a moisture content that lies within 3% of the optimum moisture content or 80% relative density for cohesionless granular material.

G. For Pipe Trenches

- 1. Unless otherwise shown on the DRAWINGS or otherwise described in the specifications for the particular type of pipe installed, relative compaction in pipe trenches shall be as follows:
 - a. Pipe trenches—90 percent relative compaction unless shown otherwise on the DRAWINGS.
 - b. Sand slurry refill for overexcavation–90 percent relative compaction.

3.02 TESTING

A. In the event that the use of special vibratory and/or heavy-duty machinery is used for compaction, the following methods will be approved:

1. Proctor Density Tests

a. Subject to field conditions, Proctor Density Tests shall be used throughout the course of the project to determine the standard density of material. These tests, when required, will be performed in accordance with ASTM D 1557, unless otherwise specified.

COMPACTION 31 23 23.23 - 2

2. Compaction Tests

a. Subject to field conditions and installation procedures Compaction Tests shall be required throughout the course of the project to verify the in-place density of compacted soil backfill. These tests will be performed at locations as determined in the field. These tests will be performed in accordance with ASTM D1556 or by nuclear methods designated as ASTM D6938-07b D2922, unless otherwise specified.

END OF SECTION

COMPACTION 31 23 23.23 - 3

SECTION 31 23 33 – TRENCHING AND BACKFILLING

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section describes the general trenching and backfilling specifications for installation, and burial of conduit and environmental piping.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. The CONTRACTOR shall verify all soil conditions and the trenches shall be dug according to the plan. The CONTRACTOR shall have all trenches dug and inspected prior to the arrival of the pipe installation crew.
 - B. Unless otherwise indicated, excavation shall be open cut.
 - C. During excavation, material suitable for backfilling shall be stockpiled in an orderly manner, a distance back from the edges of the excavations specified by the governing safety agency. Materials unsuitable for backfilling shall be wasted as specified.
 - D. Caution shall be exercised in operating heavy equipment over pipelines. Leaks or breaks caused by the CONTRACTOR's operations shall immediately be repaired at no additional expense to the OWNER and in a manner acceptable to the ENGINEER.
 - E. The banks of excavated areas shall be controlled as is necessary to prevent movement of soil in areas supporting existing foundations, slabs, pole lines, underground power or telephone cables, trees, pipelines or other structures.
 - F. If, as a result of the excavation or through fault or neglect of the CONTRACTOR, the earth or ground under or around such foundations, slabs, pole lines, underground power or telephone cables, trees, pipelines or other structures, slips or is otherwise disturbed, corrective measures shall be taken as directed at no additional expense to the OWNER.
 - G. The bottom of the trench shall be excavated to the lines and grades shown with proper allowance for pipe thickness, and for foundation stabilization and special bedding when required. Material containing rocks or cobbles larger than 2 inches in maximum dimension shall not be permitted within 6 inches of the pipe. Material of this type shall be removed from the bottom of the trench and replaced with backfill material. Parts of the trench excavated below grade shall be corrected with backfill as specified. The depth of trenches shall be as indicated on the DRAWINGS.
 - H. Measurements for cover requirements shall be taken from the existing grade. (It is the responsibility of the CONTRACTOR to maintain these cover requirements with any future grade changes that may occur.)

I. The pipe shall have a minimum vertical clearance of 18 inches from other underground utilities unless denoted otherwise on the DRAWINGS.

J. Pipe Base

1. The pipe base shall be defined as a layer of material immediately below the bottom of the pipe or conduit and extending over the full trench width in which the pipe is bedded. Thickness of pipe base shall be 6 inches or as otherwise shown on the DRAWINGS or otherwise described in the specifications for the particular type of pipe installed.

K. Safety

- 1. All excavations shall be performed, protected, and supported as required for safety and in the manner set forth in the operation rules, orders, and regulations prescribed by the Division of Industrial Safety of the State of California.
- 2. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrians and vehicular traffic of such excavations. Lights shall also be placed along excavations from sunset each day to sunrise of the next day until such excavation is entirely refilled.

1.06 SUBMITTALS

- A. Submit excavation DRAWINGS for worker protection in accordance with **Section 01 33 00 Submittal Procedures**.
- B. Submit six (6) copies of a report from a testing laboratory verifying that imported material conforms to the specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Backfill and Bedding

- 1. Backfill and bedding material shall be imported sand slurry delivered and placed by Readimix Truck.
- 2. Sand used for bedding and backfilling pipe and utilities shall have the following gradation:

P	ercent Passing
Sieve Size	By Weight
2 inch	-100
No. 4	70 - 100
No. 16	35 - 75
No. 50	10 - 40
No. 200	0 - 10

Minimum sand equivalent shall be 30 per ASTM D-2419.

B. Concrete for Pipe Encasement

1. Concrete for pipe encasement shall be 520C-2500 per the SSPWC, unless otherwise shown on the DRAWINGS.

C. Water for Compaction

1. Water used in compaction shall have a maximum chloride concentration of 500 mg/l, a maximum sulfate concentration of 500 mg/l, and shall have a pH of 7.0 to 9.0. Water shall be free of acid, alkali, or organic materials injurious to the pipe coatings.

PART 3 - EXECUTION

3.01 PREPARATION

- A. The CONTRACTOR shall prepare the trench width one foot wider than the width of the pipe to be buried unless specified otherwise in the design DRAWINGS. Where more than one pipe is specified for a given trench, the trench shall be at least one foot wider than the width of the combined piping.
- B. Trench width at the top of the trench will not be limited except where the width of the excavation would undercut adjacent structures, footings or slopes. In such cases, trench width shall be such that there is at least 18 inches between the top of edge of the trench and the structure, footing or slope.
- C. Excavate the trench to the lines and grades shown on the DRAWINGS with allowance for pipe thickness and for pipe base or special bedding. If the trench is inadvertently excavated below the required grade, refill any part of the trench excavated below the grade at no additional cost to the OWNER with sand slurry. Place the refilling material over the full width of trench in compacted layers not exceeding 6 inches deep to the established grade with allowance for the pipe base or special bedding.
- D. The CONTRACTOR shall slope the sides of the trench at an angle above the highest point of the piping to assist in minimizing soil loads in loose soil conditions prior to compaction.
- E. Dewatering shall be performed as needed per the requirements in **Section 31 23 19**.
- F. The CONTRACTOR shall have the trench inspected by the OWNER or the ENGINEER.
- G. If there is any conflict between the trenching and pipe bedding described and that of the detail DRAWINGS, the trenching and pipe bedding shall be performed in accordance with the design DRAWINGS.

H. Location of Excavated Material

1. During trench excavation, place the excavated material only within the working area. Do not obstruct any roadways or streets. Conform to federal, state, and local codes governing the safe loading of trenches with excavated material.

I. Length of Open Trench

1. Limit the length of open trench to 600 feet in advance of pipelaying or amount of pipe installed and backfilled in one working day.

J. Foundation Stabilization

- 1. After the required excavation has been completed, the ENGINEER will inspect the exposed pipe zone and trench subgrade to determine the need for any additional excavation. It is the intent that additional excavation be conducted in all areas within the influence of the pipeline where unacceptable materials exist at the exposed subgrade.
- 2. Overexcavation shall include the removal of all such unacceptable material that exists directly beneath the pipeline or within the pipe zone to the width shown on the DRAWINGS and to the depth required. This may require excavating a wider trench.
- 3. Backfill the trench to subgrade of pipe base with refill material for foundation stabilization. Place the foundation stabilization in layers not exceeding 6 inches deep to the required grade.
- K. Refill material used by the CONTRACTOR for his convenience will not receive any additional payment.

3.02 INSTALLATION

A. Pipe Bedding

- 1. Bedding of the pipe shall be done only in the presence of the ENGINEER, and in accordance with the trench detail on the DRAWINGS. Bedding shall be done only after foundation preparation, laying and jointing of the pipe.
- 2. As the pipe is installed it shall be bedded by hand with material as shown. Care shall be taken to prevent any damage or shifting of the pipe. The pipe bedding material shall be compacted into place to the same density as specified for backfill above the pipe bedding material with materials as specified.
- 3. Thickness of pipe base shall be 6 inches or as otherwise shown on the DRAWINGS or otherwise described in the specifications for the particular type of pipe installed.
- 4. Excavate coupling or bell holes at each joint to permit proper assembly and inspection of the entire joint.
- B. After pipe has been bedded, place bedding material simultaneously on both sides of the pipe, keeping the level of bedding the same on each side. Carefully place the material around the pipe so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling.
- C. The CONTRACTOR shall install a second layer of approved backfill material to a depth of approximately 12 inches unless specified otherwise in the DRAWINGS. Place the backfill material carefully onto the bedding material previously placed. Do not permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe. Do not drop sharp, heavy pieces of material directly onto the pipe. This second layer of backfill material shall be graded to provide an even bed and compacted as per the compaction requirements in **Section 31 23 23.23 Compaction**.
- D. The pipe installation crew will install the warning tape in the trench not more than one foot below finish grade. The CONTRACTOR will provide the warning tape.

- E. Tracer wire shall be installed on HDPE/PVC piping in accordance with Division 43 specifications and as shown in the Detail DRAWINGS.
- F. Continue backfill to grade in accordance with compaction requirements in **Section 31 23 23.23 Compaction**.
- G. Throughout the installation process, the CONTRACTOR shall not allow newly installed piping to be left uncovered overnight without prior approval from the OWNER or the ENGINEER.

END OF SECTION

SECTION 31 41 33 – TRENCH SHIELDING

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section provides information in regarding to trench shielding that shall be followed by the CONTRACTOR.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. The CONTRACTOR shall be responsible for providing adequate lateral restraint for the walls of any excavation required to complete his work.
 - B. Shoring, sheeting and bracing shall be adequate to withstand all loads superimposed thereon and shall be furnished to protect personnel and existing or proposed structures, pipelines or other facilities.
 - C. The CONTRACTOR shall design the lateral restraint facilities to include any necessary sheeting, bracing or shoring to protect any facilities, stockpiled excavation or construction materials adjacent to the excavation and/or any personnel required to be in or near the excavation.
 - D. The methods proposed for providing the lateral support for any excavation shall be submitted to the ENGINEER on the site, for his review and/or comment.
 - E. Bracing elements shall not be cast into or included in permanent concrete work, except as specifically approved by the ENGINEER, in which case, the proper keys, cutoffs, waterstops, and waterproofing must be provided.
 - F. The CONTRACTOR shall save harmless the ENGINEER and the OWNER from any and all personal injuries or property damages resulting from his failure to provide and properly maintain the lateral restraints heretofore mentioned.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials for walls and bracing shall be new or of sound material. If of steel, they shall be standard structural steel sections, as listed in the "Manual of Steel Construction", current edition, of the American Institute of Steel Construction. If timber, they shall be structural grade Southern Pine or Douglas Fir.
- B. The steel sections used shall have no more than surface rust and shall conform to the requirements of the ASTM Specification A-36 or A-572, current edition, "Requirements for

TRENCH SHIELDING 31 41 33 - 1

Delivery of Structural Steel", in respect to straightness, defect deformations, camber and any other condition which would affect their efficient performance in the bracing system.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Shoring, sheeting, and/or bracing shall be installed in accordance with OSHA regulations, current edition. All trenching and other excavations which present a hazard to personnel working in the excavated areas because of depth of trench embankments, stockpiling of excavated materials along the top of the trench or adjacent traffic shall be shored, sheeted or braced.
- B. All shoring, sheeting and bracing, where necessary, shall be designed and installed by the CONTRACTOR for the materials and depths encountered. The CONTRACTOR shall be fully responsible for the adequacy of the system to withstand all loads imposed thereon, and shall save harmless the OWNER and ENGINEER in the field from any and all personal or property damages resulting from his failure to properly install and maintain sufficient sheeting, shoring and bracing.
- C. The CONTRACTOR shall be fully responsible and liable for any improper or premature removal of sheeting, shoring or bracing and any and all personal or property damages resulting therefrom.
- D. Should the CONTRACTOR's operations impair foundations for new or existing structures, he shall provide concrete underpinning piers or supports for such structures at no additional cost to the OWNER. The proposed underpinning methods shall be reviewed by the ENGINEER prior to installation. This, however, shall not relieve the CONTRACTOR of his responsibility to safeguard the structures.

END OF SECTION

TRENCH SHIELDING 31 41 33 - 2

SECTION 33 12 13.13 – WATER SUPPLY BACKFLOW PREVENTER ASSEMBLIES

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. The CONTRACTOR shall purchase and install reduced pressure zone backflow preventers as specified herein and as shown on the DRAWINGS.
- 1.02 RELATED SECTIONS NONE
- 1.03 CITED STANDARDS
 - A. All reduced pressure backflow preventers shall conform to the following standard specifications, of the latest revisions, as applicable:
 - 1. ANSI/AWWA Conformance (C511-89)
 - 2. ASSE standard 1012. AWWA standard C511, and the USC Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL NONE

PART 2 - PRODUCTS

- 2.01 REDUCED PRESSURE ZONE BACKFLOW PREVENTER ASSEMBLIES
 - A. The reduced pressure backflow preventer assemblies shall consist of two independent "Y" configured check valves and one differential relief valve.
 - B. By design, the assembly shall automatically reduce the pressure in the zone between the check valves. Should the differential between the zone and upstream pressure drop to 2psi, the differential relief valve will open, maintaining proper zone differential.
 - C. Valve bodies and covers shall be manufactured of ductile iron ASTM A536, Grade 65-45 12; ductile iron bodies shall be flanged, ANSI B16.1, Class125, epoxy coated.
 - D. The assembly shall be constructed so all internal parts, including seat rings, can be serviced from the top or side or removed while assembly is in line.
 - E. The assembly shall be rated for 175psi (12.1 bar) MWWP, hydrostatically tested to 350psi, with an operating temperature range of 32°F to 140°F.
 - F. The materials of construction shall be:
 - 1. Main Valve Body Ductile iron grade 65-45-12 fusion epoxy coated internal and external;
 - 2. Main Valve Trim Bronze;
 - 3. Internal Check Assembly Stainless Steel;

- 4. Relief Valve Body and Trim Bronze;
- 5. Elastomers Nitrile;
- 6. Diaphragms Nitrile, fabric reinforced;
- 7. Springs Stainless Steel;
- 8. Internal Check Assembly Stainless Steel;
- 9. Shutoffs Non-rising stem, resilient seated gates.
- G. Relief valve assembly shall be of a modular design for ease of maintenance.
- H. The assembly shall meet or exceed requirements of ASSE standard 1013, AWWA standard C511, and the USC Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California.
- I. Reduced pressure backflow preventer assemblies shall be FEBCO 825YD, or prior approved equal.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prior to installation, the supply lines shall be flushed of all foreign material. Failure to flush the supply line may cause the check valves to become fouled and require disassembly and cleaning.
- B. The CONTRACTOR shall consult with local codes for specific installation requirements and restrictions applicable to the area.

3.02 INSTALLATION

- A. The backflow preventers shall be installed by the CONTRACTOR in accordance with: the manufacturer's recommendations; the flange connections, supports and testing requirements as shown on the DRAWINGS.
- B. The CONTRACTOR shall adhere to the manufacturer's recommendations for clearance around the backflow preventer.
- C. The CONTRACTOR shall not lift the assembly by connecting to the gate valve handwheels or stems.
- D. After installation the CONTRACTOR shall slowly fill the assembly with water and bleed air from the body using the #2, #3 and #4 test cocks, as per the manufacturer's installation instruction documents.

3.03 TESTING – NONE

END OF SECTION

SECTION 33 12 46 - ELECTRIC MOTOR ACTUATORS

PART 1 - GENERAL

1.1 Work Included

A. Materials, testing, and installation of motorized actuators and required intermediate gearing between actuator and valve.

1.2 Related Work

- A. Section 01 22 00: Unit Prices
- B. Section 01 33 00: Submittal Procedures
- C. Section 01 40 00: Quality Requirements
- D. Section 01 61 00: Common Product Requirements
- E. Section 01 65 00: Product Delivery Requirements
- F. Section 01 66 00: Product Storage and Handling Requirements
- G. Section 01 73 00: Execution
- H. Section 01 73 24: Seismic Restraint
- I. Section 01 73 33: Mechanical Identification
- J. Section 09 90 00: Painting and Coating
- K. Section 09 96 56: Epoxy Linings and Coatings
- L. Section 26 05 10: Common Work Results for Electrical
- M. Section 33 05 39: Manual Valve Operators
- N. Section 33 12 12: Resilient-Wedge Gate Valves
- O. Section 33 12 14: Butterfly Valves
- P. Section 40 90 10: Common Work Results for Instrumentation and Control

1.3 **Definitions**

- A. The following definitions apply:
 - 1. Cycle Time: Time required to move valve from close to open and back to close.
 - 2. Open/Close Travel Time: Time required to move valve from close to open or open to close

1.4 System Description

- A. Furnish and install complete operating motorized actuator including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building, and electrical codes and standards.
- B. Provide in 1 integral modular assembly motor, internal reduction gearing, position limit switches, torque switches, travel limit switches, position indicator, declutch lever, handwheel, and reversing starter.
- C. Design shall facilitate rapid replacement of faulty modules or subsections.
 - 1. Motor shall be removable without draining oil or grease from gearbox.
 - 2. Housing for electrical components, limit switches and torque switches shall be modular with captive hardware.
 - 3. Facilitate fuse replacement and switch adjustments without removal of other components within enclosure.
 - 4. For ease of motor or gear replacement, motor shall be independent sub-assembly of actuator power unit such that power gearing is not integral part of motor assembly.
 - 5. Wiring shall be easily disconnected during replacement.
 - 6. Wiring connections compartment shall contain sufficient screw-type terminals to allow connection of step-mode controls
 - 7. Control wiring shall be physically separated from power wiring.
 - 8. Terminals shall be easily accessible without removing components or use of special tools.

- D. Provide intermediate operators of spur, helical, or bevel gears, between new electric motor actuator and new or existing geared valve operators, if needed to provide specified open/close time, and to provide proper operation of valve.
 - 1. Design intermediate geared operators with bearings suitable for adapting to electric actuator.
 - 2. Do not use operators designed with bushings.
 - 3. Enclose intermediate geared operators.
 - a. Provide seals on shafts to prevent dirt or water entry into operator.
 - b. Lubricate seals with oil or grease.
 - 4. Intermediate geared operators do not need a dial indicating position of valve.
 - 5. Intermediate geared operators shall be of totally enclosed design proportioned to permit operation of valve under full differential pressure equal to valve pressure rating, with input ≤150 foot-pounds torque on operating shaft.
 - 6. Orient intermediate geared operators to operate with valve stem and electric actuator as directed by District's Representative.
 - 7. Support gear shaft at each end by ball or tapered roller bearings.
 - 8. Provide reduction gearing to meet maximum torque and pull design requirement.
 - 9. Reduction gearing shall run in proper lubricant.
- E. Provide drop-in stem nut drive sleeve held in place with snap ring, torque bushing, or threaded locknut and keyway which couples actuator to intermediate geared operator or valve stem and provides versatile means of disassembling actuator from operator or valve.
- F. It shall be possible to orient actuator in field to best suit installation geometry and facilitate maintenance.

1.5 Quality Assurance

- A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.
- B. Factory testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Valve Actuator	Proof of Design Test with Valve Attached	AWWA C540	1 test on 1 motor actuator	Contractor	Contractor
	Performance Test with Valve Attached		1 test on each motor actuator	Contractor	Contractor

C. Powered actuators shall be tested and adjusted on valve for which it is supplied by valve Manufacturer, actuator Manufacturer, or authorized distributor and service facility for actuator.

1.6 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - 1. AWWA C504 Rubber-Seated Butterfly Valves 3"-72"
 - 2. AWWA C515 Reduced Wall, Resilient Seated Gate Valves for Water Supply Service
 - 3. AWWA C540 Power Actuating Devices for Valves and Sluice Gates
 - 4. IEC 60529 Degrees of Protection Provided by Enclosures (IP Code)
 - 5. NEMA/ANSI 250 Enclosures for Electrical Equipment
 - 6. NFPA 70 National Electric Code (NEC)

1.7 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
MOBILIZATION SUBMITTALS		

SUBMITTAL	DESCRIPTION	
Factory Training Certification		
	specific models installed prior to technicians performing Work on valves and	
	actuators.	
Oh a a Danvila a a	DRAWINGS	
Shop Drawings	Submit for actuator under electrically controlled equipment Shop Drawing requirements and requirements of AWWA C540.	
	Submit dimensional drawings for all views	
	Submit electrical schematic diagrams and wiring diagrams showing	
	interconnects for power, control, monitoring, solenoid, and protective circuits.	
	MANUFACTURER'S LITERATURE	
Product Data	Submit the following for items of standard manufacture:	
	Product name or identification in sufficient detail to facilitate reordering.	
	List of parts and construction materials referenced by ANSI, NEMA, ASTM,	
	SAE or CDA specification and grade.	
	Dimensions and weights	
	Coating data and thicknesses.	
Installation Instructions	Submit per Installation Instruction requirements.	
	QUALITY ASSURANCE AND CONTROL SUBMITTALS	
Engineering Calculations	Submit actuator torque calculations throughout flow range.	
	Submit information showing relationship between operator output torque and	
	torque limit switch settings.	
	For motors submit for seismic anchorage per Section 01 73 24.	
Certificates of Compliance	Submit affidavit of compliance and certification of performance test per	
T. (D IT	AWWA C540 and Certificate of Compliance requirements.	
Test Record Transcripts	Submit test report for proof of design test per AWWA C540 §6.2 and per test record transcript requirements.	
	Submit test report for performance tests per AWWA C540 §6.2 and per test	
	record transcript requirements.	
	Submit written cycle test results.	
	CLOSEOUT SUBMITTALS	
O & M Instructions	Submittal shall include:	
	Theory of operation of actuator and intermediate gearing.	
	Expanded parts drawings of mechanical and electrical parts.	
	Parts list and part changeout instructions.	
	List of recommended spare parts.	
	Specifications and ordering information for replacement motors.	
	List of special tools for installation, maintenance and adjustments.	
	Preventative maintenance schedules.	
	Lubrication guide with list of recommended lubricants.	
	Troubleshooting data.	
	Certified performance data and curves from factory tests.	
Motor Data	Submit per motor data requirements of Section 26 05 10.	
	Show nameplate data, insulation type, output torque, voltage, phases,	
	frequency, current at running torque, locked rotor current, duty rating.	
	Show open/close travel time.	
	Do not use intermittent or pulsed operation to conform to specified travel	
Warrant	time.	
Warranty	Furnish 1-year warranty from date of final acceptance.	

B. Refer to Section 01 33 00 for definition of requirements for Shop Drawings, Product Data, Installation Instructions, O&M Instructions, Certificates of Compliance, Engineering Calculations, and Test Record Transcripts.

1.8 <u>Delivery, Storage, and Handling</u>

A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.

- B. Strictly follow Manufacturer's instructions and warranty requirements for delivery, storage, and handling of motorized actuators.
- C. Actuator and valve shall be shipped and delivered to jobsite as unit.

1.9 **Project Site Conditions**

A. Refer to Section 01 10 01 for full list of project site conditions.

1.10 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for electric motor actuators.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Actuators – Quarter-	AUMA USA SG Series	Tustin, CA (714) 318-8596
turn Direct-Acting		
		T (1 0 4 (744) 0 40 0 500
Actuators – Multi-turn	AUMA USA SA Series	Tustin, CA (714) 318-8596
Worm Gear and Motor		
Actuators – Linear	AUMA USA	Tustin, CA (714) 318-8596
Actuators – Lever	AUMA USA	Tustin, CA (714) 318-8596

- A. Equipment furnished shall operate through its full operating range powered by amperages specified or shown on Plans.
 - 1. Equipment requiring horsepower or amperage > specified or shown is unacceptable absent written statement from District electrical infrastructure and switchgear can support increased amperage.
- B. Test and adjust powered actuators on valve for which it is supplied.
 - 1. Valve supplier, operator Manufacturer, or factory-authorized distributor and service facility for actuator shall conduct testing.

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Electric motor valve actuators shall conform to AWWA C540.
 - 1. Controls shall be integral with actuator and fully equipped as specified in AWWA C540.
- C. Valves shall open by turning counterclockwise.
- D. Identify electric motor actuators by model number and serial number cast or molded into actuator body or on permanently attached plate in raised letters
- E. Unless otherwise specified, materials for electric-motor actuators shall be.

ITEM	MATERIAL	SPECIFICATION
Gear Housing	Ductile Iron	Conform to ASTM A536 Grade 65-45-12
Spur or Helical Gearing	Steel or	Machined hardened alloy steel
	Stainless Steel	Machined hardened alloy steel
Worm Gears	Alloy Bronze	
Exposed Threaded	Stainless Steel	SAE Type 316
Parts, Cap Screws,		
Case Bolts, Carriage		
Bolts, cover Screws,		
Machine Screws, and		
Set Screws		
Lubricants		Suitable for ambient conditions of -20°F-150°F

F. The following product design criteria, options and accessories are required for above-grade installations:

nstallations:		
ITEM	DESCRIPTION	
Valve Operating	Valve Description	Refer to Plans
Characteristics	Service	Open/Close
	Action on Failure	Ensure valve remains in last known position
	Partial Stroke Test	Required on Open/Close Valves
	Feature	
	Travel Time	5 seconds per diameter inch
	Travel Time Tolerance	±2%.during ±10% fluctuation in voltage.
	Fluid	Potable or Nonpotable Water
	Maximum Differential	As shown
	across Closed Valve	
	Maximum Line Velocity	10 feet per second
	through Fully Open	
	Valve	
	Required Output Torque	Size to 1.5 times maximum required operating torque of valve for
		open-close valves
		Maximum torque requirement shall be torque required at most
		severe operating condition, including
		Seating and unseating
		2. Maximum differential pressure across valve or pressure rating
		of valve, whichever is greater.
		 Maximum flow velocity based on maximum design flow rate shown but ≥7 fps.
		4. Maximum mechanical friction or other restrictive conditions
		inherent in valve assembly
		Neglect water-hammer effects in determining required torque
		Calculate maximum actuator torque with applied voltage 10%
		below nominal voltage rating.
		Motor stall torque shall be ≤ torque capacity of valve, valve
		stem, shaft, or stops.
	Noise	≤72dBA within 3' radius
Operation	Range of Operation	Provide full 90° rotation on quarter turn valves / Provide full range
		of operation for multi-turn valves
	Stem Protection	Required on rising stem valves.
	Manual Override	Provide override handwheel with declutch mechanism,
	Handwheel	Size handwheel for maximum pull of 50 pounds under full
		differential pressure at any point through valve travel, and
		including seating or unseating.
		Handwheel shall include arrow and wording to show rotation
		direction to OPEN or CLOSE valve.
		In MANUAL mode, actuator shall remain in MANUAL mode until
		motor is energized, at which time actuator shall automatically
		return to AUTO mode and electric operation.
	Handwheel-Motor	Facilitate transition between motor and handwheel operation by
	Declutch Mechanism	positive, declutching lever, which mechanically disengages

ITEM		DESCRIPTION
		motor and related gearing so handwheel does not rotate during motor operation and operation of handwheel does not cause motor to rotate. Fused motor shall not prevent manual operation. Do not use friction type declutch mechanisms
		Declutch lever shall be padlockable in MANUAL and AUTO position.
	Position Indicator	Required
Mounting		ble of field mount in any orientation or position yht-side-up after installation
Power Transmission	Gearing	Provide actuator with internal, multiple reduction power gearing unit, consisting of spur or helical gears and worm gearing. Provide self-locking worm gear set in drive train to maintain valve position.
	Bearings	Use anti-friction bearings with caged balls or roller throughout.
	Shaft Seals Service Access	Provide adequate seals on shafting. Rotating power train components shall operate immersed in grease or oil with provisions for inspection and relubrication without disassembly.
		Design shall permit gear case to be opened for inspection or disassembled without releasing stem thrust or taking valve out of service.
Limit Switch	Туре	Single Pole Double Throw (SPDT) type Magnetically latching contact relay and programmable to be NO or NC Contacts rated for 5 amps at 120VAC
	Quantity	Each actuator shall have ≥2 transfer contacts at end position, 1 for valve FULL OPEN, and 1 for valve FULL CLOSED.
	Location	House limit switch in actuator control enclosure
Torque Sensor	Function	De-energize motor if over-torque condition is sensed Automatically adjust for initial valve unseating or programmed torque seating of valves.
	Programming	Automatically adjust for initial valve unseating or programmed torque seating of valves.
		Valve movement in opposite direction of overtorque move shall reset torque limit protection
	Location	Provide at each end of travel
Local Control Panel	Functions	Locally operate valves Interface with SCADA and remote control stations.
	Construction	NEMA rating as shown below with white-painted steel interior back-pan for mounting interior devices.
		Provide separate local control panel adjacent to operator for local operation of actuator. No local control pushbuttons, switches or indicating lights shall be provided on actuator face.
	Instrumentation	Semi-flush mounted, back-connected, direct reading with 3½, 7-segment, 0.56" red LED digital display unless otherwise shown. Instrument cases shall be dust tight with antiglare faceplates.
Local Control Panel Nameplates	Location	Provide for instruments, relays, control switches, push buttons, indicating lights, and items where circuit and function of device is not obvious.
	Construction	White plastic cut through to black background Lettering legible from reasonable observation angles and up to 10' Screw-retained type

G. The following product design criteria, options and accessories are required for below-grade installations:

ITEM	DESCRIPTION		
Valve Operating	Valve Description	Refer to Plans	
Characteristics	Service	Open/Close	
	Action on Failure	Ensure valve remains in last known position	
	Partial Stroke Test Feature	Required on Open/Close Valves	
	Travel Time	5 seconds per diameter inch	
	Travel Time Tolerance	±2%.during ±10% fluctuation in voltage.	
	Fluid	Potable or Nonpotable Water	
	Maximum Differential across Closed Valve	As shown	
	Maximum Line Velocity through Fully Open Valve	10 feet per second	
	Required Output Torque	Size to 1.5 times maximum required operating torque of valve for open-close valves	
		 Maximum torque requirement shall be torque required at most severe operating condition, including 1. Seating and unseating 2. Maximum differential pressure across valve or pressure rating of valve, whichever is greater. 3. Maximum flow velocity based on maximum design flow rate shown but ≥7 fps. 4. Maximum mechanical friction or other restrictive conditions inherent in valve assembly 5. Neglect water-hammer effects in determining required torque Calculate maximum actuator torque with applied voltage 10% 	
Operation	Range of Operation	below nominal voltage rating. Provide full 90° rotation on quarter turn valves / Provide full	
		range of operation for multi	
	Stem Protection	Required on rising stem valves.	
	Manual Override Handwheel	Provide override handwheel with declutch mechanism, Fused motor shall not prevent manual operation.	
		Accomplish movement from motor operation to handwheel operation by positive, declutching lever, which mechanically disengages motor and related gearing from handwheel. Do not use friction type declutch mechanisms Declutch lever shall be padlockable in MANUAL and AUTO position. In MANUAL mode, actuator shall remain in MANUAL mode until motor is energized, at which time actuator shall automatically return to AUTO mode and electric operation.	
		Size handwheel for maximum pull of 50 pounds under full differential pressure at any point through valve travel, and including seating or unseating.	
Mounting		of field mount in any orientation or position	
	Readouts shall read right-		
Power Transmission	Gearing	Provide actuator with internal, multiple reduction power gearing unit, consisting of spur or helical gears and worm gearing. Provide self-locking worm gear set in drive train to maintain valve position.	
	Bearings	Use anti-friction bearings with caged balls or roller throughout.	
	Shaft Seals Service Access	Provide adequate seals on shafting. Rotating power train components shall operate immersed in grease or oil with provisions for inspection and relubrication without disassembly.	
		Design shall permit gear case to be opened for inspection or disassembled without releasing stem thrust or taking valve out of service.	
Limit Switch	Туре	Single Pole Double Throw (SPDT) type	

ITEM	DESCRIPTION	
		Magnetically latching contact relay and programmable to be NO or NC Contacts rated for 5 amps at 120VAC
	Quantity	Each actuator to have ≥2 transfer contacts at end position, 1 for valve FULL OPEN, and 1 for valve FULL CLOSED
	Location	House limit switch in actuator control enclosure
Torque Sensor	Function	De-energize motor if over-torque condition is sensed
	Programming	Automatically adjust for initial valve unseating or programmed torque seating of valves.
		Valve movement in opposite direction of overtorque move shall reset torque limit protection
	Location	Provide at each end of travel
Local Control Panel	Functions	Locally operate valves
		Interface with SCADA and remote control stations.
	Construction	NEMA rating as shown below with white-painted steel interior backpan for mounting interior devices.
	Instrumentation	Semi-flush mounted, back-connected, direct reading with 3½, 7-segment, 0.56" red LED digital display unless otherwise shown. Instrument cases shall be dust tight with antiglare faceplates.
Control Panel Nameplates	Location	Provide for instruments, relays, control switches, push buttons, indicating lights, and items where circuit and function of device is not obvious.
	Construction	White plastic cut through to black background Lettering legible from reasonable observation angles and up to 10' Screw-retained type

H. The following product design criteria, options and accessories are required for motors for actuators for open-close or open-close-throttling service:

tuators for open-close or open-close-throttling service:		
ITEM		DESCRIPTION
Electric Motor Actuator	Motor Type	Squirrel-cage induction
for Open-Close-	Running Condition	Motor shall operate at rated load and open and close valve at
Throttling Service		±10% of rated voltage and/or ±5% of rated frequency
	Operating Frequency	60 Hz
	Synchronous Speed	3600 rpm (2-pole)
	Efficiency	Premium Efficiency (RUS)
	Starting Code	Code F or G for motors ≥15 hp / Manufacturer's standard for
	_	motors <15 hp
	Duty	S2 Short-Time Duty
	Temperature Rise	NEMA Design B Rated for Operation at 50°C (122°F)
	Service Factor	1.15
	Motor Sizing	Size for valve actuation and 100 start/stops per hour and 3 full
	_	consecutive valve cycles with heat rise ≤50°C (122°F)
	Insulation	Class F (155°C)
		Size motor to limit temperature rise to Class B rise at unity
		service factor.
	External Ground	¾" for motors ≤100-hp
	Connection	Bronze bolt and lock washer or bronze post connector
		Provide threaded motor frame hole to depth ≥1½ x whole
		diameter to ensure firm connection.
		If necessary, bond metal pad to motor frame to provide required
		threaded hole depth.
		Locate grounding means in connection box or on same side of
		motor as main lead terminal box.
	Overtemperature	Provide automatic reset normally closed thermal overloads in
	Protection Motor	each phase of motor windings per NEMA MG-1
	Windings (motors	
	<200hp)	

ITEM		DESCRIPTION	
	Control Leads on	Color code control leads and terminate in separate conduit box.	
	Overtemperature	'	
	Protection Devices		
	Other Requirements	Insulate and brace windings for full voltage operation.	
	Throttling	Motor actuator shall be suitable for throttling valve at intermediate	
		positions	
Motor Bearings	lotor Bearings Bearing Life ANSI/ABMA 9 L ₁₀ of 50,000 hours		
	Lubrication	Oil bath upper bearing	
		Grease lubricated lower bearing, prelubricated at factory	
	Bearing Type	Anti-friction type, permanently lubricated	
Motor Enclosure (Damp Environment)	Enclosure	CISD-TEFC Chemical Industry Severe Duty	
Motor Terminal Boxes	Design	Bolted with adequate space for connections	
		Motor shall have oversized power junction box and auxiliary junction box for overtemperature switch and space heater	
		circuit.	
	Gaskets	Provide gaskets between box and housing and between box and cover	
	Grounding Terminal	Provide in connection box	
	Markings	Permanently mark motor leads in agreement with connection diagram	
Safety Guards		Safety-guard exposed rotating parts.	
Controls	Hand-Off-Auto Switch	Provide key-operated LOCAL-OFF-REMOTE (Hand-Off-Auto) mode selector switch	
		Padlockable for lockout/tagout	
	Local Pushbutton	Provide OPEN-STOP-CLOSE pushbutton controls for use in	
	Controls	LOCAL mode	
	Control Power	Provide internal 115VAC control power transformer fused on	
	Transformer	both line side and load side.	
		Include vacuum-impregnated coils and dual-primary fuses	
	Loss-of-Signal Failure Mode	Valve shall remain in last position on loss of signal	
	Indicating Lights	Provide OPEN and CLOSED indicating lights	
Starter	Туре	Reversing solid-state AC motor starter	
	Motor Phase Protection	On 3-phase motors, provide syncro-phase device to ensure motor runs in correct direction regardless of how 3-phase wires	
		are landed.	
		On 3-phase motors, provide motor protection against phase loss	
		or single-phasing.	
	Starts per Hour	Capable of 100 starts per hour	
Coatings	Ероху	Refer to Section 09 90 00.	
		Coat fabricated steel enclosures on inside and outside surfaces	
		except shafts, register fits and nameplates.	
		Do not field-paint motors unless motor warranty permits.	

I. The following electrical design criteria are required for equipment specified in this section:

ne following electrical design criteria are required for equipment specified in this section.				
ITEM	DESCRIPTION			
Electrical Work	NEC Article 505	Nonhazardous		
	Classification			
Enclosures – Indoor	NEMA 250 Enclosure	NEMA 12 – Industrial Use		
Dry or Damp Locations	Rating			
Enclosures – Outdoor	NEMA 250 Enclosure	NEMA 4X – Watertight, Corrosion-Resistant, Stainless steel		
or Wet Locations	Rating	-		
All Enclosures	Construction	Lockable		
		With powdercoat epoxy finish on steel surfaces		
	IEC 60529 Enclosure	IP 65 water jet		
	Rating for Underground	,		
	Equipment			

ITEM	DESCRIPTION		
Conduit Seal	Double O-Ring Seal for	Required as needed to prevent entry of water from conduit to	
	Underground Actuators	actuator	
Control Panel Mounting	g Local Mount See plans		
	Remote Mount	See plans	
Power Supply Motor Circuit 120VAC – 1 phase – 60Hz		120VAC - 1 phase - 60Hz	
	Control Panel	120VAC - 1 phase - 60Hz	
	Limit Switch	24 VDC at control panel	
	Power Source	Provide 120VAC local power source for District use to power	
		contacts or for local devices such as push button stations.	

PART 3 - EXECUTION

3.1 Preparation

- A. Make field measurements needed to install motorized actuators before submitting shop drawings or ordering.
 - 1. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Maintain and protect actuators from damage according to Manufacturer's recommendations before commissioning.
 - Electrical enclosures and electrical components found with condensation or condensation related damages shall be rejected and replaced at no additional cost to District before acceptance of Work.
- C. Valve Manufacturer shall mount electric motor actuator and accessories on each valve in valve Manufacturer's shop and use it to shop-test valve before shipment.
- D. Orientation shall be as shown or in most accessible position for maintenance as accepted by District's Representative.
- E. Factory-adjust limit switch positions, valve position transmitter and torque switches.
 - 1. Measure and record voltage, current, torque, timing, and other operational parameters and combine with factory test data for comparison during startup testing.

3.2 Installation

- A. Refer to Sections 01 73 00, and 01 73 24 for basic execution and installation requirements.
- B. Furnish and install actuators at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Applicable OSHA and Cal OSHA regulations
 - 2. Applicable building, fire, plumbing, mechanical and electrical code requirements
 - 3. Manufacturer's installation and warranty requirements
- D. Refer variances between above documents and Contract Documents to District's Representative.
- E. Install actuators to tolerances recommended by Manufacturer.
 - 1. Unless otherwise shown, install motorized actuators true, plumb and level using precision gauges and levels.
- F. Valve Manufacturer shall provide, install and calibrate each valve actuator on specified valve.
 - 1. Valve Manufacturer factory-certified employees shall install and calibrate valve actuators.
 - 2. Certify valve actuators have been installed and adjusted by valve Manufacturer.
 - 3. Orient actuator access cover, if present, to prevent cover from falling into workspace, causing injury to personnel.

3.3 Field Quality Control

A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Electric Motor Actuators	Installation, Noise, Vibration, Odors and Heat	Visual inspection of finished installation	1 inspection	District	Contractor
	Running Amperage	Record amperage draw for unseating, seating, and running conditions and compare to rated motor FLC	1 test	Contractor	Contractor
	Temperature Rise	Record motor temperature before actuator is energized and after actuator is cycled once. Temperature difference shall be ≤50°C	1 test	Contractor	Contractor
	Limit Switches	Open and close valves twice and verify position transmitters function properly	1 test	Contractor	Contractor
	Field Performance	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	Contractor	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	District	Contractor

- B. Provide services of Manufacturer's factory-authorized representative on-site to provide:
 - 1. Installation assistance, inspection, set-up, adjustment, and startup of complete motorized actuator system.
 - 2. Field testing and adjustment.
 - 3. Instruction of District's personnel in operation and maintenance.

3.4 Spare Parts

A. Furnish the following spare parts:

QUANTITY	PART
1	Setting tool or dongle for programming actuator
1 ea size or style motor assembly	Spare motor

END OF SECTION

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SECTION 33 41 00 – STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section includes a description of Sanitary and Storm Drainage System Testing.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL
 - A. The CONTRACTOR shall perform all pipeline flushing and testing, complete for sanitary sewerage and storm drainage system piping as specified herein and in accordance with the requirements of the Contract Documents.

PART 2 - PRODUCTS

- 2.01 MATERIALS
 - A. All test equipment, temporary valves, bulkheads or other water control equipment and materials shall be determined and furnished by the CONTRACTOR subject to the ENGINEER's review.

PART 3 - EXECUTION

- 3.01 PREPARATION NONE
- 3.02 INSTALLATION NONE
- 3.03 TESTING
 - A. Leakage Tests
 - 1. All gravity sewer pipes shall be tested for leakage by one of the following three test methods as directed by the ENGINEER and following the specific procedures outlined in the referenced sections of the "Standard Specification for Public Works Construction" (SSPWC) latest edition.
 - B. Deflection Test
 - 1. All flexible and semi-rigid pipe shall be tested for deflection, joint displacement or other obstruction by passing a rigid mandrel through the pipe by hand, not less than 30-days after completion of the trench backfill, but prior to any resurfacing. The mandrel test shall comply with the specific procedures required in the SSPWC, except for the additional provision that the mandrel shall be a full circle, solid cylinder, or a rigid, non-adjustable, odd-numbered leg (9 leg minimum) steel cylinder, approved by the ENGINEER as to design and manufacture.

END OF SECTION

T-SECTION 33 05 19 MANUAL VALVE OPERATORS

PART 1 - GENERAL

1.1 Work Included

A. Materials, testing, and installation of manual valve operators.

1.2 Related Work

- A. Section 01 22 00: Unit Prices
- B. Section 01 33 00: Submittal Procedures
- C. Section 01 40 00: Quality Requirements
- D. Section 01 61 00: Common Product Requirements
- E. Section 01 65 00: Product Delivery Requirements
- F. Section 01 66 00: Product Storage and Handling Requirements
- G. Section 01 73 00: Execution
- H. Section 01 73 24: Seismic Restraint
- I. Section 05 05 19: Post-Installed Concrete Anchors
- J. Section 09 90 00: Painting and Coating
- K. Section 33 12 10: Line-Stop Valves, Insertion Valves, and Pipe Freezing
- L. Section 33 12 12: Resilient-Wedge Gate Valves
- M. Section 33 12 14: Butterfly Valves
- N. Section 33 12 46: Electric Motor Actuators

1.3 System Description

A. Furnish and install complete operating manual valve operator including appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building, plumbing, and electrical codes and standards.

1.4 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - 1. ASTM A126 Gray Iron Castings for Valves, Flanges, and Pipe Fittings
 - 2. ASTM A148 Steel Castings, High Strength, for Structural Purposes
 - 3. ASTM A322 Steel Bars, Alloy, Standard Grades
 - 4. ASTM B427 Gear Bronze Alloy Castings
 - 5. AWWA C504 Rubber-Seated Butterfly Valves 3"-72"
 - 6. AWWA C515 Reduced Wall, Resilient Seated Gate Valves for Water Supply Service
 - 7. AWWA C540 Power Actuating Devices for Valves and Sluice Gates

1.5 Submittals

A. Include submittals for manual valve operators in submittals for valves to which they are attached.

B. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Shop Drawings	Submit per equipment Shop Drawing requirements	
Product Data	Submit per Product Data requirements.	
	Include dimensions and orientations of valve operators to operate with valve stem extensions Show locations of internal stops for gear actuators.	
	Include factory torque sheets showing torque required through opening and closure.	
Installation Instructions	Submit per Installation Instruction requirements	
Test Record Transcripts	Submit for factory tests per test record transcript requirements	

SUBMITTAL	DESCRIPTION	
Warranty	Furnish 1-year warranty from date of final acceptance	

C. Refer to Section 01 33 00 for definition of requirements for Shop Drawings, Product Data, Installation Instructions, and Test Record Transcripts.

1.6 <u>Delivery, Storage, and Handling</u>

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Strictly follow Manufacturer's instructions and warranty requirements for delivery, storage, and handling of manual valve operators.
- C. Actuators and valves shall be assembled and factory-tested at valve factory and shipped and delivered to jobsite as unit.

1.7 <u>Unit Prices</u>

- A. Payment for Work in this section shall be included as part of lump-sum or unit-price bid amount for which such Work is appurtenant.
- B. Refer to Section 01 22 00 for measurement and payment clauses for manual valve operators.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Gear Actuators –	Dezurik/Apco/Hilton M Series	Sartell, MN (320) 259-2000
Traveling Nut Type	Mueller Co MDT	Chattanooga, TN (423) 209-4800
	Henry Pratt Co MDT	Aurora, IL (877) 436-7977
	Accepted Equal	
Gear Actuators –	AUMA USA GS Series	Tustin, CA (714) 247-1250
Worm-Gear Type	EIM / Emerson Model WB Series	Houston, TX (281) 477-2801
	Limitorque Div Flowserve Model HBC or PT Series	Lynchburg VA (434) 528-8595
	Sambo Industrial Company Ltd.	Seoul ROK
	Accepted Equal	
Valve Boxes and	Brooks Products No 4TT	Ontario, CA (909) 947-7470
Covers – Triangular	Eisel Enterprises, Inc.	Placentia, CA (714) 993-1706
Cover – Concrete	H&C No 4TT	
	T Christy Enterprises G-4	Anaheim, CA (714) 507-3300
	Accepted Equal	
Valve Boxes and	Bingham & Taylor Mark VTB	Culpepper, VA (540) 825-8334
Covers – Triangular		Corona, CA 951 280 4588
Cover – Iron	Accepted Equal	
Valve Extension Stems	Pipeline Products SX	San Marcos, CA (760) 744-8907
- Solid Steel	Troy Valve Division Penn-Troy Manufacturing, Inc.	Troy, PA (570) 297-4442
	Trumbull Industries, Inc.	Youngstown, OH (800) 677-1799
		Orange, CA (714) 505-7079
	Accepted Equal	

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
 - 1. Also refer to sections covering valves to which manual operators are attached.
- B. Provide valves complete with operating handwheels, handwheel locking devices, shafting, extension stems, levers, gear actuators, operating nuts, position indicators, and wrenches required for operation.

- C. Actuators for valves in exposed service shall contain dial indicating position of valve disc or plug.
- D. Valves shall open by turning counterclockwise.
- E. Provide lever or wrench actuators for exposed valves ≤3".
- F. Provide traveling nut or worm-gear actuators on butterfly, ball, and plug valves ≥4" as specified below.
- G. Provide stop-limiting devices in actuators in open and closed positions.
- H. Where operating torque requirements for valve actuators are not stipulated by AWWA standards, valves shall open:
 - 1. with ≤80-pound pull on handwheel, lever, when differential pressure across valve equals valve rated pressure class.
 - 2. with ≤150-ft-pound torque input on operating nut when differential pressure across valve equals valve rated pressure class.
- I. Provide reduction gearing to meet maximum torque and pull design requirement.
 - 1. Gears shall be oil-lubricated.
 - 2. Provide shaft seal to prevent entry of dirt and water into actuator.

J. Unless otherwise specified, materials for traveling-nut gear actuators shall be.

ITEM	MATERIAL	SPECIFICATION
Gear Housing	Same material as valve body	Totally enclosed, watertight
Exposed Threaded Parts, Including Cap Screws, Case Bolts, Carriage Bolts, cover Screws, Machine Screws, Set Screws, and Bonnet Bolts	Stainless Steel	SAE Type 316
Thrust Nut	Bronze	

K. Unless otherwise specified, materials for worm-and-gear actuators shall be.

ITEM	MATERIAL	SPECIFICATION
Gear Housing	Same material as valve body	Totally enclosed, watertight
Exposed Threaded Parts, Including Cap Screws, Case Bolts, Carriage Bolts, cover Screws, Machine Screws, Set Screws, and Bonnet Bolts	Stainless Steel	SAE Type 316
Worm	Hardened Alloy Steel	Conform to ASTM A148 Grade 105-85 or ASTM A322 Grade 41500 Grind and polish threads
Worm Gears	Gear Bronze	Conform to ASTM B427 Self-locking 1-piece machine-cut design to prevent creeping
Thrust Nut	Bronze	
Exposed Threaded Parts, Including Cap Screws, Case Bolts, Carriage Bolts, cover Screws, Machine Screws, Set Screws, and Bonnet Bolts	Stainless Steel	SAE Type 316

L. Unless otherwise specified, materials for valve boxes shall be H-25 traffic rated and shall be.

ITEM	MATERIAL	SPECIFICATION
Valve Boxes	Cast Iron	Conform to ASTM A126 Class B 2-piece sliding type
	Concrete	

ITEM **MATERIAL SPECIFICATION** Conform to ASTM A126 Class B Valve Box Covers (Triangular) Cast Iron Solid skirt 20-lb minimum weight Coating None Color Black "TVMWD WATER" Inscription Valve Stem Extension Pipes Galvanized solid steel rod Steel Refer to dimensions below Extension Pipe Stabilizing Plate Steel Two 7" OD x 3/16" steel plates Weld to valve stem extension with 1/8" weld all-around on both sides. Weld on 1 plate near top of extension and 1 near bottom.

M. The following product design criteria, options and accessories are required:

ITEM	DESCRIPTION
Minimum Rated Working	Class 150 (300 WOG psi at 150°F)
Pressure	
Design Differential Pressure	Assume differential pressure across plug or disc equals specified rated working
	pressure of valve.
Fluid Temperature	33°F-120°F
Surface Loading Criteria	H-25 (40k axle 20k wheel load)
Soil Cover	Refer to Plans, if no cover is stated, scale cover from Plans.

N. The following product design criteria, options and accessories are required for worm gear operators:

ITEM	DESCRIPTION
Worm Gear Helix Angle	Design and cut to prevent valve creeping under flow conditions.
Worm Gear Shaft Supports	Support worm gear shaft at each end by ball or tapered roller bearings

2.3 Equipment

- A. Valves shall close drip tight at rated pressures.
- B. Valve operator shall hold valve in any intermediate position between fully open and fully closed without creeping or fluttering
- C. Valve operators shall be satisfactory for applications involving valve operation after long periods of inactivity.
- D. Unless otherwise shown, install valves in horizontal runs of pipe having centerline elevations ≤4' 6" above floor with operating stems vertical.
- E. Install buried or submerged operators with nut ≤48" below grade.
- F. Gear actuators shall conform to applicable requirements of AWWA C540.
- G. Where possible, actuators shall be self-locking to prevent disc or plug from creeping.
- H. Unless otherwise specified valves shall be furnished with actuators conforming to the following:

ITEM	DESCRIPTION		
Buried Valves and Valves within Manholes or Pipe	Valve Can and Cover	Provide as shown above except in manholes, vaults, tunnels, or pipe trenches	
Trenches	Actuator	2" AWWA nut / Handwheel / Lever / or Electric Motor as shown	
		Handwheels shall include arrow and wording to show rotation direction to OPEN or CLOSE valve.	
	Extension Stem Connector to Actuator	Square socket to fit actuator nut	

ITEM		DESCI	RIPTION
<u>-</u>	Extension Stem	Required on valves where centerline of valve is >48" below	
		grade.	
			shall bring nut to within 24"-36" of surface.
			d or square stock of diameter shown below.
			n in valve well with extension pipe
	Value eine	stabilizing plate.	
	Valve size 8"	IVIIN	imum extension stem diameter
	10"-12"		11/8" 11/4"
	14"		1 3/8"
	16"-18"		1½"
	20"-36"		13/4"
	42"-54"		2"
	Stop-Limiting Devices		n and closed positions. e adjustable without disassembling gear box
	Enclosure		t-term immersion in water and for buried
			ght shaft seals and watertight valve and
		actuator cover o	
	Lubrication	Oil-lubricated	
	Position Indicator	Indicator shall s	ide standard 5¼" valve box. how valve position and direction and number d to fully open or close valve.
	Position Transmitter	Not required	, , , , , , , , , , , , , , , , , , , ,
Submerged Valves	Actuator	2" AWWA nut.	
	Extension Stem	Square socket to fit actuator nut	
	Connector to Actuator	-	
	Extension Stem		on stem on valves where centerline of valve
		is >48" below high water surface. Extension stem shall bring nut to within 6" of water surface.	
			size shall be as shown above for buried
		valves.	Size Stiali be as shown above for buried
	Stop-Limiting Devices		n and closed positions.
			e adjustable without disassembling gear box
	Enclosure		t-term immersion in water and for buried
		service	
			ght shaft seals and watertight valve and
	1 1 2 0	actuator cover g	gaskets
	Lubrication	Oil-lubricated	
	Position Indicator Position Transmitter	Required Not required	
Valves Above Ground or in	Manual Operators for	Not required Design	Lever
Vaults	Above-Ground Valves ≤ 6"	Design	Level
	Manual Operators for	Design	Handwheel
	Above-Ground Valves ≥	Handwheel	12"-24"
	8"	Diameter	
	Manual Operators for		Install valves with valve stems vertical.
	Valves <4'6" above		
	Floor or Finish Surface		Install colors with our book of the first
	Manual Operators for Valves 4'6" - 6'-9" or		Install valves with valve stems horizontal.
	More above Floor or		
	Finish Surface		
	Manual Operators for		Install valves with valve stems horizontal
	Valves on Vertical Pipe		and hand-wheel on side of valve opposite
	Valvoo oli Voltioal I ipo		
	near Walls		wall.

ITEM DESCRIPTION rotation direction to OPEN or CLOSE valve. Stop-Limiting Devices Provide for open and closed positions. Devices shall be adjustable without disassembling gear box Enclosure Design for short-term immersion in water and for buried service Provide watertight shaft seals and watertight valve and actuator cover gaskets Lubrication Oil-lubricated Position Indicator Required **Position Transmitter** Not required Actuators on Manual Butterfly, Worm-and-gear or traveling-nut type gear actuators. Ball and Plug Valves 4"-20" Size actuator per AWWA C504 for bi-directional pressures. Actuators on Manual Butterfly, Worm-and-gear type gear actuators. Valves 24"-54" Size actuator per AWWA C504 for bi-directional pressures. Worm-and-gear type gear actuators. Actuators on Ball and Plug Valves ≥ 6" Actuators on Motorized Worm-and-gear type gear actuators. Butterfly valves

I. Traveling nut gear actuators shall conform to the following:

ITEM	DESCRIPTION	
Traveling Nut Gear Actuators	Design	"Self-locking" conform to AWWA C540
	Allowable Input Torque	Withstand 450 ft-lbf against stop limiting devices
		with no damage

J. Worm-gear actuators shall conform to the following:

ITEM		DESCRIPTION	
Worm Gear Actuators	Design	"Self-locking" 1-piece design Conform to AWWA C540	
	Allowable Input Torque – Handwheel, Chainwheel, Lever, or Crank Actuators	200 lbf against stop limiting devices with no damage	
	Allowable Input Torque – Operating Nuts	300 ft-lbf against stop limiting devices with no damage	

K. Worm-gear actuators for valves <24" shall rotate valve element (disc, plug, or ball) from fully closed to fully open position with number of turns of actuator nut or wheel equal to 2 x nominal valve diameter.

1. Actuators shall conform to the following requirements for turns to open or close:

	WORM GEAR VALVE ACTUATOR SELECTION						
Nominal	Specified Range of Turns						
Valve							
Diameter							
4"	8						
6"	12						
8"	16						
10"	20						
12"	24						
14"	28						
16"	32						
18"	36						
20"	40						

L. Worm-gear actuators for valves \geq 24" shall rotate valve element (disc) from fully closed to fully open position with number of turns of actuator nut or wheel \geq 1.5 x nominal valve diameter and \leq 3 x nominal valve diameter.

M. Actuators shall conform to the following requirements for turns to open or close:

150-PSI WORM GEAR VALVE ACTUATOR SELECTION

Nominal Valve	Specified Range of	AUMA Make &	Turns to Open or	EIM Make Model	Turns to Open or	Limitorque Make &	Turns to Open or
Diameter	Turns	Model	Close		Close	Model	Close
24"	36-72	GS125.3	13*	WB52	64	PTA30/3.5	60
30"	45-90	GS160.3 / GS160.3 4:1	54.5*	WB52	64	PTA65/3.1	47
36"	54-108	GS160.3 / GS160.3 4:1	54.5*	WB54	70	PTA120/6.3	95
42"	63-126	GS200.3 / GZ200.3 8:1	108.5*	WB54	70	PTA120/6.3	95
		250-PSI WO	RM GEAR VAL	VE ACTUATOR	RSELECTION		
Nominal	Specified	AUMA	Turns to	EIM Make	Turns to	Limitorque	Turns to
Valve	Range of	Make &	Open or	Model	Open or	Make &	Open or
Diameter	Turns	Model	Ċlose		Ċlose	Model	Close
24"	36-72	GS125.3	13*	WB52	64	PTA30/3.5	60
30"	45-90	GS160.3 / GS160.3 4:1	54.5*	WB52	64	PTA65/3.1	47
36"	54-108	GS160.3 / GS160.3 4:1	54.5*	WB54	70	PTA120/6.3	95
42"	63-126	GS200.3 / GZ200.3 8:1	108.5*	WB65	148*	PTA120/6.3	95

- Indicates number of turns does not meet requirement and spur-gear reduction is required to correct.
- Spur-gear submittal is required.
- N. Spur gear assemblies shall be integrally mounted to actuator by accepted means and shall meet component and torque requirements specified herein.
- O. Furnish special tools, wrenches and appliances needed to adjust, operate, maintain or repair valve operators supplied.

PART 3 - EXECUTION

3.1 Preparation

- A. Install valves and equipment so as to be easy to operate and service.
 - Where geometry of manufactured valves and equipment and field conditions make it difficult or impossible for average workers to operate or service installed valve or piece of equipment, notify District's Representative of conflict before installing valve or item of equipment.

3.2 Installation

- A. Refer to Sections 01 73 00 and 01 73 24 for basic execution and installation requirements.
- B. Furnish and install valve operators on valves at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Applicable OSHA and Cal OSHA regulations.
 - 2. Other applicable building, fire, plumbing, mechanical and electrical code requirements.
 - 3. Manufacturer's installation and warranty requirements.
- D. Refer variances between above documents and Contract Documents to District's Representative.
- E. Install operators and extensions to tolerances recommended by Manufacturer.
 - 1. Unless otherwise shown, install manual valve operators true, plumb, and level using precision gauges and levels
- F. Support valve boxes and keep centered during backfill
 - 1. Center of valve box shall be within ½" of valve operating nuts.
 - 2. Valve box shall be plumb to within 5°.
 - 3. Do not use beveled pipe sections at top of valve box extension pipe.

- 4. Top cut shall be square and machine-made.
- 5. Where pavement has not been placed, extend valve box extension risers for key valves well above ground to facilitate location for emergency shutoffs.
- 6. Final valve box elevation shall be flush with pavement.

3.3 <u>Field Quality Control</u>

A. Field testing shall include:

		TEST STANDARD		FIRST TEST PAID	RETESTS PAID
ITEM	TEST FOR	(ASTM OR OTHER TEST STANDARD)	FREQUENCY	FOR BY	FOR BY
Valve Boxes	Plumb	Center of valve box shall be within ½" of valve operating nuts and valve box shall be plumb to within 5°.	1 inspection	District	District
	Elevation	Valve box shall be flush with finished pavement	1 inspection	District	District
	11-month Warranty Inspection	Confirm Work conforms to Contract Documents and Manufacturer's printed literature	1 test	District	Contractor

3.4 Adjusting and Lubricating

- A. Plans do not show valve box cover elevations.
 - 1. Determine and set cover elevations in field so finished rim elevations are flush with finished pavement where directed by District's Representative.

END OF SECTION

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T-SECTION 33 08 11

PRESSURE TESTING AND FLUSHING OF WATER UTILITIES

PART 1 - GENERAL

1.1 Work Included

- A. Field pressure testing and flushing of potable and non-potable water mains intended for conveyance of water under pressure.
- B. Test pipelines for water-tightness by subjecting each section to Hydrostatic Pressure and Leakage Tests in accordance with applicable requirements of AWWA C600 or C605, except as modified herein.
- C. Plan construction activities to allow and facilitate testing, flushing of all sections of applicable pipelines.
- D. Obtain permits required to complete Work specified herein.

1.2 Related Work

- A. Section 01 22 00: Unit Prices
- B. Section 01 33 00: Submittal Procedures
- C. Section 01 40 00: Quality Requirements
- D. Section 01 61 00: Common Product Requirements
- E. Section 01 65 00: Product Delivery Requirements
- F. Section 01 66 00: Product Storage and Handling Requirements
- G. Section 01 73 00: Execution
- H. Section 01 75 00: Starting and Adjusting
- I. Section 33 13 00: Disinfecting Water Utility Pipelines

1.3 System Description

A. Pressure test pipe to AWWA and Contract Document standards.

1.4 Quality Assurance

A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.

1.5 References

- A. Reference publications listed below and in various sections form part of specification to extent referenced. These are referred to within text by basic designation only.
 - 1. ASME Boiler and Pressure Vessel Code §VIII
 - 2. AWWA C600 Installation of Ductile Iron Water Mains and their Appurtenances
 - 3. AWWA C604 Installation of Buried Steel Water Pipe—4" and Larger
 - 4. AWWA C605 Underground Installation of PVC Pipe
 - National Pollutant Discharge Elimination System Permit (NPDES) Los Angeles Regional Water Quality Control Board (LARWQCB) – General National Pollutant Discharge Elimination System Permit and Waste Discharge Requirements for Discharges of Hydrostatic Test Water to Surface Waters in Coastal Watersheds of Los Angeles and Ventura Counties, Los Angeles Region Orders No. R4-2012-0175, NPDES Permit No. CAS004001, and most recent orders or amendments.
 - 6. Standard Methods for Examination of Water and Wastewater

1.6 Submittals

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Testing Plan	On District's request, submit detailed plan showing how Contractor intends to test and flush pipeline and dechlorinate discharge from flushing operation.	
	Submit bulkhead locations.	

Submit Calculated quantity of water to be discharged On pipe ≥ 16", submit, bulkhead design calculations, pipe attachment details, and provisions to prevent excessive pipe wall stresses. Submit from owner of sanitary sewer prior to discharge of flushing water into sewer.	
and provisions to prevent excessive pipe wall stresses. Submit from owner of sanitary sewer prior to discharge of flushing water into sewer.	
sewer.	
Submittal shall include special requirements for treatment of flushing water prior	
to sewer discharge, estimate of expected maximum discharge rate of flushing flow and analysis of sewer's capacity.	
storm drain.	
Submittal shall include special requirements for treatment of flushing water prior to storm drain discharge, estimate of expected maximum discharge rate of flushing flow and analysis of storm drain's capacity.	
Submit test record transcripts for pressure tests upon completion of testing	
 Show date of test. Identify pipeline or pipeline section tested or retested. Identify pipeline material and size. Identify pipe specification number. Identify test fluid. 	
 Identify test hald. Identify test pressure. Identify test duration. Provide notes of leaks identified (type and location) For leaks, identify types of repairs or corrections made. Identify allowable losses. Identify actual losses. Contractor shall certify leakage rate measured conformed to Contract 	
	to sewer discharge, estimate of expected maximum discharge rate of flushing flow and analysis of sewer's capacity. Submit from owner of any storm drain prior to discharge of flushing water into storm drain. Submittal shall include special requirements for treatment of flushing water prior to storm drain discharge, estimate of expected maximum discharge rate of flushing flow and analysis of storm drain's capacity. Submit test record transcripts for pressure tests upon completion of testing 1. Show date of test. 2. Identify pipeline or pipeline section tested or retested. 3. Identify pipeline material and size. 4. Identify pipe specification number. 5. Identify test fluid. 6. Identify test fluid. 6. Identify test duration. 8. Provide notes of leaks identified (type and location) 9. For leaks, identify types of repairs or corrections made. 10. Identify allowable losses. 11. Identify actual losses.

B. Refer to Section 01 33 00 for definition of requirements for Engineering Calculations and Test Record Transcripts.

1.7 <u>Delivery, Storage, and Handling</u>

A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.

1.8 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for pressure testing and flushing of water utilities.

PART 2 - PRODUCTS

2.1 <u>Materials</u>

- A. Furnish labor, water, and equipment necessary to complete pressure testing and flushing process.
- B. Provide for vents or drains at high points and low points of above-ground piping whether shown on Plans or not.
- C. Provide manual air release valves for pipeline tests.
- D. The following design criteria are required for equipment specified in this section:

ITEM		DESCRIPTION					
Filling Rate	Water Velocity in Pipe	≤1fps.					
Flushing Rate	Water Velocity in Pipe	≥3fps.					
	Water Velocity in Outlets	≤25fps					
Flushing Time		T≥ ² / ₃ L, where T=flushing time in seconds L=pipe length in feet					
Pressure Test	Test Pressure	Refer to Plans					
	Test Duration	Pipe ≤18"	4 hours				

ITEM		DESCRIPTION			
		20"-36" pipe	8 hours		
		Pipe >36" 24 hours			
	Maximum Length of Test	2500' or distance between valve	es, whichever is greater.		
	Section	Provide test bulkheads as required.			
		Do not test against closed valve	es unless accepted by District,		
		and with acceptable backpressu	ıre applied.		
Outlets for Flushing		Provide sufficient number of our			
		flushed in addition to those show			
		of main with water at specified			
		Provide outlets meeting require	ments for fittings specified for		
		type of main constructed.			
		Construct drainage facilities suc			
		contaminated through flushing of			
Vents or Drains on	Outlets	Provide for vents at high points whether shown on Plans or not.			
Above-Ground Piping		Provide for drains at low points whether shown on Plans or not			
	Valves	Provide at each vent or drain point.			
	Valve Sizes	½" for piping <3"			
		³ ⁄ ₄ " for piping ≥3"			
Air Release Valves	Outlets	Construct pipe outlet in same manner as permanent air valve.			
	Outlet Sealing	After use, seal outlet with blind equal to adjacent pipe.	flange, cap, or plug, and coat		
Test Bulkheads on	Test Bulkheads	Conform to ASME Boiler and P			
Steel Pipelines		Materials shall conform to ASM	E Boiler and Pressure Vessel		
		Code Part UCS.			
Test Equipment	Pressure Gauges	New calibrated 4"-face diamete	r pressure gauge.		
	Range	0-300 psi			
	Chart Recorder	Required			
	Other Equipment	Provide pipes, pumps, valves, a			
Test Fluid	Potable Water		lines to District 48 hours before		
		pressure test.			
		Contractor may obtain water from			
		If initial test fails, Contractor will	be charged cost of additional		
		water at District's current rates.			

PART 3 - EXECUTION

3.1 Preparation

- A. Set up for pressure testing shall include:
 - 1. Fire hydrant with construction meter and backflow preventer.
 - 2. Temporary hose
 - 3. Connections to pipeline being tested or flushed.
- B. Flush mains and services with potable water (or water as otherwise accepted by District and regulatory agencies) after completion of construction.
 - 1. Contractor shall be solely responsible for providing source of flushing water and methods for discharge of test water, including associated costs and permits.
 - 2. Provide temporary hoses, piping, fittings and equipment to direct test water into pipe being tested.
 - 3. Provide temporary hoses, piping, fittings and equipment to direct flushing water to point of discharge such as gutter and storm drain inlet or natural drainage channel to prevent damage to public or private property and to prevent creating a public hazard.
 - 4. If flushing water must be discharged into traffic lanes, set up traffic control in accordance with requirements of agency having jurisdiction over public right-of-way.
 - 5. Schedule flushing in or adjacent to public streets during periods of reduced traffic volume
 - 6. Discharge, vacuum, or otherwise remove from pipe accumulated water, sediment, dirt, and foreign material.

- 7. Flushing water may be discharged to sanitary sewer system rather than discharging to storm drain, provided Contractor obtains and submits to District copy of written permission to discharge from sanitary sewer District including supplementary information described above under Submittals.
- 8. Schedule discharges to sewers during off-peak periods as recommended by sewer owner
- 9. After test is completed and demonstrated to conform to Specifications, disconnect and remove temporary piping.
- 10. Do not remove vent and drain valves at high and low points in tested piping.
- 11. Plug or cap taps or connections to existing piping from which test water was obtained.
- C. Before testing, anchor pipe to resist thrust forces based on specified test pressure.
- D. When testing new pipelines to be connected to existing pipelines, isolate new line from existing line using pipe caps, spectacle flanges, or blind flanges.
- E. Pressure test buried pipelines as follows:
 - 1. Where air valves or suitable outlets are unavailable, provide accepted taps and fittings for air release, and plug these later.
 - 2. Conduct pressure tests on buried piping after trench has been backfilled and compacted.
 - a. Complete trench backfill compaction requiring equipment weighing > 100 pounds before conducting pressure tests or retests.
 - b. Allow concrete anchors and thrust blocks to cure for ≥ 10 days before use during tests to restrain pipelines and appurtenances.
 - c. After pipe, appurtenances and permanent thrust blocks have been installed and backfilled, and temporary plugs, caps, thrust blocks and shoring have been installed for required restraint, subject pipeline to hydrostatic pressure test.
 - 3. Test pressure and duration shall be as shown above.
 - 4. Maximum length of pipe to be included in one test shall be distance shown above.
 - a. Provide test bulkheads, blocking, and fittings to permit such sectionalizing.
 - b. Operate and check valves prior to test.
 - c. Equipment, such as butterfly or other valves, may have maximum working water pressure less than test pressure.
 - d. Conduct tests with valves open and open ends of pipes, valves, and fittings suitably closed.
 - e. If blind flanges or bulkheads cannot be placed behind valves, notify District's Representative.
 - f. With permission from District's Representative apply back pressure against closed valves equal to difference between test pressure and rated pressure of valve.
 - 5. Fill line slowly and maintain at operating pressure for 24 hours prior to testing to satisfy system water absorption.
 - a. While filling and immediately prior to testing, expel air from pipeline.
 - 6. Apply test pressures at approved outlet or fitting located within elevation of 5' of lowest point of each pipe section to be tested.
 - a. Pump pressure in pipeline to specified test pressure following 24-hour soak period.
 - b. Apply and maintain test pressure using hydraulic force pump.
 - c. Maintain test pressure for specified duration.
 - d. When test pressure has been reached, discontinue pumping until line pressure has dropped 10-psi, at which time line pressure shall again be pumped up to test pressure.
 - e. Repeat procedure until specified number of hours elapse from time test pressure was first applied.
 - f. At end of this period, pump pressure up to test pressure for last time.
 - g. Compute leakage as total quantity of water pumped into pipeline during test period, including water added to achieve specified test pressure for final time.
 - h. Leakage shall not exceed rate specified for type of pipe tested.
 - Allowable leakage in tables below is based on AWWA formulas specific to pipe materials tested.

- j. These formulas appear in respective AWWA publications for each type of pressure pipe.
- F. Pressure test exposed and above-ground piping as follows:
 - 1. Conduct tests after piping has been installed and attached to pipe supports, hangers, anchors, expansion joints, valves and meters.
 - 2. Air and vacuum valves shall be in place and functional in case of pipe failure during testing.
 - 3. When valves are near pipe end closures for testing, open valves and do not exceed pressure limits of those valves.
 - 4. Do not test against closed valves.
 - 5. Install blind flange plate or bulkhead on downstream side of valve as needed for pressure testing.
 - 6. Open vents at high points of piping system to purge air while pipe is filled with water.
 - 7. Subject piping system to specified test pressure.
 - 8. Maintain test pressure for duration specified above.
 - 9. Examine joints, fittings, valves, and connections for leaks.
 - 10. Piping system shall show zero leakage or weeping.
- G. Correct leaks and retest until zero leakage/weeping is obtained.
 - 1. Complete and pass test prior to connecting new pipe into existing pipe and mains.
 - 2. Complete tests in presence of District's Representative.
 - a. District's Representative will record results.
 - 3. Locate and correct leaks as required to pass test.
 - 4. Repair visible leaks regardless of amount of leakage.
 - 5. Restore Work and damage resulting from leaks and their repair.
 - 6. Repeat testing until leakage does not exceed specified leakage rate.
 - 7. After new pipe has passed test, remove bulkheads, caps or flanges and connect to existing piping.
- H. Pay costs for repairing collateral damage resulting from pipeline flushing and pressure testing.
- I. Do not place new lines in service until pressure testing, disinfection, and bacteriological testing are successfully completed.

3.2 Field Quality Control

A. Field testing shall include:

		TEST STANDARD (ASTM OR OTHER TEST		FIRST TEST	RETESTS PAID
ITEM	TEST FOR	` STANDARD)	FREQUENCY	PAID FOR BY	FOR BY
Pipe	4-hour Hydrostatic Pressure Test	AWWA C600 or C605 as amplified below but using test pressures shown in 3.1A above and Contract Documents	All pipe sections	Contractor (District's Representative will observe and	Contractor (District's Representative will observe and
	Installation & Leakage	Visual inspection of finished installation	1 inspection	record results) District	record results) District

- B. Allowable leakage shall be as follows:
 - 1. No ductile iron or PVC pipe installation will be accepted if leakage exceeds that determined by the following formula (taken from AWWA C600 or AWWA C605):
 - $L = (SD\sqrt{P}) / 148.000$
 - 2. in which L = allowable leakage, in gallons per hour
 - S = length of pipe tested, in feet
 - D = nominal diameter of pipe, in inches
 - P = average observed test pressure of pipe being tested, as shown, in pounds per square inch gauge, based on elevation of lowest point in line or section under test and corrected to elevation of test gauge.

- 3. No gasketed steel pipe installation will be accepted if leakage exceeds that determined by the following formula (taken from AWWA C604):
 - L=10 gallons per inch-diameter per mile of pipe per 24 hours
- 4. When testing against closed valves is accepted, an allowance of 0.0078 gallons per hour per inch of nominal valve size may be added to that computed using formulas above to account for leakage around seals.

C. For PVC, ductile iron, or gasketed steel pipe, allowable leakage is tabulated below.

ALLOWABLE LEAKAGE IN PVC OR DUCTILE IRON PIPE (GALLONS PER HOUR PER 1000 FT OF PIPE)				ALLOWABLE LEAKAGE IN GASKETED STEEL PIPE (GALLONS PER HOUR PER 1000 FT OF PIPE)	ADDITIONAL ALLOWABLE LEAKAGE THROUGH SEALS OF CLOSED VALVES (GALLONS PER HOUR PER VALVE)	
PIPE				TEST P	RESSURE	
DIAMETER	150 psi	200 psi	250 psi	300 psi	All Pressures	All Pressures
3"	0.25	0.29	0.32	0.35	0.24	0.02
4"	0.33	0.38	0.43	0.47	0.32	0.03
6"	0.50	0.57	0.64	0.70	0.47	0.05
8"	0.66	0.76	0.85	0.94	0.63	0.06
12"	0.99	1.15	1.28	1.40	0.95	0.09
16"	1.32	1.53	1.71	1.87	1.26	0.12
18"	1.49	1.72	1.92	2.11	1.42	0.14
20"	1.66	1.91	2.14	2.34	1.58	0.16
24"	1.99	2.29	2.56	2.81	1.89	0.19
30"	2.48	2.87	3.21	3.51	2.37	0.23
36"	2.98	3.44	3.85	4.21	2.84	0.28
42"	3.48	4.01	4.49	4.92	3.31	0.33

- D. For welded, threaded, or flanged steel pipe, no leakage will be permitted.
- E. For brazed, threaded, or flanged brass or copper pipe, no leakage will be permitted.
- F. For HDPE polyethylene pipe, no leakage will be permitted.

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T-SECTION 33 11 11

DUCTILE-IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.1 Work Included

- A. Materials and installation of Ductile-Iron Pipe (DIP) and fittings 3"-64".
- B. Refer to the following sections for Work not covered herein.
 - 1. Section 33 11 20: Polyethylene Encasement for Iron Pipe, Fittings, Couplings, and Valves

1.2 Related Work

- A. Section 01 22 00: Unit Prices
- B. Section 01 33 00: Submittal Procedures
- C. Section 01 40 00: Quality Requirements
- D. Section 01 61 00: Common Product Requirements
- E. Section 01 65 00: Product Delivery Requirements
- F. Section 01 66 00: Product Storage and Handling Requirements
- G. Section 01 73 00: Execution
- H. Section 01 73 33: Mechanical Identification
- I. Section 03 30 00: Cast-in-Place Concrete
- J. Section 09 90 00: Painting and Coating
- K. Section 09 96 56: Epoxy Linings and Coatings
- L. Section 26 05 44: Raceway and Boxes for Cathodic Protection Systems
- M. Section 31 05 50: Protecting Existing Utilities
- N. Section 31 23 33: Trenching and Backfilling
- O. Section 33 05 26: Utility Identification
- P. Section 33 05 31: Pipeline Joint Materials
- Q. Section 33 05 38: Hangers and Supports
- R. Section 33 08 11: Pressure Testing and Flushing of Water Utilities
- S. Section 33 11 20: Polyethylene Encasement of iron Pipe, Fittings, Couplings, and Valves
- T. Section 33 13 00: Disinfecting Water Utility Pipelines

1.3 System Description

A. Furnish and install ductile-iron pressure pipe as shown on Plans including appurtenant fittings and connections in conformance with Manufacturer's installation requirements and in compliance with applicable construction safety codes and standards.

1.4 Quality Assurance

- A. Manufacturer of pipe and fittings shall employ manufacturing methods and material formulations in use for > 5 years.
- B. District or District's Representative shall be entitled to inspect pipes and witness manufacturing process.
- C. Factory testing shall include:

		TEST STANDARD		FIRST	RETESTS
ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	TEST PAID FOR BY	PAID FOR BY
Fittings	Hydrostatic Pressure	Test at 150% of working pressure for 10 seconds.	All fittings	Contractor	Contractor
	Test				
Pipe Joints	Visual Inspection	Ring grooves and bell interiors shall be smooth and free from ridges, notches, or uneven surfaces	All bells	Contractor	Contractor
Fusion-Bonded Epoxy Lining	Visual Inspection	Refer to Section 09 96 56.	Refer to Section 09 96 56.	Contractor	Contractor

				FIRST	RETESTS
		TEST STANDARD		TEST PAID	PAID FOR
ITEM	TEST FOR	(ASTM OR OTHER TEST STANDARD)	FREQUENCY	FOR BY	BY
	Holidays			Contractor	Contractor
	Lining			Contractor	Contractor
	Thickness				

1.5 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - 1. ASME/ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800
 - 2. ASME/ANSI B16.42 Ductile Iron Flanged Fittings Classes 150 and 300
 - 3. ASTM A377 Index of Specifications for Ductile Iron Pressure Pipe
 - 4. AWWA C104/ANSI A21.4 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
 - 5. AWWA C105/ANSI A21.5 Polyethylene Encasement for Ductile-Iron Pipe Systems
 - 6. AWWA C110/ANSI A21.10 Ductile-Iron and Gray-Iron Fittings, 3"-48", for Water
 - 7. AWWA C111/ANSI A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 - 8. AWWA C115/ANSI A21.15 Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
 - AWWA C116/ANSI A21.16 Protective Fusion-Bonded Epoxy Coatings for Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
 - 10. AWWA C150/ANSI A21.50 Thickness Design of Ductile Iron Pipe
 - 11. AWWA C151/ANSI A21.51 Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
 - 12. AWWA C153/ANSI A21.53 Ductile-Iron Compact Fittings, 3"-64", for Water Service
 - 13. AWWA C213 Fusion-Bonded Epoxy Coating for Interior and Exterior of Steel Water Pipelines
 - 14. AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances
 - 15. AWWA M41 Ductile-Iron Pipe and Fittings
 - 16. NSF/ANSI 61 Drinking Water System Components Health Effects
 - 17. SSPC SP1 Solvent Cleaning
 - 18. SSPC SP6/NACE 3 Commercial Blast Cleaning
 - 19. SSPC SP10/NACE 2 Near White Blast Cleaning

1.6 Submittals

A. Furnish the following submittals:

SUBMITTAL	DESCRIPTION	
Product Data	Submit per Product Data requirements.	
	Submit for pipe, flanges, couplings, fittings, protective coatings, and gaskets.	
Installation	Use AWWA C600 for pipe installation	
Instructions	Submit supplementary information as needed to cover proprietary methods of joint restraint.	
Shop Drawings	Submit layout schedule and line drawings. 1. Show order of installation. 2. Show pipe numbering and mark sequence. 3. Show length and location of each pipe section and fitting. 4. Show stations, lengths, and elevations of valves 5. Show stations and elevations of outlets and pipeline structures. 6. Show stations and elevations of pipe invert at changes in grade and alignment. 7. Show data on horizontal and vertical curves and pipe bends. 8. Show resolution of bend angles into resultant angles in horizontal and vertical planes.	
	Submit materials list.	
	Submit dimensional checks.	
	Submit Work plan and schedule for installation, closures, and field-testing.	
Certificate of Compliance	Deliver with pipe affidavit from Manufacturer certifying compliance with requirements of AWWA standards and Contract Documents	
	Submit records of fitting pressure tests.	
Engineering Calculations	Submit details, locations, and calculations for bulkheads, pipe restraint, and methods required to prevent excessive pipe wall stresses during hydrostatic testing of pipe.	
(Pipe and Bulkhead Design)	Where cover on pipe is <3' or >20' submit design calculations for wall thickness under external trench load.	

Warranty	Furnish 1-year warranty from date of final acceptance	

B. Refer to Section 01 33 00 for definition of requirements for Product Data, Installation Instructions, and Certificates of Compliance.

1.7 Delivery, Storage, and Handling

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Pack, ship, handle, and store pipe in accordance with Manufacturer's instructions and warranty requirements, AWWA C600, and AWWA M41 Chapter 11.
- C. Transportation shall be by competent haulers and accomplished in manner to avoid damage to pipe, lining, or coating.
- D. Before release of chains, cables and strapping around pipe being delivered, check loads to ensure chock blocks are secure on both ends of support timbers.
 - 1. If not, provide suitable wedges or chocks to prevent pipe from rolling when other restraints are removed.
- E. Use proper care to prevent damage in handling, moving, and placing pipe.
 - 1. Carefully handle pipe to prevent damage to lining and coating.
 - 2. Unload pipe by hand or mechanical means, such as forklift, crane or backhoe, using nylon slings, rope, and skids, as recommended by Manufacturer.
 - a. When lifting, moving or lowering pipe with slings, use only wide fabric choker slings capable of safely carrying load.
 - b. Do not use wire rope or chain.
 - c. Slings shall be of sufficient capacity for load and shall be inspected before use by Contractor.
 - d. Do not use worn or damaged slings or equipment.
 - 3. Attach slings, cable, rope, or other devices used for lowering fittings into trench around exterior of fittings for handling.
 - a. Do not attach slings, cable, rope, or other device through fitting's interior for handling.
 - 4. Lower (do not drop) pipe from truck.
 - a. Dropped pipe will be rejected.
 - 5. In using skids, prevent pipes from striking other pipe.
- F. Weigh 16" and larger fittings in presence of District's Representative as each is unloaded at jobsite.
 - 1. Fittings weighing <95% of weight shown in AWWA C153 will be rejected and shall be removed from jobsite.
- G. Store gaskets at temperature ≤ 70°F.
 - 1. Do not expose to direct sunlight.
 - 2. Store gaskets in manner permitting free air circulation around elastomer.

1.8 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for ductile iron pipe and fittings.

PART 2 - MATERIALS

2.1 Acceptable Manufacturers

A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION					
	DUCTILE IRON PIPE AND FITTINGS						
Ductile-Iron Pipe 3"-64"	American Cast Iron Pipe Company (ACIPCO)	Birmingham, AL (800) 442-2347					
McWane Ductile / Pacific States Cast Iron Pipe Co.		Provo, UT (801) 373-6910					
	US Pipe and Foundry (3"-64")	Birmingham, AL (866) 347-7473					
	Accepted equal						
Ductile Iron Pipe High-	US Pipe and Foundry NXT (4"-12")	Birmingham, AL (866) 347-7473					

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Deflection (Lip-Seal- Gasket) Pipe	Accepted equal	
Ductile-Iron	American Cast Iron Pipe Company (ACIPCO)	Birmingham, AL (800) 442-2347
Mechanical-Joint Pipe	McWane Ductile / Pacific States Cast Iron Pipe Co.	Provo, UT (801) 373-6910
	US Pipe and Foundry (4"-12")	Birmingham, AL (866) 347-7473
	Accepted equal	
Tee-Head Bolts and Hex Nuts on Mechanical Joints	Refer to Section 33 05 31	
Ductile-Iron Pipe	American Cast Iron Pipe Company (ACIPCO)	Birmingham, AL (800) 442-2347
Fittings	McWane Ductile / Pacific States Cast Iron Pipe Co.	Provo, UT (801) 373-6910
	Tyler Union / McWane	Tyler, TX (903) 862-5511
	US Pipe and Foundry (3"-64")	Birmingham, AL (866) 347-7473
	Accepted equal	
Push-on Joints	American Cast Iron Pipe Company (ACIPCO) "Fastite"	Birmingham, AL (800) 442-2347
	Clow Water Systems Company / McWane	Coshocton, OH (740) 622-6651
	McWane Ductile / Pacific States Cast Iron Pipe Co.	Provo, UT (801) 373-6910
	US Pipe and Foundry "Tyton" (3"-64")	Birmingham, AL (866) 347-7473
	Accepted equal	
	THRUST RESTRAINT	
Integrally Cast Locking- Ring Restrained Joints	American Cast Iron Pipe Company (ACIPCO) "Flex-Ring"	Birmingham, AL (800) 442-2347
	McWane Ductile / Pacific States Cast Iron Pipe Co "TR-Flex" (formerly "Thrust Lock")	Provo, UT (801) 373-6910
	US Pipe and Foundry "TR-Flex" (4"-64")	Birmingham, AL (866) 347-7473
	Accepted equal	
Locking Gasket Type Restrained Joints	American Cast Iron Pipe Company (ACIPCO) "Fast-Grip""	Birmingham, AL (800) 442-2347
	McWane Ductile / Pacific States Cast Iron Pipe Co "Sure-Stop"	Provo, UT (801) 373-6910
	US Pipe and Foundry "Field-Lok" (4"-36") Accepted equal	Birmingham, AL (866) 347-7473
Restrained Joints for	Kubota Corporation	Tokyo, JAP (+81) 904 125-6914
Seismic, Landslide,	US Pipe and Foundry "TR-Xtreme" (4"-12")	Birmingham, AL (866) 347-7473
Thermal Expansion or Valve Removal Applications	Accepted equal	
Restrained Joint High	US Pipe and Foundry "XTRA-Flex"	Birmingham, AL (866) 347-7473
Deflection Coupling	Accepted equal	
Third-Party Gripping- Wedge DIP Follower-	EBAA Iron Megalug Series 1100 1100 for new MJ fittings 3"-48"	Eastland, TX (800) 433-1716
Gland-Type Mechanical Joint Restraints for Push-on	1100SD for existing MJ fittings 3"-48" Ford Uni-Flange Series 1300 Restrained End Cap for MJ fittings 4"-	Wabash, IN (260) 563-3171
DIP Bells (Do not use on PVC)	16" Series 1400 for MJ fittings 4"-36"	
511 V O J	Romac "RomaGrip"	Bothell, WA (800) 426-9341
	Smith-Blair, Inc Cam-Lock 111	Texarkana, AR (800) 643-9705
	Accepted equal	1 5 Adiriana, Aix (000) 045-3105
Third-Party Gripping Wedge DIP Restraint	EBAA Iron Megalug Series 1700 Restraint Harness	Eastland, TX (800) 433-1716
Harness for Push-on	Romac 600 Series	Bothell, WA (800) 426-9341
Bells	Smith-Blair, Inc.	Texarkana, AR (800) 643-9705
	Star National Products / Dresser Style 443 Tie- Anchor	Columbus, OH (614) 294-4951
	Accepted equal	
	COATINGS	
Factory Coat on Buried	Koppers, Inc 11-S Primer	Pittsburgh, PA (412) 826-3970

ITEM	MANUFACTURER	MANUFACTURER LOCATION			
Pipe	Accepted equal				
Field Coatings on	Koppers Bituplastic No 33	Pittsburgh, PA (412) 826-3970			
Buried Pipe	Accepted equal				
Polyethylene	Refer to Section 33 11 20.				
Encasement					
Tape for Polyethylene	Refer to Section 33 11 20.				
Encasement					
	LININGS				
Fusion-Bonded and	Refer to Section 09 96 56.				
Liquid Epoxy Linings					
and Coatings					
	JOINT PRODUCTS				
Nuts and Bolts, Flange	Refer to Section 33 05 31				
Gaskets, and Threaded					
Joint Sealants					
	IDENTIFICATION TAPE				
Buried Pipe	Refer to Section 33 05 26				
Identification Tape					

2.2 <u>Materials</u>

- H. Refer to Section 01 61 00 for basic requirements for products and materials.
- I. Ductile iron pipe and fittings shall have 200 g/m² zinc coating.
- J. Materials for ductile-iron pipe shall be:

MATERIAL/	STANDARDS/			
COMPONENT	CHARACTERISTICS	SPECIFICATION/REQUIREMENT		
Pipe	Manufacturing	Conform to AWWA C151/ANS	SI 21.50 for pipe 3"-64"	
	Standards	0 () 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	21.404.50	
	Design Standards	Conform to AWWA C150/ANS		
	NSF Listing	Provide NSF 61 listed produc	ts for potable water pipe	
	Material	Ductile-iron		
	Size	As shown on plans.		
	Wall Thickness –	3" pipe	Thickness Class 52	
	Buried Pipe	4" pipe	Thickness Class 52	
		6" pipe	Thickness Class 52	
		8" pipe	Thickness Class 50	
		12" pipe	Thickness Class 50	
		Pipe sizes ≥ 14" = Thickness	Class 50 unless otherwise specified.	
			OR	
		Pressure class pipe may be	substituted for thickness class pipe as	
		follows:		
		3"-12" pipe	Pressure Class 350	
		4" pipe	Pressure Class 350	
		6" pipe	Pressure Class 350	
		8" pipe	Pressure Class 350	
		12" pipe	Pressure Class 350	
		16" pipe	Pressure Class 250	
		18" pipe	Pressure Class 250	
		20" pipe	Pressure Class 300 / Pressure Class	
			250	
		24" pipe	Pressure Class 300 / Pressure Class 250	
		30" pipe	Pressure Class 250	
		36" pipe	Pressure Class 250	
		42" pipe	Pressure Class 200	
	Wall Thickness –	Pipe with Grooved	Thickness Class 53	
	Above-Ground Pipe	Couplings		
		All Other Pipe	Thickness Class 53	
	Markings	Conform to AWWA C151 Sec		
	1	1 222 10 / 11 / 11 / 10 / 000		

MATERIAL/	STANDARDS/			
COMPONENT	CHARACTERISTICS	SPECIFICATION/REQUIREMENT		
	Lengths	18' or 20' lengths per AWWA C151/ANSI A21.51, except where shorter lengths are required to fit horizontal or vertical alignment.		
	Coatings	Buried Pipe	Factory coat 1 prime coat of asphaltic coating approximately 1-mil DFT per AWWA C151	
		Galvanic (Zinc) Coating (Required in corrosive soils having 10 or more corrosion points as defined in AWWA C105)	200 g/m ² 99.99% pure metallic zinc Apply by thermal arc spray process to exterior metal surface	
		Above-Ground Pipe or Pipe in Vaults	Factory prime with 3-5 mils DFT moisture-cured urethane (MCU) primer for field-painted above-ground pipe	
			Factory coat with 12.0-mil DFT finish coat of fusion-bonded epoxy conforming to AWWA C116. Refer to section 09 96 56.	
			Or field coat with 16.0-mil DFT finish coat, refer to Section 09 90 00 and 09 96 56.	
	Lining	Cement Mortar Lining	Double thickness cement-mortar lined per AWWA C104 using Type II cement unless otherwise specified.	
		Cement Mortar Lining	3"-12" Pipe 1/8"	
		Double Thickness	16"-24" Pipe 3/16"	
		Dimensions	30"-42" Pipe 1/4"	
		Optional Bituminous Lining	At Manufacturer's option, NSF 61-listed bituminous lining conforming to AWWA C110 may be furnished over cement mortar lining	
		Blowoff Piping	4" or 6" blowoff piping shall receive 12 - mil DFT epoxy-lining per AWWA C116	
	Option C Fusion- bonded Epoxy Lining, where shown on Plans	Epoxy Lining	Refer to AWWA C116 and Section 09 96 56.	
	Option D Ceramic	Amine-Cured Novalac	Minimum 20% by volume ceramic	
	Epoxy Lining, where	Epoxy Lining	quartz pigment.	
	shown on Plans		Permeability rating of 0.00	
			Abrasion resistance < 4 mils loss after 1,000,000 cycles on ±22.5° sliding	
			aggregate slurry abrasion tester using sharp natural siliceous gravel with	
			particle size between 2 mm and 10 mm	

K. Materials for ductile-iron pipe joints shall be:

MATERIAL/ COMPONENT	STANDARDS/ CHARACTERISTICS	SPECIFICATION/REQUIREMENT
Joints	Integrally Cast	Push-on joint providing longitudinal restraint without thrust block.
	Restrained Joint (TR-Flex)	Boltless, restrained, push-on joint design with positive axial-locking iron-to-iron restraint system capable of deflection after assembly. Use 1 type of restrained joint exclusively for each pipe size
	Locking Gasket Type Restrained Joints (Sure-Stop, Field-Lok) Third-Party Gripping- Wedge DIP Restraint Systems	Push-on joint providing longitudinal restraint without thrust block. Boltless, restrained push-on joint capable of restraining field-cut pipe. Use 1 type of restrained joint exclusively for each pipe size Third-party harness around push-on joint providing longitudinal restraint without thrust block. Restrained push-on joint capable of restraining field-cut pipe
		T-bolts shall be Type 316 stainless steel Refer to Section 33 05 31

MATERIAL/ COMPONENT	STANDARDS/ CHARACTERISTICS		SPECIFICATION/REQUIREMENT	
		Use 1 type of restrained joint exclusively for each pipe size		
	Standard Push-on Style	Conform to AWWA C111/ANSI 21.11		
	Mechanical Joint	Conform to AWWA C111/ANSI 21.11		
Bell Joint	Material	Conform to AWWA C111/ANSI 21.11 Vulcanized Styrene Butadiene Rubber (SBR)		
(Nonlocking)				
Gaskets	Material for		ylonitrile butadiene)	
	Hydrocarbon	FLUOREL or Vito	on (FKM) (fluorocarbon)	
	Applications and			
	Contaminated Soils			
	Gasket Age	<180 days old or		
D (" D'			retested <60 days prior to installation	
Ductile Iron Pipe	Material	Ductile Iron		
Joint Restraints	Style	≤20" pipe	Integrally Cast Restrained Joint (TR-Flex)	
			Locking Gasket Type Restrained Joints –4"-24"	
			(Sure-Stop, Field-Lok)	
		>04":	Third-Party Gripping-Wedge DIP Restraint Systems	
	Marking Drassure	≥24" pipe 3"-16"	Integrally Cast Restrained Joint (TR-Flex)	
	Working Pressure Rating	18"-42"	350 psi	
Elangos	Material	Ductile Iron	250 psi	
Flanges	Pressures 0-250 psi		E/ANSI B16.42 Class 150	
	riessules 0-250 psi	Raised- or flat-fac		
	Screwed-on Type for		/A C115/ANSI A21.15	
	Pipe	Comonii to Avvvi	A OTTO/ANOTAZT.TO	
	Integrally-Cast Type for	Conform to AWWA C110/ANSI A21.10		
	Fittings	Comoni to Award of Foll Monage 1. To		
	Alignment for Valve	Boltholes shall straddle horizontal centerlines of pipe run to which		
	Mating	flanges are attact	ned.	
Flange Bolts,	Various Steels	Refer to Section 33 05 31.		
Nuts, and				
Washers				
Flange Gaskets		Refer to Section 33 05 31.		
Grooved Ends		Conform to AWWA C606		
(Provide where		Compatible with adjacent coupling		
Shown)		D ((0 "	20.05.44	
Joint Bonding	Cadweld	Refer to Section 2	26 05 44.	

L. Materials for ductile-iron pipe fittings shall be:

MATERIAL/ COMPONENT	STANDARDS/ CHARACTERISTICS	SPECIFICATION/REQUIREMENT
Fittings	Material	Ductile-iron
	Standards	Conform to AWWA C110/ANSI 21.10 or AWWA C153/ANSI A21.53
	Style	Push-on (standard) or restrained joint (as specified).
		Mechanical joint fittings not allowed unless otherwise shown on Plans.
	Marking	Show Manufacturer's name or trademark.
		Letters "DI" or "DUCTILE" shall be cast on fittings
		Mark AWWA standard complied with (AWWA C110 or AWWA C153)
		Show nominal pipe diameter.
		NSF 61 stamp (for potable water service)
		Show manufacturing date code.
	Coatings	Use same coating as adjacent pipe, as specified above
	Linings	Use same lining as adjacent pipe, as specified above
	Polyethylene PE Film	Refer to Section 33 05 26
	Wrap for Corrosion	
	Protection of Ductile	
	Iron Fittings	
Outlets	≤2"	Bronze service saddle
	2½"-3"	Tapped tee
	≥4"	Flanged tee

- M. Thickness class pipe shall be required for the following applications
 - 1. Pipe within property designated for water or wastewater pumping plants
 - 2. Pipe within property designated for reservoirs.
 - 3. Pipe within right-of-way of existing or future street crossings where right-of-way is shown on plans.

N. The following product design criteria, options and accessories are required:

ITÉM	DESCRIPTION
Design Criteria	Loading H-25 (40k axle 20k wheel load)
Depth of Soil Cover	Refer to Plans, if no cover is stated, scale cover from Plans.

O. Refer to Section 33 05 26 for requirements for identification, identification tape and warning tape for buried ductile iron pipe.

PART 3 - EXECUTION

3.1 <u>Preparation</u>

- A. Make field measurements needed to install DIP pressure pipe and fittings before submitting Shop Drawings or ordering.
 - 1. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Trench Preparation: Trench in accordance with Section 31 23 33.
 - 1. Schedule pipe laying so bell end of pipe faces in direction of laying.
 - 2. Pipe on slopes > 10% shall be laid in uphill direction.
 - 3. Prior to laying pipe, grade trench bottom and prepare flat or semi-circular trench bottom conforming to grade with allowance for pipe wall thickness.
 - 4. Remove hard spots that would prevent uniform bedding thickness.
 - 5. Before laying each pipe section, check grade with straight-edge and correct irregularities.
 - 6. Provide uniform bearing throughout length of each pipe section.
 - 7. Dig bell (joint) holes of ample dimension in trench bottom at joint locations to facilitate visual inspection and joining at each joint.
 - 8. Scoop out shallow lateral depression half a pipe length from last pipe laid to allow for easy removal of belt pipe sling and thus avoid movement of pipe after it is placed on proper line and grade.
- C. Provide and maintain means and devices at all times to remove and dispose of water entering trench during pipe-laying operations.
 - 1. Keep trench dry until pipe-laying and jointing are completed.
 - 2. Dewater trench so trench bottom and bedding material are dry.
- D. Minimum trench width at crown of pipe shall be as follows based on AWWA M41 Table 11-2 and Section 31 23 33:

PIPE NOMINAL	MINIMUM BEDDING	MINIMUM TRENCH WIDTH	PARALLEL PIPE CLEARANCE
DIAMETER	DEPTH (in below bell)	B _d (in)	(in)
4"	4"	28"	6"
6"	4"	30"	6"
8"	4"	32"	6"
12"	4"	36"	6"
16"	4"	40"	6"
18"	4"	42"	6"
20"	4"	44"	6"
24"	4"	48"	6"
30"	4"	54"	12"
36"	4"	60"	12"
42"	4"	66"	12"

3.2 <u>Installation</u>

A. Refer to Sections 01 73 00 and 01 73 33 for basic execution and installation requirements.

- B. Refer to Section 31 23 33 for open trench requirements.
- C. Furnish and install pipe and fittings at locations shown on Plans and Submittals.
- D. The following installation standards shall be followed:
 - 1. Manufacturer's installation and warranty requirements
 - 2. Applicable OSHA and Cal OSHA regulations
 - 3. Applicable building, fire, plumbing and mechanical code requirements
 - 4. AWWA C600 Installation of Ductile-Iron Water Mains and Their Appurtenances
 - 5. AWWA Manual M41 Ductile-Iron Pipe and Fittings
- E. Refer variances between above documents and Contract Documents to District's Representative.
- F. Protect water systems by maintaining separations and using materials described in Section 31 05 50.
- G. Excavation and backfill, including pipe bedding, shall conform to provisions of Section 31 23 33, AWWA C600, and AWWA M41, Chapter 11.
- H. Accurately place pipe to lines and grades shown.
 - 1. Support fittings independently of pipe.
- I. Assemble push-on joints per AWWA C600 and as follows:
 - 1. On long-radius curves, excavate trench wider than normal to allow for straight-line assembly before deflection.
 - 2. Cut and machine pipe per AWWA C600, AWWA M41, and Manufacturer's standard procedures.
 - a. Do not cut pipe with cold chisel, standard iron pipe cutter, or other method that may fracture pipe or produce ragged, uneven edges.
 - 3. Carefully lower pipe, fittings, valves, and appurtenances into trench using derrick, ropes, or other suitable equipment taking care to protect pipe and fittings from damage.
 - a. Do not drop pipe, fittings, or accessories or dump them into trench.
 - b. To lower fittings or valves into trench, attach cable, rope, or other devices around fitting or valve exterior.
 - c. Do not attach cable, rope, or other device through interior of fittings or valves.
 - 4. Clean gasket recess groove and bell socket of pipe or fitting and plain end of mating pipe.
 - a. Joint shall be dirt-free.
 - b. Lubricate plain end spigot, socket and gasket using pipe Manufacturer-furnished NSF 61-compliant pipe lubricant as recommended in AWWA C600.
 - 5. Stretch rubber ring gasket into groove of spigot end of pipe.
 - a. Distribute gasket evenly around groove.
 - b. Make sure ring is completely seated.
 - 6. Insert spigot into bell
 - a. Force spigot slowly into position using large bar lever and wood block across pipe end.
 - b. For large pipe, a come-along (with padding that will not scratch pipe) may be used.
 - c. Do not tilt pipe when inserting spigot into bell.
 - d. Spigot and bell shall slide together without displacing rubber gasket.
 - e. Use feeler gauge to verify proper gasket placement.
 - 7. Maintain joint recess recommended by Manufacturer for made up joints.
 - 8. After assembling pipe in straight line, make horizontal or vertical deflections at joints to comply with alignment shown on Plans.
 - 9. Allowable joint deflections for push-on joints shall not exceed:

PIPE NOMINAL	STANDARD TYTON®-STYLE JOINT		TYTON®-STYLE JOINT LIP-SEAL GASKET NXT® JOINT	
DIAMETER	ALLOWABLE ALLOWABLE JOINT A		ALLOWABLE JOINT	ALLOWABLE JOINT
	JOINT DEFLECTION - 1		DEFLECTION - 1	DEFLECTION - 1
	DEFLECTION - 1 RESTRAINED-		PUSH-ON-JOINT	RESTRAINED-JOINT
	PUSH-ON-JOINT	JOINT		
4"	4.0°	n/a	n/a	n/a
6"	4.0°	3.2°	8.0°	6.4°

8"	4.0°	3.2°	8.0°	6.4°
12"	4.0°	3.2°	n/a	n/a
16"	2.4°	1.6°	n/a	n/a
18"	2.4°	1.6°	n/a	n/a
20"	2.4°	1.6°	n/a	n/a
24"	2.4°	1.6°	n/a	n/a
30"	2.4°	1.6°	n/a	n/a
36"	2.4°	1.6°	n/a	n/a
42"	2.4°	1.6°	n/a	n/a

- 10. Values shown above are based on 80% of that recommended by AWWA M41 Table 11-4 and 11-5 or Manufacturer.
- 11. Minimum radii shall not be less than the following unless pipe lengths shorter than 18' or 20' are used:

PIPE NOMINAL	STAN	STANDARD TYTON®-STYLE JOINT			LIP-SEAL GASKET NXT® JOINT			
DIAMETER	MINIMUM RADIUS -		MINIMUM RADIUS -		MINIMUM RADIUS -		MINIMUM RADIUS -	
	1	ſ		ſ	1	•	1	r
	PUSH-0	N-JOINT	RESTR	AINED-	PUSH-0	N-JOINT	RESTR	AINED-
			JO	INT			JO	INT
	18'	20'	18'	20'	18'	20'	18'	20'
	SPOOLS	SPOOLS	SPOOLS	SPOOLS	SPOOLS	SPOOLS	SPOOLS	SPOOLS
4"	241'	286'	n/a	n/a	n/a	n/a	n/a	n/a
6"	241'	286'	322'	358'	121'	143'	161'	179'
8"	241'	286'	322'	358'	121'	143'	161'	179'
12"	241'	286'	322'	358'	n/a	n/a	n/a	n/a
16"	430'	477'	645'	716'	n/a	n/a	n/a	n/a
18"	430'	477'	645'	716'	n/a	n/a	n/a	n/a
20"	430'	477'	645'	716'	n/a	n/a	n/a	n/a
24"	430'	477'	645'	716'	n/a	n/a	n/a	n/a
30"	430'	477'	645'	716'	n/a	n/a	n/a	n/a
36"	430'	477'	645'	716'	n/a	n/a	n/a	n/a
42"	430'	477'	645'	716'	n/a	n/a	n/a	n/a

- J. Assemble mechanical joints per AWWA C600 and as follows:
 - 1. On long radius curves, excavate trench wider than normal to allow for straight-line assembly before deflection.
 - 2. Cut and machine pipe per AWWA C600, AWWA M41, and Manufacturer's standard procedures.
 - a. Do not cut pipe with cold chisel, standard iron pipe cutter, or other method that may fracture pipe or produce ragged, uneven edges.
 - 3. Carefully lower pipe, fittings, valves, and appurtenances into trench using derrick, ropes, or other suitable equipment taking care to protect pipe and fittings from damage.
 - a. Do not drop pipe, fittings, or accessories or dump them into trench.
 - b. To lower fittings or valves into trench, attach cable, rope, or other devices around fitting or valve exterior.
 - c. Do not attach cable, rope, or other device through interior of fittings or valves.
 - 4. Clean groove and bell socket of pipe or fitting and plain end of mating pipe.
 - a. Joint shall be dirt-free.
 - b. Lubricate plain end spigot, socket and gasket using pipe Manufacturer-furnished NSF 61-compliant pipe lubricant as recommended in AWWA C600.
 - 5. Stretch rubber ring gasket into groove of spigot end of pipe.
 - a. Distribute gasket evenly around groove
 - b. Make sure ring is completely seated.
 - 6. Insert spigot into bell
 - a. Force spigot slowly into position using large bar lever and wood block across pipe end.
 - b. For large pipe, a come-along (with padding that will not scratch pipe) may be used.
 - c. Do not tilt pipe when inserting spigot into bell.
 - d. Spigot and bell shall slide together without displacing rubber gasket.
 - e. Use feeler gauge to verify proper gasket placement.

- 7. Maintain joint recess recommended by Manufacturer for made up joints.
- 8. Push gland toward socket and center it around pipe with gland lip against gasket.
 - a. Insert bolts and hand-tighten nuts.
- 9. After assembling pipe in straight line, make horizontal or vertical deflections at joints to comply with alignment shown on Plans.
- 10. Allowable joint deflections for mechanical joints shall not exceed:

PIPE NOMINAL DIAMETER	ALLOWABLE JOINT DEFLECTION - α MECHANICAL-JOINT	ALLOWABLE JOINT DEFLECTION - α RESTRAINED-JOINT
4"	6.6°	n/a
6"	5.7°	3.2°
8"	4.3°	3.2°
12"	4.3°	3.2°
16"	2.9°	1.6°
18"	2.4°	1.6°
20"	2.4°	1.6°
24"	1.8°	1.6°

- 11. Values shown above are based on 80% of that recommended by AWWA M41 Table 11-4 and 11-5 or Manufacturer.
- 12. After making joint deflection, tighten bolts to normal range of bolt torque recommended by Manufacturer or AWWA M41 Table 11-3.
- K. Assemble flanged joints per Section 33 05 31.
- L. Provide polyethylene encasement per Section 33 11 20.
- M. Provide thrust blocks as follows:
 - 1. Place concrete thrust blocks in accordance with Section 03 30 00 as shown using Portland cement concrete containing ≥5 sacks of cement per cubic yard.
 - 2. Place concrete blocks between undisturbed ground and fittings to be anchored.
 - 3. Quantity of concrete and bearing area of pipe undisturbed soil shall be as shown, unless otherwise determined by District's Representative.
 - 4. Place concrete, unless specifically shown otherwise, so pipe joints and fittings remain accessible to repairs.
- N. Push-on restrained joints shall incorporate integrally cast restrained joints (TR-Flex) and shall be installed in accordance with Manufacturer's installation instructions.
 - 1. For pipe ≤8", locking gasket joint systems may be used provided:
 - a. Thrust blocks are placed behind valves and fittings.
 - b. District's Representative accepts use of locking gasket thrust restraint.
- O. Third-party ductile iron pipe restraint systems may also be used.

3.3 Field Quality Control

- A. Do not backfill joints until District's Representative has observed them.
 - 1. Leave open sufficient trench space in vicinity of each joint to permit visual observation around entire joint periphery.
- B. Field testing shall include:

		TEST STANDARD (ASTM OR OTHER TEST		FIRST TEST PAID	RETESTS PAID FOR
ITEM	TEST FOR	STANDARD)	FREQUENCY	FOR BY	BY
Bedding and Backfill	Compaction	Refer to S	ection 31 23 33		
Ductile Iron Pipe	Visual Inspection	Refer to Part 1.4 "Quality Assurance" of this specification.	All pipe at District's discretion	District	District
	Line and Grade	Grade tolerance ±1" Alignment tolerance ±2"	All new pipe	Contractor	Contractor
	Pipe Separations	Refer to Section 31 05 50.	All new pipe	Contractor	Contractor

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
	Hydrostatic Test	Refer to Section 33 08 11, AWWA C600 and AWWA M41	All new ductile iron pipe	Contractor	Contractor
	Disinfection	Refer to Section 33 13 00 and AWWA C651.	All new ductile iron potable water pipe	Contractor	Contractor
	Anchorage and Support of Exposed Pipe	Visual inspection of finished installation. Support per CPC Table 3-1 and 3-2	1 inspection	District	District
	Installation & Leakage	Visual inspection of finished installation. No visible leaks	1 inspection	District	District
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	District	Contractor

C. Remove damaged pipe or fittings upon discovery and without delay from Project Site.

3.4 Cleaning and Disinfection

A. Clean and disinfect pipe in accordance with Section 33 13 00.

3.5 Protection

- A. When pipe laying is not in progress, and during noon hour and overnight, close open end of pipe with tight-fitting cap or plug to prevent entrance of foreign matter into pipe.
- B. Do not use pipeline to drain water that has infiltrated into trench.
- C. Maintain inside of pipe free from foreign materials and in clean and sanitary condition until acceptance by District.

END OF SECTION

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T-SECTION 33 12 51

VERTICAL TURBINE LINE SHAFT WELL PUMPS

PART 1 - GENERAL

Pumping equipment described in this specification is to be furnished and installed by the Contractor under this project work. Contractor shall install the pump in the already developed well down hole and complete its full functionality by furnishing and installing the electrical, instrumentation, and mechanical components.

The Contractor under this project shall coordinate with the pump supplier to develop installation and startup and testing plans and methods for the new pump. Contractor installation and testing requirements provided in this specification are to establish the minimum requirements. The pump supplier may establish required installation and testing requirements in addition to those presented herein.

1.1 Work Included

- A. Materials, testing, and installing vertical turbine line shaft water pumps and attached motors, baseplates, couplings, and guards for use as well pumps.
- B. Pumps shall rotate counterclockwise when viewed from driver end.
- C. Pump shall be NSF 61 listed for use with potable water systems.
- D. Refer to the following sections for Work not covered herein.
 - 1. Section 05 05 19 for requirements for anchor bolts.
 - 2. Section 09 90 00 for requirements for painting requirements.
 - 3. Section 09 96 56 for requirements for epoxy lining and coating.
 - 4. Section 26 05 10 and subsequent sections for electrical requirements.
 - 5. Section 33 05 31 for requirements for flange bolting materials.

1.2 Related Work

- A. Section 01 10 02: Sequence of Operation
- B. Section 01 22 00: Unit Prices
- C. Section 01 33 00: Submittal Procedures
- D. Section 01 40 00: Quality Requirements
- E. Section 01 61 00: Common Product Requirements
- F. Section 01 65 00: Product Delivery Requirements
- G. Section 01 63 00: Product Substitution Procedures
- H. Section 01 66 00: Product Storage and Handling Requirements
- I. Section 01 73 00: Execution
- J. Section 01 73 24: Seismic Restraint
- K. Section 01 75 00: Starting and Adjusting
- L. Section 01 79 00: Demonstration and Training
- M. Section 05 05 19: Post-Installed Concrete Anchors
- N. Section 09 90 00: Painting and Coating
- O. Section 09 96 56: Epoxy Linings and Coatings
- P. Section 26 05 10: Common Work Results for Electrical
- Q. Section 33 05 31: Pipeline Joint Materials

1.3 Definitions

A. The following definitions apply:

1. <u>Total Dynamic Head</u>: The sum of velocity head plus vertical static head measured from minimum suction water level or minimum suction pressure hydraulic elevation to centerline of pump discharge

1.4 System Description

- A. Furnish and install complete operating pumping system including pumps, motors and necessary appurtenances required by Contract Documents.
 - 1. Pumping units shall be supplied by 1 Manufacturer and shall be complete, including pumps, motors, baseplates, couplings, guards and accessories specified herein.
 - 2. Furnish and install anchor bolts and appurtenant structural, mechanical and/or electrical mountings or connections required for compliance with Manufacturer's installation requirements and compliance with applicable building, plumbing, mechanical and electrical codes and standards.
- B. Pumps, motors, drives, couplings and base plates shall be designed and built for 24-hour continuous service at points within specified range of operation, without overheating, damaging cavitation, or excessive vibration or noise.

1.5 **Quality Assurance**

- A. Pumps furnished shall originate from ISO 9001-certified facility.
- B. Castings shall be free of blow holes, sand holes, and other detrimental effects, and shall be accurately machined.
- C. Rotating parts including impellers shall be statically and dynamically balanced.
- D. Pumps shall be engineered and manufactured under written Quality Assurance program, which has been in effect for ≥10 years.
 - 1. Quality assurance program shall include documentation of periodic internal and external audits to confirm compliance with such program.
- E. Entire pump, including discharge head, sole plate, coupling, column, line shaft, bowl shaft, impellers, pump bowls, suction bell, and specified appurtenances shall be furnished by 1 pump Manufacturer.

F. Factory testing shall include:

		TEST STANDARD		FIRST TEST PAID	RETESTS PAID FOR
ITEM	TEST FOR	(ASTM OR OTHER TEST STANDARD)	FREQUENCY	FOR BY	BY
Test Instrument Accuracy	Calibration	Calibrate Venturi meters per ANSI/HI Standards Calibrate test instruments and gauges	within 30 days of scheduled tests.	Contractor	Contractor
Pump and Motor Assembly	Compliance with Purchase Order	Verify impeller, motor rating and electrical connections conform to Contract Documents	1 each pump assembly	Contractor	Contractor
	Hydrostatic Test	Test bowl assemblies, pump columns, and discharge heads per HI standards to 1.5 x design head or 1.25 x shutoff head, whichever is greater	1 each bowl, column, and discharge head	Contractor	Contractor
	Holidays and Lining Thickness	Refer to Section 09 96 56.	1 each pump	Contractor	Contractor
	Dynamic Balance	NEMA Method MGI 12.06 (8W/N for pumps)	1 each pump assembly	Contractor	Contractor
	Factory Test and Factory- Certified Pump Curve	Witnessed running test conforming to AWWA E103 and ANSI/HI 14.6 6-point curves shall include shutoff and 3 points as near as possible to specified performance points.	1 each pump assembly ≥100hp 30-minute test to prepare 6-point curves for pump	Contractor (Includes lodging and travel expenses	Contractor (Includes lodging and travel expenses
	Vibration	As needed to satisfy pump Manufacturer pumps will pass field tests	assembly. On variable	for up to 3 personnel	for up to 3 personnel

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
	12011011	described in Part 3 below.	speed pumps,	from	from
			test each pump	District's	District's
			and prepare 6-	and/or	and/or
			point curves at	Design	Design
			four 100-rpm	Engineer's	Engineer's
			increments.	offices.)	offices.)
Pump	Line Shaft Straightness	≤0.0005" deviation per foot of shaft	1 each line shaft	Contractor	Contractor
3-Phase	Prototype	NEMA MG1 §12.53a and IEEE 112	1 each type of	Contractor	Contractor
Motors	Test	Test Method B	motor furnished		
	Short	NEMA MG1 §12.51 and NEMA MG1	1 each motor	Contractor	Contractor
	Commercial	§23.46			
	Test Data	including no load running current,			
		current balance, full load current, locked			
		rotor current, winding resistance, high			
		potential test, bearing inspection, and			
		vibration test			
	Motor	Provide guaranteed full-load efficiencies	1 each motor	Contractor	Contractor
	Efficiency	per NEMA MG1 §12.60			
	(Motors ≤300	Determine efficiency using IEEE 112			
	hp) or Frames	Method B Dynamometer using sine			
	143T-445T	wave power and accuracy improvement			
		by segregated loss determination			
		including stray load loss measurements.			
		Stamp guaranteed efficiency on			
	Matan	nameplate per NEMA MG1 §12.58.2	4	0	0
	Motor	Provide guaranteed full-load efficiencies	1 each motor	Contractor	Contractor
	Efficiency (Motors >300	per NEMA MG1 §12.60			
	hp) or Frames	Determine efficiency using IEEE 112 Method B Dynamometer, Method E			
	>445T	Input or Method F Equivalent Circuit			
	7 4 4 5 1	Stamp guaranteed efficiency on			
		nameplate per NEMA MG1 §12.58.2			
	Insulation	NEMA MG1 §20.48 qualification test on	1 each motor	Contractor	Contractor
		motors with form-wound coils 168-hour test in humidity chamber at	1 each motor	Contractor	Contractor
	MatanNaisa	40°C and 100% relative humidity			
	Motor Noise	IEEE 85 with motor operating during test on rubber at no load with rated	1 each motor	Contractor	Contractor
	Motor	voltage and frequency Conform to NEMA MG1§12.05	1 each motor	Contractor	Contractor
	Vibration	maximum amplitudes and NEMA	i each motor	Contractor	Contractor
	Vibration	MG1§20.52 maximum peak-to-peak			
		vibration amplitudes			
		Test per NEMA MG1§12.06 or NEMA			
		MG1 §20.53			
	Dynamic	Balance and measure per NEMA MG1	1 each motor	Contractor	Contractor
	Balance	§12,06 or MG1 §20.52 with maximum			
		amplitudes shown in NEMA MG1			
		§12.05			
	Motor	NEMA MG1 Winding Temperature and	1 each thermally-	Contractor	Contractor
	Thermal	Trip Current Tests	protected motor		
	Protectors				

- G. Where motor controller other than standard across-the-line type is specified, furnish reviewed Shop Drawings to controller Manufacturer for coordination and sizing of controller.
- H. Where adjustable frequency drives are used, test project VFD with assembled project pump and motor to guarantee compatibility.

- I. Tests shall be witnessed by registered professional engineer paid for by Contractor.
 - 1. Witnessing engineer may be employee of Manufacturer and shall sign and seal copies of curves and test reports and certify tests were performed.
 - Refer to Section 01 40 00 for provisions allowing District to witness factory tests at their expense.
 - 3. Schedule District-attended witness testing ≥14 days in advance of test dates.
- J. Perform testing after final connection of pump and motor and after completion of static and dynamic balancing.
 - 1. If vibration levels fall outside of acceptable limits established by Hydraulic Institute or above, shut down pump and correct for vibration before further testing.

1.6 References

- A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.
 - 1. ABMA American Bearing Manufacturers Association Standards
 - 2. AGMA American Gear Manufacturer's Association Standards
 - 3. ANSI/AFBMA 9 Load Ratings and Fatigue Life for Ball Bearings
 - 4. ANSI/AFBMA 11 Load Rating and Fatigue Life for Roller Bearings
 - 5. ANSI/ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings-Class 25, 125, 250 and 800
 - ANSI/ASME B16.5 Steel Pipe Flanges and Flanged Fittings (Including ratings for Class 150, 300, 400, 600, 900, 1500, and 2500)
 - 7. ANSI C50.41 Poly-Phase Induction Motors for Power Generating Stations
 - 8. ANSI HI 2.4 Rotodynamic (Vertical) Pumps Installation, Operation, and Maintenance Manuals
 - 9. ANSI HI 14.6 Roto-Dynamic Pumps for Hydraulic Performance Acceptance Tests
 - 10. ASME Boiler and Pressure Vessel Code
 - 11. ASTM A36 Carbon Structural Steel
 - 12. ASTM A48 Gray Iron Castings
 - 13. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 14. ASTM A108 Steel Bar, Carbon and Alloy, Cold-Finished
 - 15. ASTM A276 Stainless Steel Bars and Shapes
 - 16. ASTM A283 Low and Intermediate Tensile Strength Carbon Steel Plates
 - 17. ASTM A351 Castings, Austenitic, for Pressure-Containing Parts
 - 18. ASTM A536 Ductile Iron Castings
 - 19. ASTM B148 Aluminum Bronze Sand Castings
 - 20. ASTM B271 Copper-Base Alloy Centrifugal Castings
 - 21. ASTM B505 Copper Alloy Continuous Castings
 - 22. ASTM B584 Copper Alloy Sand Castings for General Applications
 - 23. AWWA C207 Steel Pipe Flanges for Waterworks Service
 - 24. AWWA C213 Fusion-Bonded Epoxy Coating for Interior and Exterior of Steel Water Pipelines
 - 25. AWWA C550 Protective Epoxy Interior Coatings for Valves and Hydrants
 - 26. AWWA E103 Horizontal and Vertical Line Shaft Pumps
 - 27. California Building Code (CBC)
 - 28. California Code of Regulations Title 8 Industrial Relations, Subchapter 5, Electrical Safety Orders
 - 29. California Electrical Code (CEC)
 - 30. IEEE 43 Testing Insulation Resistance of Rotating Machinery
 - 31. IEEE 85 Airborne Sound Measurements on Rotating Electric Machinery
 - 32. IEEE 112 Test Procedure for Polyphase Induction Motors and Generators
 - 33. IEEE 115 Test Procedure for Synchronous Machines
 - 34. IEEE 841 Chemical Industry Severe-Duty Squirrel Cage Induction Motors 600V and Below
 - 35. ISO 9001 Quality Management Standard
 - 36. NEMA/ANSI 250 Enclosures for Electrical Equipment
 - 37. NEMA MG1 Motors and Generators.
 - 38. NEMA MG2 Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators
 - 39. NEMA MG10 Energy Management Guide for Selection and Use of Polyphase Motors
 - 40. NEMA MG13 Frame Assignments for Alternating Current Integral Horsepower Induction Motors
 - 41. NEMA Standards
 - 42. NFPA 70 National Electric Code (NEC)
 - 43. NSF/ANSI 60 Drinking Water Treatment Chemicals Health Effects
 - 44. NSF/ANSI 61 Drinking Water System Components Health Effects

1.7 <u>Submittals</u>

A. Furnish the following submittals.

	lowing submittals.	
SUBMITTAL	DESCRIPTION	
Shop Drawings	Pump and Motor Assembly.	
	Show certified dimensions, weights, and materials for bowls, impellers, motors, shafts,	
	bearings, seals, columns, discharge heads, sole plates, support members, shaft guards, per	
	equipment Shop Drawing requirements.	
	Show outline dimensions and assembly, foundation and installation requirements.	
	Show ASTM reference and grade for materials.	
	Anchor Bolts.	
	Show placement, embedment, and edge distances as required by CBC Chapter 19.	
	Show embedment distances and projections from concrete face.	
	Motor Wiring and Control: Show wiring and motor controls per electrically controlled equipment	
	Shop Drawing requirements.	
	Lining and Coating: Show lining and coating data and thicknesses.	
Product Data	Pretest Pump Curves: Show flowrate, TDH, efficiencies, horsepowers, and NPSHR for full	
	range of operating points.	
	Mark specified operating points.	
	Show shutoff head.	
	Torque and Thrust Curves: Show torque and thrust for operating points.	
	Other Data: Show required bowl submergence, moment of inertia of complete pump assembly,	
	coupling data, seal data, bearing life calculations, pressure limitations, and specific speed.	
	Submit data on accessory items.	
Installation	Submit per Installation Instruction requirements	
Instructions		
O & M	Submit per Operation and Maintenance Instruction requirements	
Instructions	Include parts list and list or recommended spare parts.	
	Include preventative maintenance schedules	
	Include troubleshooting data	
	Include certified performance data and curves from factory tests in O&M manual.	
Certificate of	Submit pump system certification per Certificate of Compliance requirements of AWWA E103	
Compliance	and specifications	
	Submit evidence of ISO 9001 factory certification	
	Submit coating system certification per Certificate of Compliance requirements	
	Submit Installation Certificate signed by equipment Manufacturer's factory-authorized	
	representative stating equipment has been properly installed, shaft aligned and is ready for	
	start-up and performance testing	
	Submit acknowledgement letter from pump Manufacturer that pump and motor being furnished	
	are compatible for use with variable frequency drive.	
Engineering	Line Shaft Sizing: Compute at both shutoff and peak horsepower condition per AWWA E103	
Calculations	§A4.15 to ensure:	
	Adequate lateral clearance is provided for thrust elongation	
	Torque can be transmitted without distortion or vibration during pump operation	
	Discharge Head Loading: Verify discharge head withstands loads due to thrust plusr weight of	
	hanging elements.	
	Pump Seismic Restraint: Refer to Section 01 73 24 for requirements	
	Column and Discharge Head Hydraulic Friction Losses: Submit calculated losses.	
	Horsepower Requirements: Submit for full range of operation.	
	Include shaft friction and thrust bearing losses.	
	Bearings: Compute bearing spacing (10' maximum) and calculated motor bearing life.	
Engineering	Torsional vibration and critical frequency analysis using finite element methods taking into	
Calculations	account natural resonance of motors (coupled and uncoupled to shaft) discharge head, base,	
(Vibration	columns shafts, and pump.	
Analysis)	Analysis shall demonstrate pumps are not subject to harmful vibrations at any point on pump	
	operating curves from shut-off to run-out head during start-up, shutdown, and normal operating	
	speed(s) ranging from 1,000 rpm to 1,800 rpm.	
	Pump Manufacturer shall guarantee the following separation margins:	
	1.Structural Natural Frequency ±20% separation from specified operating speed range	

SUBMITTAL	DESCRIPTION				
	2.Lateral ±15%.				
	3. Torsional ±10% - separation from rated operating point.				
	Report other structural natural frequencies or critical speeds from 0-120% of maximum normal				
	operating speed to allow these to be field-observed and locked out from operation.				
	Report shall be signed and stamped by professionally licensed engineer who performed Work.				
Test Record	Before shipping pumps, submit certified 6-point pump curves for factory tests per Test Record				
Transcripts	Transcript requirements.				
	Where variable speed drives are provided, submit certified 6-point pump curves in four 100				
	rpm increments throughout pump operating range.				
	Include written report stating date and location pumps were tested and certifying in accordance				
	with AWWA E103 that certified pump curves are accurate and comply with specifications.				
	Before shipping pumps, submit certified vibration test report including test results, torsional and				
	critical speed analysis results, and modal shape signature results stating pump and motor				
	assembly has been tested and vibration falls within limits allowed by HI 14.6 and above				
	Submit results of field tests within 14 days of test completion.				
Motor Data	Refer to motor data requirements of Section 26 05 10.				
Testing	Submit written test procedures in advance of all field pump tests.				
Procedures					
Warranty	Furnish 3-year warranty from date of final acceptance for pumps and motors.				
	Warranty shall bear appropriate serial numbers.				

B. Refer to Section 01 33 00 for definition of requirements for Shop Drawings, Catalog Data, Installation Instructions, O&M instructions, Certificates of Compliance, Engineering Calculations, and Test Record Transcripts.

1.8 <u>Delivery, Storage, and Handling</u>

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Do not ship pumps until District has accepted test reports.
- C. Strictly follow Manufacturer's instructions and warranty requirements for delivery, storage, and handling of pumps.
- D. Deliver anchor bolts and anchorage devices to be embedded into cast-in-place concrete in ample time to ensure Work is not delayed.
- E. Cover pump equipment as required to guard against entry of deleterious matter, and to protect Work from abrasion.

1.9 Project Site Conditions

A. Refer to Section 01 10 01 for full list of project site conditions.

1.10 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for vertical turbine line shaft well pumps.

PART 2 - PRODUCTS

2.1 <u>Acceptable Manufacturers</u>

A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
	PUMPS	
Vertical Turbine Line	Fairbanks Morse / Pentair	Kansas City, MO (913) 371-5000
Shaft Pumps	Flowserve Corporation	Hastings, NB (800) 728-7867
		Tustin, CA (714) 505-9700
	Goulds / Xylem	Lubbock, TX (806) 763-7867
		Irvine, CA (949) 680-4800
	ITT Goulds	Seneca Falls, NY (315) 568-2811
		Irwindale, CA (626) 856-5656

ITEM	MANUFACTURER	MANUFACTURER LOCATION
	Sulzer-Johnston Pump Company	Portland, OR (818) 790-7344
	Weir Floway	Fresno, CA (714) 904-1159
	·	Yorba Linda, CA (866) 472-3959
	Accepted equal	
	SEALS	
Mechanical Cartridge	A W Chesterton Co Seal 155	Groveland, MA (844) 484-7080
Seals	Flowserve Corporation ISC-2 Series	Hastings, NB (714) 505-9700
	John Crane / Smiths Type 1B	Cerritos, CA (562) 802-2555
	Accepted equal	
Mechanical Cartridge-	Flowserve Corporation Durametallic® P-50	Hastings, NB (714) 505-9700
Mount Pusher Seals	Accepted equal	
Mechanical Split Seals	A W Chesterton Co Seal 442	Groveland, MA (844) 484-7080
	Flowserve Corporation PSS III	Hastings, NB (714) 505-9700
	John Crane / Smiths Type 1B	Cerritos, CA (562) 802-2555
	Accepted equal	
Packing Material	Bluegard / Garlock / Coltec Style 8113 plus Glass-filled	Palmyra, NY (315) 597-4811
	Teflon	
	Accepted equal	
	VERTICAL MOTORS	
Motors	General Electric	Fairfield, CT (800) 626-2000
	US Electrical Motors / Nidec	St Louis, MO (888) 637-7333
	Accepted equal	
	LUBRICANTS	
Lubricants (Motor)	Chevron-Texaco GST ISO VG32	San Ramon, CA (925) 842-1000
	Exxon-Mobil DTE Light ISO VG32	Irving, TX (800) 243-9966
	Accepted equal	
	ANALYSIS AND TESTING	
Finite Element Analysis	Mechanica Software Inc "ProE"	Annapolis, MD (410) 263-0798
(FEA) program	Accepted equal	
Vibration Testing	Allis USA	(949) 661-3324
	Electrical Specialty Products	(909) 737-8827
	Signet Monitoring and Analysis	Lacombe, AB (403) 391-1921
	Accepted equal Class II vibration analyst certified by	
	Vibration Institute of America	

- B. Pump manufacturer shall have ≥5 years' recent continuous product history in USA waterworks industry.
- C. Pumps furnished shall operate throughout their full submitted pump curve driven by motors of horsepowers specified below or shown on Plans.
- D. Pumps requiring larger motor than specified or shown are unacceptable in absence of written statement from District electrical infrastructure, drives and switchgear can support larger motor.
- E. Pump curve shall continuously rise from minimum head to shutoff with no intermediate dips.
- F. Specified pump and pump curve have been selected based on reference pump noted in Paragraph 2.2 to provide District with optimum performance at multiple operating points, and not solely at best efficiency point.
 - 1. Contractor may substitute other pumps including pumps from other accepted equal manufacturers, provided the following conditions are met:
 - a. Provisions of HI14.6 limiting pump performance testing to 1 "guarantee point" shall be revised to provide 3 guarantee points to acceptance levels described below.
 - b. Testing shall demonstrate performance at "Point B Best Efficiency Point (BEP) conforms to Acceptance Level 1E as defined in HI14.6.
 - c. Efficiencies at BEP shall meet or exceed specified efficiencies.
 - d. Testing shall demonstrate performance at Points A and C conforms to Acceptance Level 1B as defined in HI14.6.

- e. Efficiencies at Points A and C shall be within 3% of efficiencies specified for these points.
- f. Testing shall demonstrate shutoff head falls within ±10% of specified shutoff head unless District elects to waive this requirement.
- g. Pump manufacturer, if not listed above, shall in District's opinion meet the criteria for product substitution procedures specified in Section 01 63 00.
- h. At District's option, penalties described under Section 01 22 00 may be assessed for failing pumps in lieu of District rejecting installed pumps.

2.2 Materials

- A. Refer to Section 01 61 00 for basic requirements for products and materials.
- B. Pumps and attached motors shall be constructed in accordance with AWWA E103.
- C. Pumps and attached motors shall operate smoothly throughout their specified pumping range without surging, cavitation or excessive vibration.
- D. Castings shall be free from blow holes, sand holes and other flaws and shall be accurately machined and fitted to close dimensions.
- E. Coordinate motor design with pump requirements.

F. Materials for line shaft pumps shall be:

ITEM	MATERIAL	SPECIFICATION
Vertical Turbine Pumps	Varies by part	Conform to AWWA E103 Table 1 (for Water)
NSF Listing	Parts Exposed to	Provide NSF 61 listed products and conform to NSF/ANSI
	Potable Water	372 lead threshold for potable water applications.
	SUCTION CAS	ING ASSEMBLY
Suction Bell	Cast Iron	Conform to ASTM A48 Class 30
Strainer	Stainless Steel	Conform to ASTM A240 SAE Type 316
	PUMP BOW	L ASSEMBLY
Pump Bowls – Normal Water Service <150°F Working Pressures 0-150 psi	Cast Iron	Conform to ASTM A48 Class 30
Pump Bowls – Normal Water Service <150°F Working Pressures 150-250 psi	Ductile Iron	Conform to ASTM A536 Grade 60-45-12
Bowl Lining Normal Water Service <150°F	Vitreous Enamel, VitraGlass, or Fusion-Bonded Epoxy	Conform to AWWA requirements and Section 09 96 56 12-mil minimum thickness
Impellers – Normal Water Service <150°F	Aluminum Bronze	Conform to ASTM B148 alloy 952, 953, 954, 955, 956, or 958
	Stainless Steel Type 2	Conform to ASTM A276, ASTM A351, or ASTM A744 SAE Type 316 or 316L
Wear Rings on Bowls and Impellers –	Aluminum Bronze or	Conform to ASTM B148 or B271 alloy 952, 953, 954, 955, 956, or 958
Normal Water Service <150°F	Hardfaced Stainless Steel	SAE Type 316
Bowl Shaft (Impeller Shaft) – Normal Water Service <150°F TDS<1000 ppm	Stainless Steel	Conform to ASTM B582 SAE Type 416
Impeller-Lock Collets	Same Material as Bowl Shaft (Impeller Shaft)	Use for bowl shafts ≤ 1 15/16"
Impeller-Lock Thrust Washer, Key, or Snap Rings	Same Material as Bowl Shaft (Impeller Shaft)	Use for bowl shafts > 1 15/16"
Bowl Shaft (Impeller Shaft) Coupling	Same Material as Bowl Shaft (Impeller Shaft)	

ITEM	MATERIAL	SPECIFICATION
Bowl Suction and Final Discharge	Bronze	Conform to ASTM B584 Alloy C834 or C932
Bearings – Normal Water Service		Provide above and below each impeller.
<150°F	0, 15 1	0 (
Bowl Intermediate Bearings	Steel-Backed	Conform to ASTM D2000 Rubber bearing RS 90/95A
	Cutless Rubber	Use on columns ≤12 Provide above and below each impeller
	COLUMN	ASSEMBLY
Line Shaft (Water Lube-Open Line	Stainless Steel	Conform to ASTM B582 SAE Type 416
Shaft)		
Line Shaft (Water Flush-Enclosed Line Shaft) (use for pump setting >500')	Stainless Steel	Conform to ASTM B582 SAE Type 416
Line Shaft Couplings (Shafts ≤3")	Stainless Steel	Use same material as lineshaft SAE Type 304 couplings may be used with SAE Type 316 line shaft Machine from solid-bar material or use extra-heavy wall thickness seamless steel
Line Shaft Couplings (Shafts >3")	Stainless Steel	Use same material as lineshaft SAE Type 304 couplings may be used with SAE Type 316 line shaft Solid sleeve-keyed couplings with split rings
Line Shaft Bearing Sleeves	Stainless Steel	Conform to ASTM A276 SAE Type 316 Replaceable
Open Lineshaft Bearing	Rubber	
Column Bearings – Normal Water	Steel-Backed	Conform to ASTM D2000 Rubber bearing RS 90/95A
Service <150°F	Cutless Rubber or	Use on open-line-shaft columns ≤12" Provide SAE Type 304 field-replaceable stainless steel sleeve or bearing retainer on lineshaft at each bearing location. Secure to shaft with ≥2 set screws.
	Bronze	Conform to ASTM B584 Alloy C834 or C932
Bearing Retainer	Cast Iron	Conform to ASTM A48 Class 30
Column Pipe	Steel	Conform to ASTM A36 or ASTM A53 Grade A or B
Enclosing Tube (Water	Same Material as	Machine ends of each section parallel and butt-weld
Lube>500'BGS)	Column Pipe	
/	· · · · · · · · · · · · · · · · · · ·	STMENT, AND LUBRICATION
Line Shaft Adjusting Nut (VHS Hollow Shaft Motors)	Bronze	ASTM B505
Mechanical Seals	Tungsten Carbide or	
	Silicon Carbide	Carbon No 5 stationary face
Ct. #i D	On at lease	Direct-sintered Silicon Carbide rotating face
Stuffing Box	Cast Iron	ASTM A48 Class 30
Packing Gland	Stainless Steel	Conform to ASTM A276 SAE Type 316 EAD ASSEMBLY
Discharge Head Sub-Base	Fabricated Carbon	Conform to ASTM A36 Grade D or A53
	Steel	
Discharge Head and Soleplate – Normal Water Service <150°F Working Pressures 0-150 psi	Cast Iron (3"-12" discharge)	Conform to ASTM A48 Class 30 Design to elevate discharge head natural frequency above operating speed. Machine soleplate to provide sanitary well seal.
	Fabricated Carbon Steel (4"-24" discharge)	Conform to ASTM A36 Grade D or A53 Design to elevate discharge head natural frequency above operating speed. Machine soleplate to provide sanitary well seal.
Discharge Head and Soleplate – Normal Water Service <150°F Working Pressures 150-250 psi	Fabricated Carbon Steel (4"-24" discharge)	Conform to ASTM A36 Grade D or A53 Machine soleplate to provide sanitary well seal.

ITEM	MATERIAL	SPECIFICATION
Discharge Head and Soleplate –	Cast Iron (3"-12"	Conform to ASTM A48 Class 30
High-Chlorine-Concentration	discharge)	
Service	Fabricated Carbon	Conform to ASTM A36 Grade D or A53
	Steel (4"-24"	
	discharge)	
Discharge Flange on Discharge	Cast Iron	Conform to ASME/ANSI B16.1 Class 125
Head		Raised- or flat-faced
Working Pressures 0-150 psi	Ductile Iron	Conform to ASME/ANSI B16.42 Class 150
		Raised- or flat-faced
	Carbon Steel	Conform to AWWA C207 Class D, or ANSI /ASME 16.5
		Class 150
		Raised- or flat-faced
Discharge Flange on Discharge	Ductile Iron	Conform to ASME/ANSI B16.42 Class 150
Head		Raised- or flat-faced
Working Pressures 150-250 psi	Carbon Steel	Conform to AWWA C207 Class E, or ANSI /ASME 16.5
		Class 150
		Raised- or flat-faced
Flange Alignment	Pumps	Boltholes shall straddle horizontal and vertical centerlines of
		pump and discharge head.
Head Shaft	Stainless Steel	SAE Type 416 turned and ground
Flange Bolts, Nuts, and Washers	Various Steels	Refer to Section 33 05 31.
Flange Gaskets		Refer to Section 33 05 31.
		RDWARE
Fasteners, Bolts, Cap Screws,	Stainless Steel	SAE Type 316
Anchor Bolts, Nuts, Washers and		
External Hardware	1	
Pump Nameplates	Stainless Steel	SAE Type 316
		Permanently attach to discharge head frame with
		information impressed, engraved or embossed into plate
		Pump nameplates shall show Manufacturer's name, model
		and serial number, year of manufacture, rpm, horsepower,
		impeller diameter, rated flow capacity, head rating and
		NPSHR.
	DDOTECT	See below for motor nameplate data
Column Ding Lining		IVE COATINGS
Column Pipe Lining	None	
Column Pipe Coating	Fusion-Bonded	Refer to Section 09 96 56.
Column ripe Coaling	Epoxy or Epoxy	Conform to AWWA C213 and C550
	Urethane	12-mil minimum DFT
	Jionana	Do not coat bronze or stainless steel parts
Discharge Head Lining and	Fusion-Bonded	Refer to Section 09 96 56.
Coating	Epoxy or Epoxy	Conform to AWWA C213 and C550
- County	Urethane	12-mil minimum DFT
	3,00,00,00	Do not coat bronze or stainless steel parts
Bowl Assembly Exterior Finish	Fusion-Bonded	Refer to Section 09 90 00 or 09 96 56.
Coat	Epoxy or Epoxy	12-mil minimum DFT
	Urethane	
		h.

G. Materials for motors shall be:

ITEM	MATERIAL	SPECIFICATION				
	VERTICAL MOTORS					
Motor Frames	Cast Iron	Conform to NEMA MG1				
		Provide frame assignments per NEMA MG13				
Motor Terminal Boxes	Cast Iron	Conform to ASTM A48				
Screens over Openings	Stainless Steel	Required on WP1 motors 7.5-horsepower and larger				
Stator Windings	Copper					
Drive Shaft	Stainless Steel	Same Material as line shaft				
Fasteners, Bolts, Cap Screws,	Stainless Steel	SAE Type 316				

ITEM	MATERIAL	SPECIFICATION
Anchor Bolts, Nuts, Washers and		
External Hardware		
Flexible Connectors	Neoprene	Do not use flexible metal hose, either braided or unbraided.
Motor Nameplates	Stainless Steel	SAE Type 316
		Permanently attach to motor frame with information
		impressed, engraved, or embossed into plate.
		Show information required by NEMA MG1-10.39 et seq
		Show Manufacturer's name, model and serial number
		Show year of manufacture
		Show rpm, horsepower, input voltage, phase, and
		frequency,
		Show full load current and locked-rotor kVA code
		Show motor type, frame, insulation class, centigrade degree
		rise and motor connection diagram.
		Show bearing numbers for both bearings
		Show efficiency and power factor at full load, and maximum
		recommended kVAR of power capacitors to result in 90%
		power factor.

H. The following product design criteria, options and accessories are required for pumps:

ITEM	DESCRIPTION				
Pump Design Criteria				Bowl Efficiency	HP drawn at
		Q (gpm)	TDH (ft)	η	operating point
	Shutoff	0	810	n/a	n/a
	Α	590	400	75%	-
	B (BEP)	600	465	(81% min)	87.5
	С	700	380	77%	-
	Net Positive Si Available NPS	HA	7.41'		
	Minimum Wate Pump Suction	er Level over	50"		
	Pump Speed			hown are for 1770 mp speed may var	
Well Pump Setting	Pump Setting		Elevation 995.0 M	SL	
	Pump Discharg	ge Centerline	Elevation 1587.0 I	MSL	
	(SUCTION CASING	ASSEMBLY		
Column Foot Valve			Not Required		
Strainer (Well Installation)	Туре			trainer Attached to	Suction Bowl
Suction Pipe (Well Installation)			Required		
	_	PUMP BOWL AS			
Bowls	Suction Case		Threaded Cone-T		
	Connections			nine-registered fit fo nine-registered fit o	
	Impeller Bearing	ngs	Provide 1 bearing	on each side of eve	ery impeller
	Suction Case I	Bearing	Provide extra-long	suction bell bearin	g, permanently
				nclosed, and sealed	
				om sand and abrasi	ives
Bowl Wear Rings			Required on bowls ≥6" Radial Type Attach using Interference fit and Loctite or set screws		
Impeller Wear Rings			Required on impel be maintained thro recirculation) Radial Type	lers in bowls ≥8" (s oughout ring life to r erence fit and Locti	so clearances can minimize
Impellers Clean-Water or	Туре		Enclosed Vane Ba		

ITEM		DESCRIPTION
Well Applications <150°F	Keying	Ring and key or taper-lock
	Dynamic Balance	Required
Bowl Adaptor or Discharge		Provide to ensure proper transition from bowl assembly
Case		to column assembly.
		Provide extra-long support bearing
0.1 8:	COLUMN A	-
Column Pipe	Minimum Wall Thickness	0.375" (standard wall pipe) for pipe ≥12"
		For column pipe <12" use standard wall (Schedule 40) pipe for settings ≤350'bgs
		Use extra-heavy wall pipe for settings >350'bgs
	Column Pipe Connections	Butt-threaded and sleeve-coupled pipe for deep well
	Coldini i ipo colinicationo	pumps with columns 3"-14" diameter and line shafts ≤
		1"-1 15/16" diameter
	Column Pipe Design	Size column pipe meet or exceed minimum diameter
	,	and to limit head loss to <5' per 100' at rated BEP
		capacity of pump.
		Also limit velocity to <8 fps at rated capacity of pump
	Column Pipe Construction	Construct of interchangeable sections not over 10' long
		on open-line shaft deep well pumps
		Construct of interchangeable sections not over 20' long
		on enclosed-line shaft deep well pumps Use section ≤ 5' long for top and bottom sections.
	Bearing Retainer	Rigid type
	Bearing Retainer	Provide at each column joint to support lineshaft
		bearings
		Provide machine-registered fit to ensure positive
		alignment.
		On 16" and larger column sizes, weld bearing retainer
		integral to column pipe
Tension Plate		Required on enclosed-line shaft pumps to support line
L'accobe de	Live Ober 11 To a	shaft enclosure
Line Shaft	Line Shaft Type	Open on product lube pumps with pump < 500' BGS
		Enclosed on oil lube pumps or water-lube pumps with pump ≥ 500' BGS
	Line Shaft Design	Design per AWWA E103 and ANSI B58.1.
	Line onan Design	Size for expected full load horsepower, torque and
		thrust.
		Also size shaft to maintain lateral clearances required
		at shutoff head.
	Line Shaft Construction	Construct of interchangeable sections not over 10' long
		on open-line shaft deep well pumps
		Construct of interchangeable sections not over 20' long
		on enclosed-line shaft deep well pumps
		Use section ≤ 5' long for top and bottom sections. Machine abutting faces square to shaft axis with
		misalignment of threaded axis with shaft axis <0.002" in
		6"
	Adjusting Nut	Machine upper end of line shaft (head shaft) to allow
	3, 3	vertical adjustment of impeller setting to center
		impellers in bowls.
	Line Shaft Couplings	Flat-threaded, machined from solid bar stock
		Do not use tapered thread
Bearing Guides	Spacing	10' maximum intervals
		Size spacing so pump first critical speed is ≥25%
	OFALO LUBBIO : TO	higher than pump operating speed
Duman Caal-	SEALS, LUBRICATO	
Pump Seals – Normal Water Service	Туре	Mechanical Cartridge Seals / Mechanical Cartridge-
<150°F Working Pressures		Mount Pusher Seals / Mechanical Split Seals / Packing Glands
TOO I WORKING ITESSUIES	L	Loidilus

ITEM		DESCRIPTION
0-150 psi		
Pump Seals – Normal Water Service <150°F Working Pressures 150-250 psi	Туре	Mechanical Cartridge Seals / Mechanical Cartridge- Mount Pusher Seals / Mechanical Split Seals / Packing Glands
Pump Seals (Packing Type)	Stuffing Box	Minimum 6 rings for packing Provide pressure relief connection Drill and tap for grease fitting
	Packing Gland	Split style secured with non-corrosive studs and nuts Provide rubber slinger secured to shaft above packing gland
	Recirculation	Provide API Plan 13 flush plan for pressures >100 psi
Pump Seals (Mechanical Seals)	Recirculation	Provide API Plan 13 flush plan for pressures >100 psi
Lubrication on Well Pumps	Туре	Water lubricated or Water-flush enclosed line shaft
External Bowl Bearing Flushing		Not required
	DISCHARGE HEAD	ASSEMBLY
Discharge Head	Discharge Location	Above ground Locate discharge nozzle 90° to shaft axis, in lateral orientation necessary to match discharge piping. Design to elevate discharge head natural frequency >25% above operating speed. Discharge shall be integral part of head.
	Discharge Connection Flange Size	Refer to Plans
	Driver Mounting Base	Integral to pump support base flanges with machine- registered fit If access to stuffing box is required above mounting floor, supply driver support stand, stuffing box drain connection, and pressure gauge connection
	Head Style (Packing Glands)	High-profile type to allow shaft coupled above stuffing box and provided for mounting driver
	Head Style (Mechanical Seals)	Design shall facilitate replacement of mechanical seal
	Head Shaft or Top Shaft	Maximum 10' long
	Design Pressure	Design for 150% of pump discharge pressure at shutoff
	Thrust Design	Design discharge head to withstand loads due to thrust or weight of hanging elements.
	Lifting Lugs	Design to permit lifting of assembled pump, column, discharge head and motor.
	Guard Plates	Provide hinged corrosion-resistant steel guard screens over exposed shaft couplings and packing glands or mechanical seals as shown Comply with requirements of State of California Department of Industrial Relations, Division of Safety
	Drilling and Tapping	Provide tapped connection for air release valve and pressure gauge on discharge head For open line shaft well pumps, provide 2" tap.

I. The following electrical design criteria are required for electrical equipment specified in this section:

ITEM		DESCRIPTION
Electrical Work	NEC Article 505 Classification	Nonhazardous
Enclosures – Indoor Dry Locations	NEMA 250 Enclosure Rating	NEMA 12 – Industrial Use
Enclosures – Indoor Damp Locations	NEMA 250 Enclosure Rating	NEMA 12 – Industrial Use
Enclosures – Outdoor or	NEMA 250 Enclosure Rating	NEMA 4X – Watertight, Corrosion-Resistant, Stainless

ITEM	DESCRIPTION			
Wet Locations		steel		
Enclosures	Construction Lockable With powdercoat epoxy finish on steel surfaces			
	IEC 60529 Enclosure Rating for Underground Equipment IP 65 water jet			
Control Panel Mounting	Remote Mount	MCC		
Power Supply	Motor Circuit	460VAC – 3φ – 60Hz		
	Heating Circuit	120VAC – 1φ – 60Hz		

The following prod ITEM						
	VERTICAL MOTORS					
Motors	Motor Type	Squirrel cage induction conforming to NEMA MG1				
	Running Condition	Motor shall operate at rated load at ±10% of rated				
		voltage and/or ±5% of rated frequency				
	Operating Frequency	60 Hz / 60Hz maximum with VFD drive				
	Synchronous Speed	1800 rpm (4-pole)				
	Speed Control Range	0.1-1800 rpm± 0.1 / 1 rpm throughout range				
		Paced by 4-20mA input				
		Motor torques shall be sufficient to start and operate				
		pump throughout operating range from 50% to 100% of full speed.				
	Motor Nominal Horsepower	Refer to Plans				
	Efficiency	Premium Efficiency Inverter Rated (RUSI)				
	Lindency	Stamp guaranteed efficiency on nameplate				
	Locked-Rotor (Starting Inrush	Code F or G for motors ≥15 hp / Code H for 7 ½-10-hp				
	Current) Design Code	motors				
	Locked Rotor Current	Conform to NEMA standards				
	200100 Protoi Garrone	Shall be ≤650% of motor full load current				
	Duty	S1 Continuous Duty				
	Duty with VFD	S8 Continuous Operation with Periodic Changes in				
		Load and Speed				
	Drive Shaft	Vertical hollow shaft (VHS) with packing / Vertical solid				
		shaft (VSS) with mechanical seals				
		Drive shaft shall extend through sealing assembly of				
		discharge head				
	Steady Bushing	Provide on VHS vertical hollow-shaft motors				
	Coupling	Rigid flanged coupling (Type AR) (use with VHS hollow				
		shaft) / Adjustable spacer coupling (Type AS) (use with				
		VSS solid shaft to allow removal of seal without				
		removing pump or motor)				
	New Deverse Databat (NDD)	Coupling shall provide positive locking device				
	Non-Reverse Ratchet (NRR)	Required				
	Temperature Rise	NEMA Design B Rated for Operation at 40°C (104°F) Maximum temperature rise of windings measured by				
		resistance method shall be ≤ 90°C under continuous				
		operation at service factor horsepower, rated voltage,				
		and frequency				
	Safe Stall (Locked Rotor) Time	Shall exceed maximum accelerating time under worst-				
	(2000,000,000,000,000,000,000,000,000,00	case voltage conditions.				
	Service Factor	1.15				
	Insulation	Class F (155°C)				
		Size motor to limit temperature rise to Class B rise at				
		unity service factor.				
		Motor insulation on VFD-driven motors shall meet				
		inverter-duty rating requirements of NEMA MG1, Part				
		31.				
		Dip and bake totally enclosed motors in epoxy resin.				
		Completed insulation shall have resistance $\geq 1.5M\Omega$.				

ITEM	DESCRIPTION			
		Vacuum-impregnate windings on open motors with 100% solid-epoxy resins on frames ≥ NEMA Frame		
		364.		
		Completed insulation shall have resistance ≥10MΩ.		
	External Ground Connection	½" for motors >100-hp / ¾" for motors ≤100-hp		
		Bronze bolt and lock washer or bronze post connector		
		Provide threaded motor frame hole to depth ≥1½ x		
		hole diameter to ensure firm connection.		
		If necessary, bond metal pad to motor frame to provide required threaded hole depth.		
		Locate grounding means in connection box or on same		
		side of motor as main lead terminal box.		
	Overtemperature Protection	Provide automatic-reset normally closed bi-metallic		
	Motor Windings (motors <200hp)	thermal overload thermostats in each phase of motor		
		windings per NEMA MG1		
	Overtemperature Protection	Provide 6 platinum 100Ω RTD's (two embedded in		
	Motor Windings (motors ≥200hp)	each phase of motor windings) windings per NEMA MG1		
	Overtemperature Protection Motor Bearings (motors ≥200hp)	Provide 2 platinum 100Ω RTD's (one on each motor bearing.) windings per NEMA MG1		
	Control Leads on	Provide color coded control leads and terminate in		
	Overtemperature Protection Devices	separate conduit box.		
	Lifting Lug	Provide on motor, sized to permit lifting of motor.		
	Other Requirements	Insulate and brace windings for full voltage starting and		
		operation.		
		Motor nameplate horsepower shall not be exceeded anywhere on pump curve.		
	Space Heaters (Outdoor	120V - 1φ cartridge or flexible wrap-around type		
	Applications)	condensation heaters		
	Junction Box	Motor shall have oversized power junction box and		
		auxiliary junction box for overtemperature switch and		
Motor Bearings	Bearing Type	space heater circuit. Anti-friction type designed to resist radial and thrust		
Wiotor Dearings	bearing Type	loads throughout motor operating range.		
	Bearing Life (at highest rated motor speed and total load)	ANSI/AFBMA 9 L ₁₀ ≥ 50,000 hours		
	Downthrust Capacity	High-thrust bearings		
	Upthrust Capacity	Design bearings for 30% momentary upthrust		
	Lubrication	Oil-bath upper bearing		
		Oil- or grease-lubricated lower bearing		
		Prelubricate at factory Provide oil lubrication fittings and removable oil drain		
		plugs		
Motor Enclosure	Enclosure	TEFC Totally Enclosed Fan Cooled		
Motor Connection Boxes	Design	Bolted with adequate space for connections		
	Gaskets	Provide gaskets between box and housing and		
		between box and cover		
	Markings	Permanently mark motor leads in agreement with connection diagram		
Vibration Limit		≤ 0.002" peak-to-peak unfiltered when measured per		
		MG1 20.54		
Vibration Control		Attach conduits and electrical connections to motor		
		with slack flexible connectors located as near to		
		mechanical equipment as possible.		
		Where possible, install connector in pipe parallel to motor shaft.		
Coatings	Epoxy Enamel	Refer to Section 09 90 00.		
		Coat fabricated ferrous surfaces on inside and outside		

DESCRIPTION
surfaces except machined surfaces, shafts, bearings, register fits, stainless steel surfaces, moving parts, and nameplates. Coated surfaces shall include exterior surfaces below sole plate, bottom surfaces of head and sole plate, and interior wetted surfaces not excluded above. Coat machined, polished, and non-ferrous surfaces with corrosion-prevention compound. Touch-up coated surfaces damaged during shipping. Do not field-paint motors unless motor warranty permits.

- K. Motor torque and slip characteristics shall be as recommended by Pump Manufacturer, NEMA design letter, and as specified.
- L. Motors shall start and accelerate driven equipment to design conditions without exceeding specified design requirements.
 - 1. Where motor horsepower specified above or shown on Plans appears undersized for pump specified, refer conflict to District's Representative during submittal process for resolution.
- M. Motors on VFD-driven pumps shall be compatible with VFD drives throughout expected range of operating speeds.
 - 1. Insulation voltage impulse levels shall meet NEMA 1, Part 31.

PART 3 - EXECUTION

The Contractor shall submit installation and startup and testing plans as the initial step in execution.

3.1 Installation Plan

- A. Contractor shall coordinate with the pump supplier to develop an installation plan.
 - a. Submit draft installation plan 14 day prior to schedule install activities
 - b. Participate in a teleconference with TVWMD and the pump supplier to review the draft installation plan.
 - c. Finalize the installation plan based on teleconference comments
 - d. Submit final plan to TVMWD

3.2 Startup and Testing Plan

- A. Contractor shall coordinate with the pump supplier to develop a startup and testing plan.
 - a. Submit draft startup and testing plan 14 day prior to schedule install activities
 - b. Participate in a teleconference with TVWMD and the pump supplier to review the draft startup and testing plan.
 - c. Finalize the startup and testing plan based on teleconference comments.
 - d. Submit final plan to TVMWD

3.3 Preparation

- A. Make field measurements needed to install pumps before submitting Shop Drawings or ordering.
 - 1. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.
- B. Verify structures, piping, and equipment are compatible.
- C. Prior to installation, provide site visit and up to 4 hours of time on-site by pump Manufacturer's factory-authorized representative to:

- 1. Ensure equipment shipped to job-site has been handled according to Manufacturer's recommendations and is in good working order.
- 2. Ensure equipment has been stored and protected according to Manufacturer's recommendations.
- 3. Inspect and verify structures or surfaces on which the equipment will be mounted have no defects which might adversely affect installation.
- D. Promptly report to District, in writing, defects which may affect Work.
 - 1. Provide copy of Manufacturer's field report to District.

3.4 <u>Installation</u>

- A. Refer to Section Refer to Section 01 73 00 for execution and installation requirements.
- B. Furnish and install pumps at locations shown on Plans and Submittals.
- C. The following installation standards shall be followed:
 - 1. Applicable OSHA and Cal OSHA regulations
 - 2. Applicable building, fire, plumbing, and electrical code requirements
 - 3. Manufacturer's installation and warranty requirements
- D. Refer variances between above documents and Contract Documents to District's Representative.
- E. Install pumps to tolerances recommended by Manufacturer.
 - 1. Unless otherwise shown, install pumps true and plumb using precision gauges and levels.
- F. Construct equipment sub-base plates (soleplates), support pedestals and pump bases as follows:
 - 1. Welding shall conform to ASME Boiler and Pressure Vessel Code, §VIII
 - 2. Grout soleplate to receive pump discharge head in place.
 - Mounting plate shall facilitate removal and reinstalling pumps without releveling or grouting.
 - 3. Level equipment support pedestal under pump base plate in both directions.
 - 4. Ensure holddown bolt locations are flat and level.
 - 5. Mount machine bases of rotating equipment on bases and level in both directions.
 - a. Rotating machinery shall bear firmly on mounting bases with equal loading at each support.
 - 6. Level machine feet on bases and align shafts between driver and driven unit using jackbolts and stainless steel precision cut shims.
 - 7. Use stainless steel precut shims to provide firm solid adjustable link between baseplate and machine pad
 - 8. Generously size shims to provide solid support at each anchor bolt location.
 - 9. Provide shims at each anchor bolt.
 - a. Blocks and shims shall be square shape with "U" cut out to allow blocks and shims to be centered on anchor bolts.
 - 10. After completing leveling and base alignment and before grouting, tighten anchor bolts to proper torque value.
- G. Install pumps as follows:
 - 1. Support piping independent of pump.
 - 2. Plug taps and orifices not required for pump operation and controls.
 - 3. Check and align unit components.
 - 4. Make electrical connections in conformance with electrical plans and specifications.
 - 5. Connect unit heaters per Manufacturer's recommendations.
 - a. Make final wiring connections with short lengths of moisture proof flexible conduit.
 - b. Provide installation free from objectionable noise when heater is in operation.
 - 6. For each pump, neatly place copper pipe to convey leakage to nearest drainage inlet.
 - a. Provide compression fittings on copper pipe shall to allow disassembly
 - 7. Furnish and apply initial supply of grease and oil, recommended by Manufacturer.

3.5 Field Quality Control

A. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Pumps and Motors	Lateral Clearance	Impeller lift to measure clearance and verify lateral clearance is provided	1 test each pump with >50' of line shaft	Contractor	Contractor
	6-hour Field Performance Test to demonstrate compliance to Contract Documents and Manufacturer's printed literature	Conform to HI 14.6 and requirements below to extent possible in field. Tests shall be witnessed by pump Manufacturer's factory-authorized representative who shall certify installed pumping system complies with Contract Documents and Manufacturer's warranty requirements, that interlock and control features work properly, and that no drive equipment or shafting is overloaded at any point on published pump curve.	One 6-hour test each pump	Contractor	Contractor
	Hydraulic Performance and 72-hour System Demonstration	Refer to Section 01 79 00. 6-hour field performance tests may be part of 72-hour system demonstration.	1 for pumping system	Contractor	Contractor
	Motor Current	Record current in each phase of each motor and include in O&M manual. Repair or replace motor or motor-driven equipment if current exceeds motor nameplate FLC value.	Each phase of each motor	Contractor	Contractor
	Vibration	Running test with vibration analyzer per ANSI/HI 14.6 and requirements below. Do not exceed published ANSI/HI 2.4 standards or 0.20 in/sec RMS in absence of HI standards.	1 test each pump during 6-hour field performance test On VFD-driven pumps, test each pump at four 100 rpm increments.	Contractor	Contractor
	Installation, Noise, Odors, Heat and Leakage	Visual inspection of finished installation	1 inspection	District	Contractor
	11-month Warranty Inspection	Demonstrate compliance to Contract Documents and Manufacturer's printed literature	1 test	District	Contractor

- B. Field performance testing shall conform to the following:
 - 1. Verify Work conforms to Contract Documents
 - 2. Field test using job-supplied flow meters and pressure gauges
 - 3. Bump motor to ensure motor is connected for proper rotation.
 - 4. Conduct infrared survey/testing of vertical turbine pump/motor assemblies.
 - 5. Verify controls, alarms and safety shutdowns are operational.
 - 6. Verify proper pump sequencing occurs.
 - 7. Verify valves, including check valves, open and close properly.
 - 8. Make adjustments required to place equipment in proper operating condition and to optimize operation.
- C. Vibration testing shall conform to the following:

- 1. Provide services of specialist in this field to conduct tests.
- 2. Factory test and certify each motor operating without pump.
- 3. Field test and certify each pump.
- 4. Statically and dynamically balance rotating parts on pumps and motors before testing.
- 5. Test each installed pump and motor at each operating speed for compliance with specified vibration and critical frequency limits.
- 6. To determine critical frequency Perform bump tests on each pump in each of 2 orthogonal planes 1 of which shall include discharge elbow.
- 7. Determine natural frequency of pump support structure at each pump using bump test and analyzer with frequency finder.
- 8. Perform vibration measurements at upper motor bearing of each pump at each operating speed.
 - a. Provide measurements in each of 2 orthogonal horizontal directions, 1 of which shall be in plane of greatest vibration and in addition provide measurement in vertical (pump axial) direction.
- 9. Conduct vibration level tests on each pump with pump operating at its rated capacity and motor/bearing temperatures stabilized.
- 10. Vibration when measured in direction of maximum amplitude shall not exceed limits given in latest ANSI/HI nomograph for pump.
- 11. Natural frequency of pump drive train shall not be within ±25% of drive train's calculated critical speed at any point in operating range.
- 12. Adjust or replace units and/or modify dynamic balance, if required to meet specified vibration limits or to correct excessive vibration.
- 13. Provide gussets, stiffeners, additional mass, or other measures to conform to vibration limitations.
- 14. If installed pump vibrations exceed HI 2.4 thresholds, modify discharge head and other pumping components to correct deficiencies at no additional cost to District.
- D. Provide services of pump and motor Manufacturers' factory-authorized representatives onsite to witness and inspect startup of pump operation and perform the following services:
 - 1. Provide technical assistance to Contractor during installation of pumping units.
 - 2. Check alignment and inspect installation prior to final grouting and start-up.
 - 3. Before startup, check equipment for proper lubrication, alignment, rotation, and freedom from excessive vibration.
 - 4. Notify Contractor and District of irregularities of installation which might render pump Manufacturer's warrantee null and void
 - 5. Present District with punch list detailing problems noted and suggested remedial actions.
 - 6. Prior to initial start-up, provide written statement equipment has been installed in accordance with Contract Documents and Manufacturer's installation and warranty instructions and is ready to be placed into operation.
 - 7. Assist in initial start-up, adjustments and field testing, including vibration testing.
 - 8. Test-operate system in District's presence and verify equipment conforms to specified requirements.
 - 9. If measured flows at above tabulated pump heads are >5% below flows obtained on factory test, adjust impellers or provide new impellers or otherwise repair or replace pumps or calibrate meters or pressure gages.
 - 10. Assist in correction of defective or faulty Work before and after acceptance by District.
 - 11. Re-visit job-site as often as necessary until all deficiencies are corrected and installation and operation is accepted by District.
 - 12. Prepare report on pump performance for submittal to District.
- E. Conduct field performance test in presence of District's Representative and District's personnel after ≥ 24 hours of field operation have occurred to burn in system.
- F. If field performance tests show excessive vibration or fail to demonstrate compliance with requirements of Contract Documents or certified curves furnished, District shall have right to either:
 - 1. Decline acceptance of failing pumps and require Contractor to replace them, or

2. Deduct an agreed upon allowance for District's incremental cost of additional power from payment due Contractor.

3.6 <u>Field Training of District's Personnel</u>

- A. In addition to the above, provide services of pump Manufacturer's factory-authorized representative on-site for ≥8 man-hours (travel time excluded) to provide classroom instruction of District's personnel in proper recommended lubrication, operation and maintenance procedures as well as procedures for proper lockout out of each energy source.
- B. The following handouts shall be provided by Manufacturer's factory-authorized representative to attendees during classroom instruction:
 - 1. List of actions (or inactions) by District which render Manufacturer's warranty null and void.
 - 2. Written description of proper lubrication procedures.
 - 3. Written list of required scheduled maintenance including recommended service intervals to ensure warrantee remains valid and to ensure equipment remains functional.
 - 4. Written description of procedures for lockout of each energy source.

3.7 Spare Parts

A. Furnish the following spare parts for each pump:

QUANTITY	PART
1	Set any special tools or test equipment required for proper maintenance and service
1	Bowl assembly for each style and size of vertical turbine pump
1	Sets pump bearings
1	Sets shaft sleeves
1	Mechanical seal / Set packing
2	Sets gaskets
2	Sets O-rings
1	Set wear rings
1	Duplicate nameplate for pump and motor

END OF SECTION

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T-SECTION 33 13 00

DISINFECTING WATER UTILITY PIPELINES

PART 1 - GENERAL

1.1 Work Included

- A. Disinfection, flushing, bacteriological testing, and dechlorinating of potable water mains.
 - 1. These facilities include:
 - a. New pipelines
 - b. Existing pipelines depressurized to < 20 psi.
- B. Plan construction activities to allow and facilitate flushing, disinfection, testing, and dechlorinating of new water facilities, and existing water facilities removed from service during construction and restored to service prior to final acceptance.
- C. Obtain permits required to complete Work specified herein.

1.2 Related Work

- A. Section 01 22 00: Unit Prices
- B. Section 01 33 00: Submittal Procedures
- C. Section 01 40 00: Quality Requirements
- D. Section 01 50 00: Temporary Facilities and Controls
- E. Section 01 61 00: Common Product Requirements
- F. Section 01 65 00: Product Delivery Requirements
- G. Section 01 66 00: Product Storage and Handling Requirements
- H. Section 01 73 00: Execution
- I. Section 33 08 11: Pressure Testing and Flushing of Water Utilities

1.3 System Description

- A. Disinfect pipe and wells to meet AWWA and public health standards.
- B. Disinfect other water facilities to meet AWWA and public health standards.
- C. Dechlorinate to meet AWWA and public health standards.
- D. Discharge of chlorinated water into watercourses or surface waters is regulated by National Pollutant Discharge Elimination System (NPDES) requirements.
 - 1. NPDES Permit requirements are specified in Supplemental General Conditions §6.11.1.

1.4 Quality Assurance

A. Use adequate numbers of skilled workmen trained and experienced in necessary trades and crafts and completely familiar with specified requirements and methods for proper performance of Work of this section.

1.5 References

- A. Reference publications listed below and in various sections form part of specification to extent referenced. These are referred to within text by basic designation only.
 - 1. AWWA B300 Hypochlorites
 - 2. AWWA B301 Liquid Chlorine
 - 3. AWWA C651 Disinfecting Water Mains
 - 4. AWWA C655 Field Dechlorination
 - National Pollutant Discharge Elimination System Permit (NPDES) Los Angeles Regional Water Quality Control Board (LARWQCB) – General National Pollutant Discharge Elimination System Permit and Waste Discharge Requirements for Discharges of Hydrostatic Test Water to Surface Waters in Coastal Watersheds of Los Angeles and Ventura Counties, Los Angeles Region Order No. R4-2012-0175, NPDES Permit No. CAS004001, and most recent orders or amendments.
 - 6. Standard Methods for Examination of Water and Wastewater

1.6 Submittals

3-19-dp

A. Furnish the following submittals.

SUBMITTAL	DESCRIPTION	
Disinfection, Flushing	On District's request, submit detailed plan showing how Contractor intends to test,	
and Dechlorinating Plan	disinfect and flush pipeline and dechlorinate discharge from flushing operation.	
	Plan shall show proposed locations of discharge during testing.	
	Plan shall identify test locations along new pipeline.	
	3. Plan shall show appurtenant fittings, fixtures, and testing devices.	
	4. Plan shall include flushing velocity calculations showing flowrates required to achieve specified velocities.	
	5. Plan shall include head loss and elevation loss calculations to determine head is	
	sufficient to produce required discharge through all segments from injection point	
	to discharge point, including pipe, fittings, hoses, and dechlorination diffusers.	
	6. Plan shall include MSDS sheets for disinfection and other chemicals used.	
Engineering Calculations	Submit calculation of volume and rate of discharge of water to be discharged	
Written Permission to	Submit from owner of sanitary sewer prior to discharge of flushing water into sewer.	
Discharge into Sewer	Submittal shall include requirements for treatment of flushing water prior to sewer	
	discharge, estimate of expected maximum discharge rate of flushing flow and	
	analysis of sewer's capacity.	
Written Permission to	Submit from owner of storm drain prior to discharge of flushing water into storm	
Discharge into Storm	drain. Submittal shall include requirements for treatment of flushing water prior to	
Drain	storm drain discharge, estimate of expected maximum discharge rate of flushing	
	flow and analysis of storm drain's capacity.	
Disinfection Log	Submit documentation of dosing rate, chemical used, time of dosing, duration, and	
	name and signature of person performing dosing.	
Laboratory Report for	Submit report from District-accepted testing laboratory	
Disinfection Testing		

B. Refer to Section 01 33 00 for definition of requirements for reports and certificates of compliance.

1.7 <u>Delivery, Storage, and Handling</u>

- A. Refer to Sections 01 65 00 and 01 66 00 for delivery, storage, and handling requirements.
- B. Strictly follow Manufacturer's instructions and warranty requirements and MSDS requirements for delivery, storage, and handling of chemicals and equipment.

1.8 Unit Prices

A. Refer to Section 01 22 00 for measurement and payment clauses for disinfecting of water utility distribution systems.

PART 2 - PRODUCTS

2.1 Acceptable Manufacturers

A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Chlorination and	Aqua Backflow	Riverside, CA 909 598-7251
Testing Contractor	Mattchlor, Inc.	El Monte, CA 626 443-5034
	Morr-is Tested	Yorba Linda, CA 714 979-1573
	Southwest Chlorination, Inc.	Agoura Hills, CA 818 707-4437
	Accepted equal	
Chlorine Residual Test	Hach Company Chemical Division	Loveland CO 800 227-4224
Kits	Orbeco-Hellige	Sarasota, FL 800 922-6410
	Accepted equal	
Bacteriological Testing	Advanced Technology Laboratories	Signal Hill, CA 562 989-4045
Laboratory	Eurofins Eaton Analytical	Monrovia, CA 626 386-1100
	Accepted equal certified to perform HPC and	
	coliform testing in drinking water	

2.2 Materials

- A. Furnish labor, potable water, chemicals, and equipment necessary to complete disinfection process and obtain, transport, and test samples.
- B. Contractor shall be solely responsible for safe and proper transportation, storage and handling of chlorine compounds or other hazardous chemicals used for disinfection.
- C. Only chlorine from hypochlorite solution will be allowed.
 - 1. Tablets may be allowed upon written permission from District.
 - 2. Do not directly inject chlorine gas.
 - 3. Hypochlorite solutions shall be pre-mixed and fed to tanks or piping and not placed dry.
- D. Containers and equipment used in sampling shall be clean and free of contamination.
 - Obtain sampling bottles from testing lab along with instructions for handling.
- E. Contractor shall be fully responsible for safe and proper transportation, storage and handling of sodium thyosulfate compounds or other hazardous chemicals used for dechlorination.
- F. Other appropriate means and methods of dechlorinating water flushed from pipe may be used with acceptance by District's Representative.
- G. Materials used for disinfection shall be:

ITEM	MATERIAL	SPECIFICATION
Water	Potable Water	Purchase from District through metered connection.
		Refer to Section 01 50 00.
		Request water service at least 48 hours in advance of
		using water for chlorination.
Disinfectants	Liquid Chlorine Solution	Conform to AWWA B301
		Inject with solution feed chlorinator and water booster
		pump at measured rate.
	Sodium Hypochlorite	Conform to AWWA B300
	(Solution)	Dilute in water to desired concentration, and inject with
		pump at measured rate.
	Sodium Hypochlorite Tablets	Shall have average weight of 0.009 lbm each
	and Adhesive	Shall contain ≥ 70% available chlorine.
		Adhesive shall be NSF 61 listed and shall not impart
		taste, odor, or detrimental compounds to water supply.
		Store tablets in tightly closed containers not accessible to
		children or unauthorized personnel.
Chlorine Residual Test Kit		Use medium-range drop-count titration kit or orthotolidine
		indicator comparator with wide-range color discs.
		Kit shall be capable of determining chlorine concentration
		in range 1.0-25.0 mg/l.
		Maintain adequate quantity of test kits in working order
		and available for immediate residual tests at sampling
		points.

PART 3 - EXECUTION

3.1 Preparation

- A. Flush mains and services with potable water (or water as otherwise accepted by District and regulatory agencies) after completion of pressure test.
- B. Follow requirements of District-accepted disinfection, flushing, and dechlorinating plan by flushing mains and services with potable water after completion of pressure test.
 - 1. Provide ≥72 hours advance notification to District of flushing activities discharging <1 acre-ft (325,800 gallons) of water.
 - 2. Provide ≥7 Calendar Days advance notification of flushing activities discharging ≥1 acreft (325,800 gallons) of water.
 - 3. Provide sufficient quantity of suitable outlets at ends of lines being flushed in addition to those shown on Plans to permit flushing of pipes with water at velocity meeting requirements of Section 33 08 11 over their entire length.

- 4. Outlets provided shall meet requirements for fittings specified for type of main constructed.
- 5. Velocity through outlets and fittings shall be ≤25 fps during flushing.
- 6. Construct drainage facilities so water pipelines cannot be contaminated through flushing outlets.
- C. Provide hoses, fittings and equipment to direct flushing water to established point of discharge such as gutter and storm drain inlet or natural drainage channel to prevent damage to public or private property and to prevent creating a public hazard.
 - 1. If flushing water must be discharged into traffic lanes, set up traffic control in accordance with requirements of agency having jurisdiction over public right-of-way.
 - 2. Schedule flushing in or adjacent to public streets during periods of reduced traffic volume.
- D. Provide and pay for flushing water.
- E. Provide and pay for methods for discharge of water, including associated costs and permits.

3.2 Pipeline Disinfection

- A. The following standards shall be followed:
 - 1. AWWA C651 Disinfecting Water Mains
 - 2. AWWA C655 Field Dechlorination
- B. Following pressure testing and flushing described in Section 33 08 11, pipeline disinfection shall proceed as follows:
 - 1. Where existing services are not to be disinfected, shut off each service connection served by main being disinfected at curb stop before applying water to main.
 - 2. Flush pipelines before disinfection.
 - 3. Disinfect pipelines, valves, hydrants, new service laterals, fittings, tanks and other surfaces exposed to water in accordance with AWWA C651, except as modified herein.
 - a. Disinfect pipelines ≤10" by either direct chlorine solution injection or using sodium hypochlorite tablets.
 - b. Disinfect pipelines ≥12" by direct chlorine solution injection.
 - c. Disinfect steel pipelines by direct chlorine solution injection.
 - d. If groundwater is encountered and contaminates mains, or if mains are not free from dirt, disinfect by direct chlorine solution injection.
 - 4. Disinfect with sodium hypochlorite tablets as follows:
 - a. Attach tablets using NSF61-compliant adhesive to inside soffit of pipe lengths being laid.
 - b. Minimize use of adhesive and apply to 1 side of tablet only.
 - c. Number of tablets shall be:

PIPE NOMINAL DIAMETER	NUMBER OF HYPOCHLORITE TABLETS PER LENGTH OF PIPE	
4"	2	
6"	2	
8"	3	
10"	6	

- d. Where water main is coated for disinfection, plugs and outlets shall be similarly coated.
- e. For mains ≤ 10" diameter, disinfection and hydrostatic tests may occur concurrently.
- f. If leakage and repairs are necessary, or if pipeline fails bacteriological tests, repeat disinfection of pipeline by injecting chlorine solution.
- 5. Disinfect with continuous feed chlorine solution injection as follows:
 - a. Expel air from main and services during filling.
 - b. Direct chlorine solution may be made with liquid chlorine, calcium hypochlorite in solution, or water-mixed sodium hypochlorite solution.
 - c. Inject chlorine solution at beginning of section to be chlorinated through corporation stop, hydrant, or District-accepted connection to insure treatment of entire system being disinfected.

- d. Introduce potable water into pipeline at constant measured rate.
- e. Proportion rate of potable water and chlorine solution injection into mains to produce dosage of 50-100 mg/l in all sections of new pipeline, new services, and appurtenances.
- f. Check concentration at points downstream periodically during filling to verify sufficient chlorine is being added.
- 6. During disinfection, operate valves, hydrants, and other accessories.
 - a. Ensure no chlorinated water enters active pipelines.
 - b. Ensure chlorine concentration in contact with copper is ≤ 100 mg/l
- 7. Confirm chlorine residual as follows:
 - a. Retain treated water within system for ≥24-hours.
 - b. At end of retention period chlorine residual shall be ≥ 25 mg/l in all sections disinfected.
 - c. If tests are not satisfactory, provide additional disinfection as required until tests are passed to District's satisfaction.
 - d. Do not allow chlorinated water to remain in contact with internal waterway ports of pumps, valves, and sensor line assemblies for longer than necessary.
 - e. Keep adequate chlorine residual testing and indicating apparatus available on site throughout disinfection period.
- 8. After chlorination, flush water from line at its extremities until replacement water tests of water leaving pipe are within 0.5 mg/l of replacement water.
- 9. After final flushing restore pipe.
 - a. Remove temporary disinfection and test facilities, including test bulkhead and temporary blowoffs.
 - b. Plug flushing fittings with devices intended for this purpose and rated at pressure class of pipe.
 - c. Restore pipe coating.
- B. Perform bacteriologic sampling as follows:
 - 1. Per AWWA C651 §5.1.1.1 Option A, take 2 sets of samples ≥ 16 hours apart, and submit them to District-accepted laboratory, or
 - 2. Per AWWA C651§5.1.1.1 Option B, allow pipeline to sit for ≥ 16 hours with no water use, then collect 2 sets of samples 15 minutes apart while sample taps are left running
 - 3. Passing both sets of bacteriological tests shall be achieved prior to placing pipeline or facility into service.
 - 4. If initial chlorination fails to produce 2 consecutive sets of passing bacteriological tests, repeat chlorination until 2 consecutive sets of passing bacteriological tests are achieved.
 - 5. Samples of water for specified bacteriologic test shall be taken from each end of disinfected main (located downstream of point of introduction of chlorine disinfectant).
 - a. For mains over 1,200' long, AWWA C651 §5.1.1.3 requires additional samples be taken at intermediate points so at least 1 sample is taken for each 1,200' of main.
 - b. If trench water has entered new pipeline during construction, or if, in opinion of District's Representative, excessive dirt or debris have entered new pipeline, AWWA C651 §5.1.1.3 requires taking bacteriological samples at intervals of approximately 200' to extent such sampling is possible.
- C. Satisfactory bacteriological results shall be:
 - 1. No total or fecal coliform.
 - Heterotrophic plate count (HPC) < 500CFU (colony forming units) per ml per AWWA C651 §5.1.4.
 - 3. Presence of chlorine residual.
- D. Dechlorinate and remove pollutants from water flushed from water mains where discharging or draining to gutters, streets, storm drains or constructed or natural drainage channels in accordance with AWWA C655 and NPDES Permit applicable for pipeline flushing.
 - 1. Water flushed from water mains and spread on site with no runoff does not require dechlorination.

- E. Pipelines passing disinfection bacteriological testing shall be placed into service within 72 hours from date of sampling, or shall be resampled and retested prior to being placed into service.
- F. Where connecting to existing potable water system, connect using sanitary handling procedures including:
 - 1. Before installing, swab or spray interior surfaces of pipe and fittings used to make connections with 1% sodium hypochlorite solution.
 - 2. Begin thorough flushing as soon as connection is completed and continue until all discolored water is eliminated.
- G. Connect service laterals as follows:
 - 1. After satisfactory pipeline disinfection, flush corporation stop and service lateral.
 - 2. After flushing, connect service lateral back into service.
 - 3. If service lines are installed prior to placing pip

3.3 Field Quality Control

- A. Sequence of testing shall ensure discharge of contaminated water does not occur into facilities previously decontaminated, tested and verified as decontaminated.
- B. The following test sequence is recommended:
 - 1. Satisfactorily pass hydrostatic pressure testing on new piping.
 - a. Perform pressure test on piping prior to installing corporation stops. (Plug type stops are only rated to 80 psi.)
 - b. Connect existing service laterals to pipeline
 - c. Place corporation stop in closed position to prevent debris or contamination from entering existing service laterals during construction.
 - d. Flush and disinfect pipeline.
 - e. Pass bacteriological test for pipeline with all service corporation stops in closed position
 - f. Pass bacteriological test for each new service.
 - g. Pass bacteriological test for each existing service where corporation stop was not closed during main flushing and disinfection.
 - h. After passing bacteriological test on main and services, connect pipeline to system.
 - i. Restore service to customers.
 - 2. If connections of services to mains are left open before pipeline clears hydrostatic and bacteriologic testing, Contractor shall satisfactorily pay for and pass bacteriologic test at each service line before restoring service to customers.

C. Field testing shall include:

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
Pipe	4-hour Hydrostatic Pressure Test	Refer to Section 33 08 11	All pipe sections	Contractor (District's Representative will observe and record results)	Contractor (District's Representative will observe and record results)
Pipe Disinfection	25 ppm Chlorine Residual after 24 hours	Standard Methods of Examination of Water and Wastewater	All pipe sections	Contractor	Contractor
	Bacteriological Contamination	AWWA C651 §5 "Verification" and Standard Methods of Examination of Water and Wastewater	All pipe sections at maximum spacing of 1,200'	Contractor	Contractor
Dechlorination	Residual Chlorine Level	AWWA C655 §5 "Verification"	As required to meet local health	Contractor	Contractor

ITEM	TEST FOR	TEST STANDARD (ASTM OR OTHER TEST STANDARD)	FREQUENCY	FIRST TEST PAID FOR BY	RETESTS PAID FOR BY
			agency requirements, but at least 1 measurement per discharge incident		

END OF SECTION

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SECTION 40 00 00 - INSTRUMENTATION GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 APPLICABLE SECTIONS

A. The General Conditions, Supplementary General Conditions, alternates and Addenda, applicable drawings and the technical specification herein shall apply to work under this Section.

1.02 SCOPE

- A. It is the intent of this specification to set forth the minimum acceptable requirements for the design, construction, and vendor support, requirements for the controls panels and instrumentation herein specified.
- B. Furnish all labor, material, and equipment associated with the fabrication of the new control panels and associated instrumentation complete in strict accordance with this section of the specification and applicable drawings and subject to the terms and conditions of the contract.
- C. Install, calibrate, and perform functional loop tests prior to plant start up. Start up of instrumentation to coincide with the mechanical equipment and process start up as scheduled by the owner, engineer and general contractor.
- D. Provide owner with any required operator and maintenance training by factory authorized representatives.

1.03 WORK INCLUDED

A. All instruments shown on the contractor supplied instrument schedule drawing and all control panels shown on contractor supplied electrical and control equipment schedule drawing.

1.04 SHOP DRAWINGS/SUBMITTALS

- A. Furnish Updated S20 instrumentation specification sheets indicating exact make, model and part number of instrument to be supplied.
- B. Furnish manufacturers specifications and literature on all instruments to be supplied.
- C. Furnish complete working shop drawings of all control systems including individual loop wiring diagrams for each instrument to be supplied. Reference design documents for sequence, basic components and suggested piping and wiring. Review the project with the Engineer prior to making submittal. Submit manufacturer's data sheets for all equipment, devices and materials.
- D. After initial review, make corrections requested and resubmit in clean format. Work only from final review set.
- E. Maintain record drawings in the field. Clean up originals at completion of work and resubmit for Owner's use in operation of the systems.

1.05 OPERATION AND MAINTENANCE MANUALS

- A. O&M manuals shall comply with other sections of this specification. Manuals should include the following:
 - 1. Full drawn size as built loop diagrams, schematics and control diagrams indicating all conductor information, connection information, and device identification.
 - 2. As built S20 specification sheets
 - 3. Calibration sheets
 - 4. Identification of and lists of all replaceable parts
 - 5. Periodic service requirements
 - 6. Start-up procedure
 - 7. Fault reset instruction
 - 8. Factory manuals
- B. Prior to start up the contractor shall provide owner and owners integrator with items A, B and C.

1.06 WARRANTY

- A. The vendor shall furnish a written warranty consisting of the following:
 - 1. Warranty parts and labor for two years after start up.

PART 2 - PRODUCTS

2.01 WIRING

- A. All control wiring, 120 volt and below shall be installed in conduit and wiring boxes. The installation of conduits into control panels shall not permit water to enter the control panels from the conduit.
- B. All analog signals shall be terminated on separate terminal blocks from other control conductors. Analog signals should be shielded type conductor as called for on drawings. The shield on each individual conductor should be terminated at one end only in order to prevent ground loops.
- C. All conductors in control panels shall be run within wireways. Each conductor shall be labeled and indicated on as built control drawings. One copy of such as-builts shall be affixed to inside of each control panel.
- D. Contractor shall use care to not exceed the recommended bending radius of all cables.
- E. Contractor shall install and label all termination points for external wiring. This labeling shall coordinate with control as-built drawings.
- F. Use no wire smaller than #14 AWG for 120 volt power and #16 AWG for 120 volt control wiring. Use no wire smaller than #20 AWG for DC voltage or current signal wiring.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Field mounting and conductor connections shall be provided by the contractor. Piping, tubing and process connections shall be provided by the contractor.
- B. Installation shall be done per the instrument manufacturer's specifications and project drawings and specifications. Any discrepancies shall be brought to the attention of the Owner's engineer for resolution.

3.02 CALIBRATION

- A. All instruments shall be calibrated using the manufacturers recommended calibration procedures and equipment.
- B. All analog instruments shall be calibrated or tested with three process data points.
- C. Factory calibrated equipment shall be tested to verify calibration.
- D. Contractor shall supply owner with a written calibration report on each instrument. Calibration reports shall indicate:
 - 1. Instrument by tag Number
 - 2. Test method used
 - 3. Test equipment used
 - 4. Numerical test results (preferably graphed)
 - 5. Date of test
 - 6. Technician

3.03 FUNCTIONAL LOOP TEST

- A. Contractor shall notify Owner in advance of final loop test. Final loop test shall take place with the participation of Owner, Owner's integrator and engineer.
- B. Owner shall approve final loop check procedures and sign off on check out.
- C. Loop check shall be from instrument to HMI screen indication with actual process connection simulating two or three data points per instrument.

END OF SECTION

SECTION 40 05 13 – COMMON WORK RESULTS FOR PROCESS PIPING

PART 1 - GENERAL

1.01 GENERAL CONDITIONS

- A. The General Conditions apply to all work of this specification, which shall be done as shown on the plans, and as specified, and shall be properly coordinated with work in other Specifications.
- B. The DRAWINGS and these specifications are complementary to each other; what is called for by one shall be as binding as if called for by both. If there is any conflict between what is shown on the DRAWINGS and what is written in the specifications, the details described on the DRAWINGS shall take precedence and the CONTRACTOR shall communicate the conflicts to the ENGINEER in a timely manner.

C. Safety

1. The CONTRACTOR shall be familiar with, and shall at all times conform to, the regulations of the "OSHA General Industry Occupational Safety and Health Standards," "OSHA Safety and Health Regulations for Construction," and other applicable state and municipal standards and regulations.

D. Protection of Work Area

- 1. The CONTRACTOR shall be familiar with possible/potential utilities that may impact construction work, and plan work accordingly.
- 2. The CONTRACTOR shall verify the possible locations for all underground utilities before beginning excavation work for pipe installation.
- 3. The CONTRACTOR shall protect existing site improvements from damage during construction of underground pipeline.
- E. Types of pipes and pipe fittings specified in this section include the following:
 - 1. Steel Piping
 - 2. Copper Piping
 - 3. Cast-iron Pressure Piping
 - 4. Cast-iron Soil Piping
 - 5. Grooved Joint Piping
 - 6. Miscellaneous Piping Materials/Products.
- F. Pipes and pipe fittings furnished as part of factory-fabricated equipment are specified as part of equipment assembly in **Division 43** sections.

1.02 REFERENCED SECTIONS – NONE

1.03 CITED STANDARDS

A. Codes and Standards:

- 1. Welding: Qualify welding procedures, welders and operators in accordance with ASME B31.1, or ASME B31.9, as applicable, for shop and project site welding of piping work.
- 2. Brazing: Certify brazing procedures, brazers, and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, for shop and job-site brazing of piping work.
- 3. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the latest edition of the Standard Specifications for Public Works Construction (SSPWC) ("Greenbook") together with any latest Supplement Amendment and State of California, Department of Health Services, Title 22 of the California Administration Code, the City of Rialto Municipal Code and the County of San Bernardino.

1.04 NOTED RESTRICTIONS

A. All piping flange and equipment gaskets at the treatment system shall be constructed of Kel-F and/or Teflon. Products containing neoprene and silicone are not recommended for TCE & PCE use.

1.05 QUALITY CONTROL

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications:

- 1. Firm with at least three-years history of successful experience on projects of similar nature.
- 2. Licensed as a firm in the CONTRACTOR state of origin and in the State of California.
- 3. Have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the CONTRACTOR.
- 4. All workmen employed on the project shall carry state licenses as journeyman or apprentice pipe fitters with additional certification for welders.

C. Welding Certification:

- 1. Each welder shall have passed a qualification test within the past six months.
- 2. The test shall be in accordance with the ASME Boiler and Pressure Vessel Code, Section IX, "Welding Qualifications", ASME Section VIII, and ANSI 313.
- 3. The test report shall certify that the welder is qualified to weld the material to be used at the job site.

4. The CONTRACTOR shall submit three copies of each welder's qualification test report to the Project Manager for approval prior to commencing the work. No welder shall be used on the project until so certified.

1.06 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, installation instructions, and dimensioned DRAWINGS for each type of pipe and pipe fitting. Submit piping schedule showing manufacturer, pipe or tube weight, fitting type, and joint type for each piping system.
- B. Welding Certifications: Submit reports as required for piping work.
- C. Brazing Certifications: Submit reports as required for piping work.
- D. Maintenance Data: Submit maintenance data and parts lists for each type of mechanical fitting. Include this data, product data, and certifications in maintenance manual; in accordance with requirements of **Division 01**.

1.07 DELIVERABLES

- A. Except for concrete, corrugated metal, hub-and-spigot, clay, and similar units of pipe, provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage and handling as required to prevent pipe end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.
- C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Piping Materials

1. Provide pipe and tube of type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.

B. Pipe/Tube Fittings

1. Provide factory fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

C. Steel Pipes and Pipe Fittings

1. Black Steel Pipe: Seamless or ERW, ASTM A 53.

- 2. Galvanized Steel Pipe: ASTM A 53.
- 3. Galvanized Seamless Steel Pipe: ASTM A 53.
- 4. Electric-Resistance-Welded Steel Pipe: ASTM A 135.
- 5. Electric-Fusion-Welded Steel Pipe: ASTM A 671, A 672, or A 691.
- 6. Cast-Iron Flanged Fittings: ANSI B16.1, including bolting.
- 7. Cast-Iron Threaded Fittings: ANSI B16.4.
- 8. Malleable-Iron Threaded Fittings: ANSI B16.3; plain or galvanized as indicated.
- 9. Unions: ANSI B16.39; 300 lb. ground joint malleable iron, hexagonal, selected by Installer for proper piping fabrication and service requirements, including style, end connections, and metal-to-metal seats (iron, bronze or brass); plain or galvanized as indicated.
- 10. Dielectric Unions: 175 psig WSP at 250°F. Equal to Walter Vallet Company V-line insulating coupling.
- 11. Threaded Pipe Plugs: ANSI B16.14.
- 12. Steel Flanges/Fittings: ANSI B16.5, including bolting and gasketing of the following material group, end connection and facing, except as otherwise indicated.
 - a. Material Group: Group 1.1.
 - b. End Connections: Butt-welding.
 - c. Facings: Raised-face.
 - d. Steel Pipe Flanges for Waterworks Service: AWWA C207.
- 13. Forged-Steel Socket-Welding and Threaded Fittings: ANSI B16.11, except MSS SP-79 for threaded reducer inserts; rated to match schedule of connected pipe.
- 14. Forged Branch-Connection Fittings: Except as otherwise indicated, provide type as determined by Installer to comply with installation requirements.
- 15. Pipe Nipples: Fabricated from same pipe as used for connected pipe; except do not use less than Schedule 80 pipe where length remaining unthreaded is less than 1-1/2", and where pipe size is less than 1-1/2", and do not thread nipples full length (no close-nipples).
- D. Grooved Piping Products (only where acceptable and as shown on plans.)
 - 1. As Installer's option, mechanical grooved pipe couplings and fittings may be used for piping systems having operating conditions not exceeding 230°F (110°C), excluding steam piping and any other service not recommended by manufacturer, in lieu of welded, flanged, or threaded methods, and may also be used as unions, seismic joints, flexible connections, expansion joints, expansion compensators, or vibration reducers.
 - 2. Coupling Housings Description: Grooved mechanical type, which engages grooved or shouldered pipe ends, encasing an elastomeric gasket which bridges pipe ends to create seal. Cast in two or more parts, secure together during assembly with nuts and bolts. Permit degree of contraction and expansion as specified in manufacturer's latest published literature. (Victaulic style 77) For rigid joints (Victaulic "Zero Flex" style 07).
 - a. Coupling Housings: Malleable iron conforming to ASTM A 47.

- b. Coupling Housings: Ductile iron conforming to ASTM A 536.
- c. Standard: Enamel coated, options hot dip galvanized.
- 3. Gaskets: Mechanical grooved coupling design, pressure responsive so that internal pressure serves to increase seal's tightness, constructed of elastomers having properties as designated by ASTM D 2000.
 - a. Water Services: PTFE, with green color code identification.
 - b. Other Services: As recommended by Manufacturer.
- 4. Bolts and Nuts: Heat-treated carbon steel, ASTM A 183, minimum tensile 110,000 psi.
 - a. Exposed Locations: Tamper resistant nuts.
- 5. Branch Stub-Ins: Upper housing with full locating collar for rigid positioning engaging machine-cut hole in pipe, encasing elastomeric gasket conforming to pipe outside diameter around hole, and lower housing with positioning lugs, secured together during assembly with nuts and bolts.
- 6. Fittings: Grooved or shouldered end design to accept grooved mechanical couplings.
 - a. Malleable Iron: ASTM A 47.
 - b. Ductile Iron: ASTM A 536.
 - c. Fabricated Steel: ASTM A 53, Type F for 3/4" to 1-1/2"; Type E or S, Grade B for 2" to 20".
 - d. Steel: ASTM A 234.
- 7. Flanges: Conform to Class 125 cast iron and Class 150 steel bolt-hole alignment.
 - a. Malleable Iron: ASTM A 47.
 - b. Ductile Iron: ASTM A 536.
- 8. Specialties:
 - a. Inline strainers.
 - b. Suction diffusers.
- 9. Grooves: Conform to the following:
 - a. Standard Steel: Square cut.
 - b. Lightweight Steel: Roll grooved.
 - c. Ductile Iron: Radius cut grooved, AWWA C606.
- 10. Manufacturer: Subject to compliance with requirements, provide grooved piping products of one of the following:
 - a. ITT Grinnell Corp.
 - b. Stockham Valves & Fittings, Inc.
 - c. Victaulic Co. of America.
 - d. Gustin-Bacon
 - e. Grippin.

E. Manufacturers:

- 1. Manufacturer uniformity: conform with the requirements specified in Basic Mechanical Requirements, under "Product Options."
- 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering piping materials and specialties which may be incorporated in the work include, but are not limited to, the following:
 - a. Pipe Escutcheons:
 - 1) Chicago Specialty Mfg. Co.
 - 2) Sanitary-Dash Mfg. Co.
 - 3) Grinnell
 - b. Dielectric Waterway Fittings:
 - 1) Epco Sales, Inc.
 - 2) Victaulic Company of America
 - c. Dielectric Unions:
 - 1) Eclipse, Inc.
 - 2) Perfection Corp.
 - 3) Watts Regulator Co.
 - d. Strainers:
 - 1) Armstrong Machine Works.
 - 2) Hoffman Specialty ITT; Fluid Handling Div.
 - 3) Spirax Sarco.
 - 4) Victaulic Co. of America. (low pressure applications only)
 - 5) Watts Regulator Co.
 - e. Expansion Joints:
 - 1) Flexonics Div.; UOP, Inc.
 - 2) Hyspan Precision Products, Inc.
 - 3) Keflex, Inc.
 - 4) Metraflex Co.
 - 5) Vibration Mountings and Controls, Inc.
 - f. Flexible Connectors:
 - 1) Flexonics Div.; UOP, Inc.
 - 2) Hyspan Precision Products, Inc.
 - 3) Keflex, Inc.
 - 4) Metraflex Co.
 - 5) Vibration Mountings and Controls, Inc.

F. Piping Specialties:

- 1. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.
- 2. Unions: Malleable-iron, Class 150 for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.
- 3. Dielectric Unions: Provide dielectric unions with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.
- 4. Dielectric Waterway Fittings: electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.
- 5. Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens shall be Type 304 stainless steel, with 3/64" perforations at 233 per square inch.
 - a. Provide strainers with 125 psi working pressure rating for low pressure applications, and 250 psi pressure rating for high pressure application.
 - b. Threaded Ends, 2" and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
 - c. Threaded Ends, 2-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
 - d. Flanged Ends, 2-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
 - e. Grooved Ends, 2-1/2" and Larger: Tee pattern, ductile-iron or malleable-iron body and access end cap, access coupling with EPDM gasket.

G. Expansion Joints

- 1. Rubber Expansion Joints: Construct of duck and butyl rubber with full-faced integral flanges, internally reinforced with steel retaining rings. Provide steel retaining rings over entire surface of flanges, drilled to match flange bolt holes, and provide external control rods.
- 2. Expansion Joints for Grooved Piping: Provide expansion joints constructed of cut grooved short pipe nipples and couplings, designed by manufacturer to suit intended service. Select couplings and gasket materials to match balance of piping system.

H. Flexible Connectors

- 1. Braided Flexible Pump Connector: Stainless steel annular corrugated metal surrounded with a woven braid of high tensile stainless steel flange connection. Minimum 125 psi pressure rating, similar to Keflex KSSPC.
- 2. Flexible Connector: Stainless steel annular, close pitch hose with stainless steel braid. Flanged or threaded connection, Minimum 125 psi pressure rating, similar to Keflex KFCS.

I. Sleeves

- 1. Sheet-Metal Sleeves: 10-gauge, galvanized sheet metal, round tube closed with welded longitudinal joint.
- 2. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A53, Grade A.

J. Mechanical Sleeve Seals

1. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

K. Miscellaneous Piping Materials/Products:

- 1. Welding Materials: Except as otherwise indicated, provide welding materials as determined by Installer to comply with installation requirements.
 - a. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.
- 2. Soldering Materials: Except as otherwise indicated, provide soldering materials as determined by Installer to comply with installation requirements. Use <u>no</u> lead bearing solders in domestic water applications.
 - a. Tin-Antimony Solder: ASTM B 32, Grade 95TA.
 - b. Silver-Lead Solder: ASTM B 32, Grade 96TS.
- 3. Brazing Materials: Except as otherwise indicated, provide brazing materials as determined by Installer to comply with installation requirements.
 - a. Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials.
- 4. Gaskets for Flanged Joints: ANSI B16.21; full-faced for cast-iron flanges; raised-face for steel flanges, unless otherwise indicated.
- 5. Piping Connectors for Dissimilar Non-Pressure Pipe: Elastomeric annular ring insert, or elastomeric flexible coupling secured at each end with stainless steel clamps, sized for exact fit to pipe ends and subject to approval by plumbing code.
 - a. MANUFACTURER: Subject to compliance with requirements, provide piping connectors of the following:
 - 1) Fernco, Inc.
 - 2) Mission.

PART 3 - EXECUTION

3.01 PREPARATION – NONE

3.02 INSTALLATION

A. Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently- leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate

and accessible union, flanges, etc., for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance. Do not cold spring. Store filler weld materials in accordance with codes.

- 1. Comply with ANSI B31 Code for Pressure Piping.
- 2. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, columns and other clearance to 1/2" where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1" clearance outside insulation. Wherever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall construction or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated. Provide high point vents, low point drains with valves and extension to drain for all piping.
- 3. All piping in press room, mechanical rooms, fan rooms, etc., shall be exposed. Do not conceal or imbed piping in walls, floors or other structures.
- 4. Make changes in direction or size with manufactured fittings. Anchor and support piping for free expansion and movement without damage to piping, equipment or to building.
- 5. Piping shall be arranged to maintain head room and keep passageways clear.
- 6. Provide unions at connections to equipment and elsewhere as required to facilitate maintenance.
- 7. Run full pipe size through shutoff valves, gas cocks, balancing valves, etc. Change pipe size within three pipe size diameters of final connection to equipment, coils, etc.
- 8. All piping shall be erected to insure proper draining. Air piping shall pitch down in the direction of flow a minimum of 1" per 40 feet. Domestic water and utility water shall slope down a minimum of 1" per 40 feet towards the drain (low point). Refrigerant suction line shall slope a minimum of 1" per 10 feet towards compressor. Soil, waste, vent, and roof drain lines shall slope in accordance with requirements of California Plumbing Code.
- 9. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.
- 10. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6" shall be steel; pipe sleeves 6" and larger shall be sheet metal.
- 11. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained.
- 12. Use fittings for all changes in direction and all branch connections.
- 13. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, and elsewhere as indicated.

- 14. Install unions adjacent to each valve and at the final connection to each piece of equipment and plumbing fixture having 2" and smaller connections, and elsewhere as indicated.
- 15. Install Flanges in piping 2-1/2" and larger, where indicated, adjacent to each valve, and at the final connection to each piece of equipment.
- 16. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air).
- 17. Install dielectric fittings to connect piping materials of dissimilar metals in wet piping systems (water). Insulating fittings are not required between bronze valves and steel pipe or between copper coil headers and steel pipe.
- 18. Electrical Equipment Spaces: Do not run piping in or through, electrical room, transformer vaults and other electrical or electronic equipment spaces and enclosures or above electrical gear unless authorized and directed. Install drip pan under piping that must be run through electrical spaces.

B. Expansion and Contraction

- 1. Make all necessary provisions for expansion and contraction of piping.
- 2. Use grooved joint couplings, expansion compensator, offsets or loops as required to prevent undue strain.
- 3. At piping connection to heat exchangers provide expansion (joint) as shown on DRAWINGS.

C. Flexible Connectors:

- 1. At pumps, engines and at all rotating or vibrating pieces of equipment, provide and install flexible connectors to accommodate alignment and vibration.
- 2. At pumps provide and install a series of three grooved joint couplings or braided flexible pump connectors.
- 3. At engines provide and install flexible connector. If necessary, install OWNER furnished flex connectors for digester gas and natural gas.

D. Protective Coatings

- 1. All underground steel pipes shall be wrapped with Scotchwrap No. 50 tape to give not less than two complete layers on the underground piping system, or piping shall have "X-tru Coat", factory applied plastic protective covering, or pipe shall be coated and wrapped with coal tar enamel and Kraft paper, all with coated and taped joints.
 - a. Piping System Joints
- 2. General: Provide joints of type indicated in each piping system.
- 3. Threaded: Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.
- 4. Brazed: Braze copper tube-and-fitting joints where indicated, in accordance with ASME B31.

5. Soldered: Solder copper tube-and-fitting joints where indicated, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in a manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.

6. Welded:

- a. Weld pipe joints in accordance with ASME Code for Pressure Piping, B31.
- b. Weld pipe joints in accordance with recognized industry practice and as follows:
- c. Weld pipe joints only when ambient temperature is above 0°F (-18°C) where possible, with minimum pipe preheat to 50°F.
- d. Bevel pipe ends at a 37.5° angle where possible, smooth rough cuts, and clean to remove slag, metal particles and dirt.
- e. Use pipe clamps or tack-weld joints with 1" long welds; 4 welds for pipe sizes to 10", 8 welds for pipe sizes 12" to 20".
- f. Build up welds with stringer-bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or un-fused metal, cracks, oxidation, blow-holes and non-metallic inclusions.
- g. Do not weld-out piping system imperfections by tack-welding procedures; refabricate to comply with requirements.
- h. At Installer's option, install forged branch-connection fittings wherever branch pipe is indicated; or install regular "T" fitting.
- i. At Installer's option, install forged branch-connection fittings wherever branch pipe of size smaller than main pipe is indicated; or install regular "T" fitting.
- 7. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.
- 8. Lead Joints: Tightly pack joint with joint packing material. Do not permit packing to enter bore of finished joint. Clean joint after packing. Fill remaining joint space with one pouring of lead to indicated minimum depth measured from face of bell. After lead has cooled, calk joint tightly by use of hammer and caulking iron.
- 9. Hubless Cast-Iron Joints: Comply with coupling manufacturer's installation instructions.
- 10. Plastic Pipe/Tube Joints: Comply with manufacturer's instructions and recommendations, and with applicable industry standards:
 - a. Heat Joining of Thermoplastic Pipe: ASTM D 2657.
 - b. Making Solvent-Cemented Joints: ASTM D 2235, and ASTM F 402.
- 11. Grooved Pipe Joints: Comply with fitting manufacturer's instructions for making grooves in pipe ends. Remove burrs and ream pipe ends. Assemble joints in accordance with manufacturer's instructions.

3.03 TESTING

- A. Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.
 - 1. Inspect pressure piping in accordance with procedures of ASME B31.
- B. Disinfect water mains and water service piping in accordance with AWWA C601.
- C. Note specific requirements in Section 40 05 13.09.
- D. Note specific requirement in Section 40 05 13.11.

SECTION 40 05 13.09 – FLUSHING AND DISINFECTION (CHLORINATION OF WATER MAINS)

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section describes requirements for disinfection of water mains, services, appurtenances and connections by chlorination.
- 1.02 REFERENCED SECTIONS NONE

1.03 CITED STANDARDS

A. All water mains, water services, attached appurtenances, and connections, if any, shall be disinfected in accordance with AWWA C651 and as specified herein.

1.04 NOTED RESTRICTIONS

A. The CONTRACTOR shall make sure that the City's requirements are being met when performing flushing and disinfection methods.

1.05 QUALITY CONTROL

A. Before being placed in service, all facilities shall be chlorinated.

1.06 SUBMITTALS – (SEE **SECTION 40 05 13.11** PARAGRAPH 1.06)

PART 2 - PRODUCTS

2.01 MATERIALS REQUIREMENTS

A. All temporary valves, temporary blow-offs, bulkheads, backflow devices, or other water control equipment and materials shall be determined and furnished by the CONTRACTOR. No materials shall be used which would be injurious to the pipeline or its future function.

PART 3 - EXECUTION

3.01 DISINFECTION PLAN:

- A. Contractor shall submit to the Engineer for review a detailed plan on disinfection of the new piping, appurtenances, and equipment.
 - a. Details on isolation means, dechlorination and water disposal systems and proposed means.
 - b. Provide worker safety plan for protection against high levels of disinfectant chemical.
 - c. Include sketches of the site showing water access and disposal areas, dechlorination equipment location and types, injection and sampling locations, and timeline of disinfection work events and miles stones.

B. Conduct a teleconference describing the plan to the Engineer and Owner, receive comments, and revision requirements for as finalized Disinfection Plan.

3.02 PREPARATION

A. Procedure

- 1. Only a certified chlorination and testing CONTRACTOR shall perform the work specified herein. The CONTRACTOR shall furnish all equipment in good operating condition, labor and material, and water necessary for chlorinating and flushing the pipeline. Bacteriological testing after the disinfection will be performed by the CONTRACTOR.
- 2. In the event groundwater is encountered and it is impossible to prevent its entrance into the mains, or the mains are not free from dirt, they shall be thoroughly flushed prior to disinfection. After the required period of retention of the chlorine solution and flushing, an CONTRACTOR will test the water for residual chlorine and will make any additional test that may be necessary.
- 3. The chlorine shall be applied at the beginning of the section to be chlorinated and shall be injected through a corporation stop, a hydrant, or other approved connection to ensure treatment of the entire system being disinfected. All required corporation stops and other plumbing materials necessary for chlorination or flushing of the main shall be installed by and at the expense of the CONTRACTOR.
- 4. Every service connection served by a main being disinfected shall be tightly shutoff at the curb stop before water is turned into the main. Care shall be taken to expel all air from the main and services during the filling operation.
- 5. Water shall be fed slowly into the pipeline with chlorine applied in amounts to produce a dosage of not less than 50 ppm nor more than 100 ppm in all sections of the pipeline and appurtenances.
- 6. Methods of chlorine application are as follows:
 - a. Chlorine shall be fed directly from the chlorine solution tank equipped with a suitable device for regulating the rate of flow and the effective diffusion of solution within the pipe.
 - b. Note: For all mains, chlorination shall be applied only by a certified chlorination and testing company.
- 7. During the chlorination process, all valves and facilities shall be operated.
- 8. Treated water shall be retained in the system for a minimum of 24 hours and shall contain a chlorine residual of not less than 35 ppm at the end of the retention period in all sections being disinfected.

3.03 INSTALLATION – NONE

3.04 TESTING

A. Concurrent Testing

1. Disinfecting the mains and appurtenances, hydrostatic testing, and preliminary retention may run concurrently for the required 24-hour period, but in the event there is leakage

and repairs are necessary, additional disinfection shall be made by injection of chlorine solution into the line as provided hereinafter.

B. Additional Disinfection

1. If the tests are not satisfactory the CONTRACTOR shall provide additional disinfection as required. If the requirement for additional disinfection is due to any omission, negligence, or nonconformance with these specifications on the part of the CONTRACTOR, or because of repairs made to the pipeline after its initial filling with water for disinfection, the CONTRACTOR shall provide such additional chlorination at his expense.

C. Flushing

- 1. After chlorination, the water shall be flushed from the line at its extremities until the replacement water tests are equal chemically and bacteriologically to those of the permanent source of supply. The chlorinated water may be used later for testing other lines, or if not so used, shall be disposed of by the CONTRACTOR. The OWNER will not be responsible for loss or damage resulting from such disposal.
- 2. The CONTRACTOR shall de-chlorinate the test water in accordance with ANSI/AWWA C651, Appendix B, or otherwise make the water safe for disposal prior to disposal.

SECTION 40 05 13.10 - FLUSHING AND TESTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This Section includes flushing of all pressure pipelines, and testing of all pipelines, complete. The CONTRACTOR shall flush and test all pipelines as per the Specifications contained herein.
- B. Each pipeline shall be flushed in accordance with these procedures and, tested as per the general requirements of this section and more specific testing procedures in following sections.
- C. The CONTRACTOR may include equipment flushing and testing while performing same on pipelines. The requirements for equipment testing are in Division 43 and must be included in the written plan required herein.

1.02 REFERENCED SECTIONS

- A. Related Sections
 - 1. SECTION 40 05 13.11 LEAK TESTING OF PIPING
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS
 - A. The CONTRACTOR shall make sure that the city's requirements are being met when performing flushing and testing methods.

1.05 FLUSHING, AND TESTING REQUIREMENTS AND RESULTS

- A. A written plan for proper flushing and testing of each pipeline shall be submitted to the ENGINEER for approval prior to start of work. The plan will address how the CONTRACTOR will meet the requirements of this specification. At a minimum, it will include:
 - 1. Schematic map(s) of the project showing points of connection and flushing points.
 - 2. Mechanical flow diagram(s) marked to identify the boundaries of the test and valve line-up.
 - 3. A completed Hydrostatic and Pneumatic Test Data Sheet (Attachment 1 at the end of this Section) including pretest release signatures. Alternate Data Sheets shall be considered by the ENGINEER.
 - 4. The type of pipeline being flushed and tested with a notation of whether it is above or below ground.
 - 5. Make and model number of backflow prevention device(s) and flow meter used to connect to the water system for flushing and testing.
 - 6. Calculations for sizing of source water connection(s), flushing velocities and total quantity.
 - 7. A detailed work schedule listing the approximate dates for each activity covered in this specification.

- 8. Detailed procedures for each activity.
- 9. NPDES permit and compliance procedures for flushing.
- 10. Emergency contact information.
- B. The written plan for installation, flushing, testing, shutdowns, tie-ins, and activation will be submitted to the ENGINEER two weeks prior and returned to the CONTRACTOR one week prior to the activity.
- C. Protection of the potable water distribution system is the ultimate responsibility of the City. No entity or agent other than City staff will be allowed to operate any valve or facility of the approved distribution system without the written consent and direct supervision of the City.

D. Flushing

- 1. The minimum flushing velocity will be 5.0 fps.
- 2. The backflow device and metered connection to the potable supply will be sized to meet the minimum flow requirement based on 5.0 fps. Supporting calculations will be submitted with the flushing plan.
- 3. The pipeline(s) and equipment shall be flushed for sufficient time to achieve two (2) exchanges of the total volume of the pipeline as a minimum and until the water flushed runs clear. Clear means not more than two (2) NTU turbidity as measured with a potable turbidity meter and a maximum of 0.5 mg/L suspended solids as measured in an Eimhoff cone at all outlets.
- E. Testing shall be performed in accordance with the Specifications in Section 40 05 13.11.

PART 2 - PRODUCTS

2.01 MATERIALS REQUIREMENTS

- A. All temporary valves, temporary blow-offs, bulkheads, backflow devices, or other water control equipment and materials shall be determined and furnished by the CONTRACTOR. No materials shall be used which would be injurious to the pipeline or its future function.
- B. All pressurizing equipment and measuring devices required for testing shall be determined and furnished by the CONTRACTOR. No materials shall be used which would be injurious to the pipeline or its future function.

PART 3 - EXECUTION

3.01 GENERAL

- A. Unless otherwise indicated, potable water for flushing and testing will be furnished by the CONTRACTOR. The CONTRACTOR shall furnish and install all materials including, but not limited to, approved backflow devices and also make all necessary arrangements for conveying the water to the points of use.
- B. All pressure pipelines shall be tested per the requirements of this division. Equipment testing requirements are as stipulated in Division 43.

3.02 FLUSHING

- A. The CONTRACTOR shall flush each pipeline at a minimum flushing velocity of 5.0 fps, utilizing potable water as per the written plan.
- B. The CONTRACTOR shall continue flushing for sufficient time to achieve two (2) exchanges of the total volume of the pipeline as a minimum and until the water flushed runs clear.
- C. Leak testing shall be conducted following flushing and shall be performed in accordance with the Specifications in **Section 40 05 13.11.**

SECTION 40 05 13.11 – LEAK TESTING OF PIPING

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This specification identifies the minimum requirements for leak testing of all piping performed by the CONTRACTOR.
 - B. This section describes the requirements and procedures for pressure and leakage testing of transmission pipelines, pump station and vault piping, and pressure distribution mains. This includes all suction, discharge, and drain piping. Testing shall be performed concurrent with installation.
 - C. The CONTRACTOR shall develop detailed procedures for leak testing based on the minimum requirements of this specification, and manufacturer's instructions. All leak testing procedures shall be submitted to the ENGINEER for review and approval.
 - D. All leak testing shall be witnessed by the OWNER or ENGINEER.
 - E. Requirements Prior to Testing
 - 1. All concrete anchor blocks shall be allowed to cure a sufficient time to develop a minimum strength of 3,000 psi before testing unless otherwise directed by the ENGINEER.
 - 2. Steel pipelines shall not be tested before the mortar lining and coating on all pipe lengths in the line have attained an age of 14 days. Cement-mortar lined pipe shall not be filled with water until a minimum period of eight hours has elapsed after the last joint in any section has been made.
 - 3. Submit test bulkhead locations and design calculations, pipe attachment details, and methods to prevent excess pipe wall stresses.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL NONE
- 1.06 SUBMITTALS
 - A. A written plan for proper flushing and testing of each pipeline shall be submitted to the ENGINEER for approval prior to start of work. The plan will address how the CONTRACTOR will meet the requirements of this specification. At a minimum, it will include:
 - 1. Schematic map(s) of the project showing points of connection and flushing points.
 - 2. Mechanical flow diagram(s) marked to identify the boundaries of the test and valve line-up.

- 3. A completed Hydrostatic and Pneumatic Test Data Sheet (Attachment 1 at the end of this Section) including pretest release signatures. Alternate Data Sheets shall be considered by the ENGINEER.
- 4. The type of pipeline being flushed and tested with a notation of whether it is above or below ground.
- 5. Make and model number of backflow prevention device(s) and flow meter used to connect to the water system for flushing and testing.
- 6. Calculations for sizing of source water connection(s), flushing velocities and total quantity.
- 7. A detailed work schedule listing the approximate dates for each activity covered in this specification.
 - a. A detailed work plan listing procedures and approximate dates for each activity covered in the specification.
 - b. Detailed procedures for each activity.
 - c. NPDES permit and compliance procedures for flushing.
 - d. Emergency contact information.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All temporary test gauges, fittings, hoses, valves, pumps, compressors, test media, relief devices, and leak inspection materials, including soap solutions, shall be specified and provided by the CONTRACTOR.
- B. Any replacement piping components required to repair leaks, shall be provided by the CONTRACTOR at no additional cost to the OWNER.

C. Water

- 1. The same water used for chlorination of the pipeline may be used to fill the line for testing.
- 2. Make-up water for testing shall be potable water.

D. Test Bulkheads

1. Design and fabricate test bulkheads per Section VIII of the ASME Boiler and Pressure Vessel Code. Materials shall comply with Part UCS of said code. Design pressure shall be at least 2.0 times the specified test pressure for the section of pipe containing the bulkhead. Limit stresses to 70 percent of yield strength of the bulkhead material at the bulkhead design pressure. Include air-release and water drainage connections.

E. Vents and Drain for Aboveground Piping

1. Install vents on the high points of above ground piping, whether shown on the DRAWINGS or not. Install drains on low points of aboveground piping, whether shown on the DRAWINGS or not. Provide a valve at each vent or drain point. Valves shall be 3/4-inch for piping 3 inches and larger and 1/2-inch for piping smaller than 3 inches.

F. Manual Air-Release Valves for Buried Piping

1. Provide temporary manual air-release valves for pipeline test. Construct the pipe outlet in the same manner as for a permanent air valve and after use, seal with a blind flange, pipe cap, or plug and coat equal to the adjacent pipe.

2.02 TESTING EQUIPMENT

- A. The CONTRACTOR shall provide all equipment required for hydrostatic and pneumatic testing, including, but not limited to:
 - 1. All fittings bleed points, pumps, flanges, connections, etc., necessary to perform hydrostatic test.
 - 2. Clean water, with sufficient quantity to fill pipeline section under test.
 - 3. A strainer on the inlet side of pump to prevent foreign matter from entering the pipeline.
 - 4. Flange connections and/or valves suitable to isolate the pipeline section being tested without leaking.
 - 5. A relief valve capable of permitting pressure relief if pressure exceeds 20 to 25 percent above required test pressure to prevent pipeline failure.
 - 6. Testing pressure gauge(s)
 - a. Sufficient number of pressure gauges capable of measuring 50 percent over the intended test pressure. Pressure gauges shall be accurate within 1.0 percent.
 - b. Pressure gauges and relief valves shall be checked for accuracy prior to use during actual testing of the pipeline.
 - 7. A booster pump with sufficient capacity to boost the source water pressure to the required test pressure.
 - 8. An air compressor with sufficient capacity to provide air pressure to the required test pressure for the leak tests.

PART 3 - EXECUTION

3.01 GENERAL EXAMINATION

- A. The system or portion of the system to be tested shall be verified to determine that the system is mechanically completed and the following requirements have been met:
 - 1. All solvent welded or bonded joints have cured for at least 8 hours unless the ambient temperature is less than 70°F. If the ambient temperature is less than 70°F, the cure time shall be in accordance with the manufacturer's instructions.
 - 2. Assure that the "Requirements Prior to Testing" in Paragraph 1.01E are in place.
 - 3. All welding has been completed, including the acceptance of all required nondestructive examinations on pressure retaining welds.
 - 4. All fusion joints have been completed, including the acceptance of all required nondestructive examinations on pressure-retaining welds.
 - 5. All flanged connections have been completed, including bolting and gaskets.

- 6. All expansion joints have been installed and suitably anchored or guided in accordance with the manufacturer's instructions.
- 7. All nipples and valves have been installed for vents, drains, and instrument connections as specified on the applicable design DRAWINGS.
- 8. All anchors and supports have been placed as specified on the applicable design DRAWINGS and that the pipeline is sufficiently restrained to prevent buckling during testing.
- 9. All joints, including welds, bonds, and piping joints have been left uninsulated and/or unburied and exposed for examination during testing.
- B. Verification shall include a comparison of the system to be tested to the mechanical flow, piping, and other applicable design DRAWINGS and the requirements of Section 40 05 13 Common Work Results for Process Piping, as applicable.

3.02 GENERAL PREPARATION

- A. The CONTRACTOR shall have a written plan, approved by the ENGINEER, in place as required by **Paragraph 1.06** and shall follow the requirements of the plan.
- B. Equipment or piping that is not to be tested shall either be disconnected or isolated by blinds or other means. A valve may be used in place of a blind if the valve is rated to the test pressure.
- C. Instrumentation shall not be installed prior to testing unless the instrument is vented.
- D. If the ENGINEER approves hydrostatic testing of vapor or gas lines, temporary supports shall be provided, if necessary, to support the weight of the test liquid.
- E. Sufficient vents and drains shall be located and installed by the CONTRACTOR to allow the removal of air.
- F. All temporary test connections shall be completed.
- G. If impractical to test in place and if specifically approved by the OWNER or the ENGINEER, short runs or spools of piping may be interconnected and tested together.
- H. Check valve internals shall be disassembled if the direction of the check valve does not allow complete filling or depressurizing of the system.
- I. Booster pump(s) shall provide sufficient capacity to boost the source water pressure to the required test pressure.
- J. Prior to testing the pipeline shall be properly flushed as per the flushing specifications in Section 40 05 13.09 Flushing and Disinfection.

3.03 HYDROSTATIC LEAK TEST

A. General Requirements

1. Hydrostatic leak tests shall conform to the requirements of this specification. Hydrostatic leak testing of piping shall also conform to the manufacturer's instructions.

- 2. Test pressures for all piping systems shall not exceed 150 percent of the design pressure for the least-rated pipe, fitting, or valve installed in the system.
- 3. Air vents shall be provided by the CONTRACTOR at high points in the system to ensure that all air is purged from the system during filling.
- 4. The CONTRACTOR shall conduct a leak test on installed piping. The CONTRACTOR shall also furnish all necessary equipment and materials, and make all taps in the pipe as required. The OWNER shall be notified at least 72 hours in advance of testing.
- 5. Drain valves shall be provided to facilitate filling and draining of all test liquid from the system. Drain valves may be omitted if the system is to operate liquid filled.
- 6. Tests shall not be performed unless weather conditions ensure a dry surface on the system to be tested or suitable weather protection can be provided.
- 7. Testing shall not commence until all sections of the pipeline to be tested have been secured to prevent damage to adjacent piping and equipment in the event of a joint failure. Any appurtenant instruments or devices that could be damaged by the test shall be removed from the piping or suitably isolated prior to applying the test. The CONTRACTOR will be held responsible for any damage caused by the testing.
- 8. During hydrostatic leak testing, joints shall be exposed for visual inspection. It is advised to cover the pipeline in intervals, especially at curves to hold the pipe in place during pressure testing.
- 9. Expansion joints and/or expansion compensators shall be restrained, isolated, or removed during pressurized leak testing.
- 10. All leaks identified shall be repaired and retested at no additional expense to the OWNER, including labor and replacement of any material. After repair, the system shall be retested.
- 11. A "leak" shall be defined as a measurable loss in system pressure during the test or the appearance of water at any location within the system.
- 12. After testing, the CONTRACTOR shall remove all temporary blinds and remake all connections disassembled for the leak test.
- 13. The pipe shall not be backfilled until visual inspection has been completed. Joints shall not be backfilled until successful completion of the leak test.
- B. The hydrostatic test procedure developed by the CONTRACTOR shall include the following provisions:
 - 1. Air vents shall be opened to allow elimination of air from the system.
 - 2. The tested pipeline shall be slowly filled (<1fps) with test fluid at the lowest point in the system. The CONTRACTOR shall provide means for increasing pressure to the required test pressures.
 - 3. On long straight runs of pipe, a soft pig shall be used ahead of the test fluid to ensure elimination of all air from the system.
 - 4. The test section shall be completely filled with the test medium, taking care to bleed off any trapped air.
 - 5. When the tested pipeline is completely filled with the test fluid, the vents shall slowly be closed and line pressure shall slowly be brought up to the indicated test pressure.

- 6. Piping shall be tested up to 150 percent of the MAOP of the lowest rated component of each specified line segment.
- 7. The primary system shall be pressure tested hydrostatically in two phases as follows:
 - a. Initial Phase: Using clean water, the piping shall be tested up to 150 percent of the MAOP. Once the target is reached, allow 3 hours for diametric expansion.
 - b. Test Phase: After the pipeline has had time for equilibration, the test section shall be returned to 150 percent of the MAOP, the pump turned off, and a final test pressure held for 2 to 3 hours. If there are no visual leaks or significant pressure drops during the final test period, the pipeline passes the test. If there is a leak observed, then the pipeline fails the test.
- 8. Examination for leakage shall be made of all welds, joints, and connections.
- 9. If a pressure test fails, the pipe shall be relieved, and the test section allowed to "relax" for a minimum of 8 hours before another test is attempted.
- 10. Upon satisfactory completion of the test, the system shall be slowly depressurized and completely drained. Air vents shall be opened as required to prevent inducing a vacuum on the system.
- 11. Provisions shall be made to divert draining test fluid from excavated and trenched areas and to maintain well-formed and supported excavations throughout the testing procedure.
- 12. Detailed procedures for hydrostatic leak testing of HDPE and PVC pipe shall be prepared by the CONTRACTOR in accordance with applicable portions of this specification and the manufacturer's instructions.

C. Test Records

- 1. Records shall be made of each piping system installation during the test. These records shall include:
 - a. Date of test.
 - b. Description and identification of piping tested.
 - c. Starting test pressure and end pressure.
 - d. Remarks, to include such items as:
 - 1) leaks (type, location)
 - 2) repairs made on leaks
 - e. Certification by the CONTRACTOR and signed acknowledgement by the ENGINEER.

3.04 PNEUMATIC LEAK TEST

A. General Requirements

- 1. The CONTRACTOR shall conduct pneumatic leak testing on the instruments, tubing and connections operating with an air or gaseous media.
- 2. The inner pipe of double walled HDPE piping shall remain full of water throughout the pneumatic testing of the outer pipe to prevent collapsing.

- 3. Pneumatic leak tests shall conform to the requirements of this specification and ANSI B31.3. Pneumatic leak testing of double-contained piping shall also conform to the manufacturer's instructions. Special precautions for pneumatic leak testing are identified in ANSI B31.3.
- 4. Test pressures shall not exceed 10 psig.
- 5. A pressure relief device shall be provided with a set pressure that does not exceed 110 percent of the test pressure. Sizing and selection of the pressure relief device shall be determined by the CONTRACTOR.
- 6. Tests shall not be performed unless weather conditions ensure a dry surface on the system to be tested or suitable weather protection can be provided.
- 7. All leaks shall be repaired at no additional expense to the OWNER, including labor and replacement of any material. After repair, the system shall be retested.
- 8. A "leak" shall be defined as a formation of bubbles observed when a soap solution is applied or as indicated by the criteria for double walled HDPE piping in Paragraph B. 5. below.
- 9. Upon satisfactory completion of the test, the pressure shall be slowly released.

ATTACHMENT 1 HYDROSTATIC AND PNEUMATIC TEST DATA SHEET

Project Number:	Project Name:		
Piping System/Equipment:			
Description of Piping System/Equipment Being Tested:			
Reference Criteria:			
Type of Test:	Test Medium:		
Operating Pressure:	Operating Temperature:		
Test Pressure:	Test Temperature:		
Examination Pressure:	Examination Temperature:		
Minimum Holding Time at Test Pressure:	Minimum Holding Time at Examination Pressure:		
Allowable Leakage:			

Pressure Test Gauge(s) Test Relief Valve(s)		Identification Number: Calibration Due Date: Identification Number: Calibration Due Date:			
Mechanical	Eng	Date:	Supt:	Date:	
Welded Joints	Eng	Date:	Supt:	Date:	
Instrumentation	Eng		Supt:	Date:	
Time Test Started	1:		Time Test Completed:		
Comments:					
Performed by			Witnessed by Client		
Name:		Date:	Name:	Date:	
Verified by			Witnessed by ENGINEER		
Name:		Date:	Name:	Date:	

SECTION 40 05 13.12 – TRACER WIRE AND MARKING TAPE FOR BURIED PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section includes specifications applicable to non-metallic buried piping unless specified otherwise by the ENGINEER.
- B. During installation of buried non-metallic piping, the CONTRACTOR shall furnish and install tracer wire and detectable Mylar marking tape as per the DRAWINGS and the following specifications.

PART 2 - PRODUCTS

2.01 TRACER WIRE

A. Tracer wire shall be No. 14 AWG bare copper wire with TW insulation.

2.02 DETECTABLE MYLAR MARKING TAPE

- A. The marking tape shall be 6" wide foil detectable Mylar marking tape. The detectable marking tape will bear the words "CAUTION BURIED PIPELINE BELOW", "CAUTION BURIED WATER LINE BELOW" or "CAUTION BURIED ENVIRONMENTAL LINE BELOW". The printing will be under Mylar so as to be readable through the clear Mylar.
- B. Maximum spacing between the continuous warning messages shall be 16". The tape shall be a highly visible color and the tape will be color coded in accordance with the American Public Works Association and Utility Location Coordination Council Standards for non-potable water.
- C. The tape shall be specially designed for prolonged underground use and shall be easily detectable with an electronic locator.
- D. The Detection tape shall be as manufactured by Pollard Co. Inc., Long Island, NY (Model Nos. 802, 803, 804); Reef Industries, Inc., Houston, TX; Seton Identification Products, Branford, CT; or an approved equal.

PART 3 - EXECUTION

3.01 TRACER WIRE

- A. Buried non-metallic utilities (electrical, mechanical, and civil) shall have a tracer wire along the entire length of the pipeline unless indicated otherwise. The tracer wire shall be installed in accordance with its corresponding drawing shown in the Standard Details.
- B. The tracer wire shall be installed on top of the buried utility crown and shall be attached to the pipe line by taping or other suitable means approved by the OWNER at a maximum of 10 ft. intervals.

- C. The tracer wire shall be positively attached to the non-metallic buried utilities by plastic wire ties of similar type of attachment at a maximum of every 10 feet for straight run of utility and at all changes of direction.
- D. The ends of the tracer wire shall be exposed above the finished grade.
- E. Concrete valve boxes shall be installed at the locations where the ends of the tracer wire are exposed above the finished grade.
- F. Tracer wire shall be exposed above finished grade in the precast concrete boxes at the transition where the non-metallic buried utility connects to the existing metallic utility.
- G. Tracer wire shall be continuous between boxes and shall be tested for continuity.

3.02 DETECTABLE MYLAR MARKING TAPE

A. General

- 1. The CONTRACTOR shall install a six-inch wide foil detectable Mylar marking tape over all nonmetallic water lines. It shall be inductively locatable and conductively traceable using standard pipe and/or cable locating devices.
- 2. Care shall be taken to insure that the buried marking tape is Mylar encased aluminum foil.
- 3. The detectable marking tape will be buried 8 in. below finish grade. The tape should be placed into backfill and allowed to settle into place in the backfill.
- 4. The marker tape shall be in accordance with its corresponding drawing shown in the Standard Details.

B. Installation Details:

- 1. The tape shall be laid directly above the piping or conduit and directly on top of the compacted earth subgrade immediately before restoring the pavement.
- 2. In open areas, the tape shall be laid during the backfilling operation on smooth, compacted backfill at a distance of 8 inches below the surface of the area.
- 3. The ends of the tape shall be lapped approximately six (6) inches.

3.03 SURFACE RESTORATION

A. All areas disturbed during construction, including, but not limited to, roads, curbs, sidewalks, open areas, and landscaped areas, shall be repaired in accordance with the current City/County Standard DRAWINGS OR Public Works Standards.

3.04 CERTIFICATION OF COMPLETION

- A. Upon completion of the piping system, the CONTRACTOR shall certify the following to the Company:
 - 1. The piping system has been constructed in accordance with the contract plans and specifications.

2. The piping system has been field flushed and tested and has passed all of the required tests in the approved project plans and specifications.

SECTION 40 05 13.13 – STEEL PROCESS PIPING (BLACK AND GALVANIZED)

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. This section covers furnishing and installing all steel piping, fittings, accessories, and supports, etc., with the exception of any piping which is an integral part of any equipment assembly and which would be furnished by the manufacturer. Flushing and testing requirements for installed steel piping are specified in **Sections 40 05 13.09-11**.
- B. Where piping connects to equipment, particular care shall be taken to see that pipe fittings are suitable for connection to the equipment fittings.

1.02 RELATED SECTIONS – NONE

1.03 CITED STANDARDS

- A. All steel piping and fittings shall conform to the following standard specifications, of the latest revisions, as applicable:
 - 1. ASME/ANSI B16.1 1998 Cast Iron Pipe Flanges and Flanged Fittings
 - 2. ASME/ANSI B16.3 1998 Malleable Iron Threaded Fittings
 - 3. ASME/ANSI B16.4 1998 Cast Iron Threaded Fittings
 - 4. ASME/ANSI B16.5 2003 Pipe Flanges and Flanged Fittings
 - 5. ASTM A53 / A53M 07 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 6. ANSI B36.10 2004 Welded and Seamless Wrought Steel Pipe

1.04 NOTED RESTRICTIONS – NONE

1.05 QUALITY CONTROL

- A. The CONTRACTOR shall furnish and install steel pipe and all appurtenances, complete in place, all in accordance with the standard DRAWINGS and as described in these specifications.
- B. All pipes shall be subject to inspection at the place of manufacture, in accordance with the provisions of the referenced standards, as supplemented by the requirements herein.
- C. During the manufacture of the pipe, the OWNER or ENGINEER shall be given access to all areas where manufacturing and testing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- D. Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with requirements as applicable.

PART 2 - PRODUCTS

2.01 STEEL PROCESS PIPING

- A. The steel pipe shall consist of welded or seamless carbon steel type in accordance with ANSI B36.10. The steel pipe shall be black unless otherwise indicated or specified on the DRAWINGS. All pipe 12" and larger shall be standard weight. All steel pipe 10" diameter and smaller shall be Schedule 20, unless otherwise specified.
- B. Where flanged pipe is required, the flanges shall be ANSI 150 lb. Flanges may be screwed on using tapered pipe threading, weld neck, or slip-on welded.
- C. All flange gaskets on the piping at the treatment system shall be constructed of Kel-F or Teflon. Products containing neoprene and silicone are not recommended for TCE & PCE use.
- D. Where threaded pipe is required, screwed fittings shall be Grinnell, Providence, RI, or equal. Where welded pipe is required, fittings shall be long radius type, Tube Turns Technologies, Louisville, KY, or equal.
- E. Pipe sizes, joints, wall thicknesses, (or thickness schedule), shall be as indicated in the Pipe Schedule included with these specifications.
- F. Cement Mortar Lining. Steel pipe specified or shown on the Plans to be cement mortar lined shall be shop lined in accord with AWWA C 205, or lined after installation by means of a pipe lining machine. Lining shall be 1/4-inch minimum thickness. If a lining machine is used, it must be approved by the Owner and be capable of applying a lining comparable in density and smoothness and of the same thickness as the above specified shop applied lining. In-place lining shall conform to applicable portions of AWWA C 602.
- G. Coating. Aboveground steel pipe shall be cement mortar lined per AWWA C205 and fusion bonded epoxied per AWWA C213. Belowground steel pipe shall be cement mortar lined and coated per AWWA C205.

H. Joints

1. Threaded Joints

a. Pipe screw threads to conform to ANSI B2.1. Ream pipe ends and remove all burrs and chips after cutting and threading. Protect pipe thread during assembly. Apply thread lubricant to male threads as follows: John Crane Co., Morton Grove, IL, "Anti-Seize"; red lead graphite for vent lines and roof conductors and Teflon tape for all other services.

2. Flanged Joints

- a. Steel pipe flanges shall conform to ANSI B16.5 "Steel Pipe Flanges and Flanged Fittings." Cast iron pipe flanges shall conform to ANSI B16.1 "Cast Iron Flanges and Flanged Fittings." Steel flanges shall be raised face except when bolted to flat face cast iron flange.
- b. Flanged joints shall be made with bolts, bolt studs with nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts shall conform to the same ANSI Standard as the flanges.

- c. SAE Grade 5 zinc coated bolts shall be used for above-ground joints. Threads shall be coated with an anti-seizing compound before nut installation.
- d. 316 Stainless Steel per ASTM F593-95 with an 85,000 psi average tensile strength shall be used for buried joints. Threads shall be coated with an anti-seizing compound before nut installation.
- e. Bolting for services up to 500 degrees F shall be ANSI/ASTM A307 Grade B with square head bolts and heavy hexagonal nuts conforming to ANSI B18.2.1 "Square and Hex Bolts" and B18.2.2 "Square and Hex Nuts." Bolt studs and studs shall be of the same quality as machine bolts.
- f. Set flange bolts beyond finger tightness with an indicating torque wrench to insure equal tension in all bolts. Tighten bolts such that those 180 degrees apart or directly opposite are torqued in sequence.
- g. Gaskets for flat face flanges shall be full face type. Gaskets for raised face flanges shall conform to requirements for "Group I Gaskets" in ANSI B16.5. Gaskets shall be 1/8 in. thick minimum and of following types: Kel-F or Teflon.
- h. All welded joints shall be electric welded. Welding shall be in accord with AWWA C 206. Qualification of welders shall be as covered in AWWA C 206. All testing of welders shall be at the Contractor's expense, including cost of test nipples, welding rod, and equipment.

PART 3 - EXECUTION

3.01 PREPARATION – NONE

3.02 INSTALLATION

A. The maximum spacing between pipe supports shall be in accordance with the following table.

Steel (Std. Weight or heavier) Cast Iron, Ductile Iron	Max. Spacing		
	Steam & Liquids	Air & Gases	
1-1/2" and smaller	7'-0"	7'-0"	
2" - 3"	10'-0"	14'-0"	
4" - 6"	14'-0"	20'-0"	
8" and above	20'-0"	20'-0"	

- B. Additional supports shall be provided where the following occurs:
 - 1. where the pipe changes direction
 - 2. adjacent to flanged valves and strainers
 - 3. at equipment connections and heavy fittings
 - 4. Where indicated on the drawings
- C. The CONTRACTOR shall provide at least one hanger adjacent to each joint in cast-iron soil pipe and grooved-end steel pipe with mechanical couplings.

D. Vertical pipe runs shall be supported and laterally braced at every floor level in multistory structures and at intervals not exceeding 15 ft. in other structures.

3.03 FLUSHING AND TESTING

A. Installed piping shall be flushed and tested as per the manufacturer's specifications and the specifications contained in **Sections 40 05 13.09-11**.

SECTION 40 05 13.15 – FIELD WELDED STEEL PROCESS PIPING

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section includes emplacement of welded steel pipelines and pipe bedding, pipeline closures, welding and welded connections, lining and coating at joints, and encasement.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS NONE
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL NONE
- 1.06 SUBMITTALS
 - A. Submit shop DRAWINGS in accordance with the Section 01 33 00 Submittal Procedures.
 - B. Submit installation schedule.
 - C. Submit weld procedure specifications, procedure qualification records, and welder qualification certificates.
 - D. Submit affidavit of compliance with standards referenced herein. All tests of material referenced shall be executed prior to fabrication and installation. Submit certified results with affidavits of compliance.
- 1.07 DELIVERABLES NONE

PART 2 - PRODUCTS

- 2.01 MATERIALS
 - A. Bolts and Nuts for Flanges
 - 1. Bolts and nuts for buried flanges shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8 for bolts, and ASTM A 194, Grade 8 for nuts. Bolts and nuts for above ground flanges and flanges in vaults shall be Type 316 stainless steel. Fit shall be Classes 2A and 2B per ANSI B1.1 when connecting to valves with body bolt holes.
 - 2. Bolts for flange insulation kits shall conform to ASTM A 193, Grade B7. Nuts shall conform to ASTM A 194, Grade 2H.
 - 3. Provide washers for each nut. Washers shall be of the same material as the nuts.

2.02 EQUIPMENT – NONE

2.03 FABRICATIONS – NONE

PART 3 - EXECUTION

3.01 PREPARATION

A. Existing Conditions

1. Location and invert elevations, materials of construction, and dimensions of existing pipelines and concrete encasements shown on the DRAWINGS are approximate.

B. Delivery and Temporary Storage of Pipe at Site

- 1. Limit onsite pipe storage to a maximum of one week.
- 2. For shop lined pipe keep plastic caps or plastic with steel straps placed over the ends of each pipe until immediately prior to installation. Add water to interior of pipe if plastic cap is temporarily removed and replaced or repaired.
- 3. Do not remove the plastic caps placed over the ends until the pipe is ready to be placed in the trench. Plastic caps may be opened temporarily to spray water inside the pipe for moisture control.

C. Handling of Pipe

- 1. Lift steel pipes with two 16-inch-wide belt slings and spreader bar or as recommended by the pipe manufacturer. Do not use cable slings. Avoid damage to coating.
- 2. Measure the outside diameter of bell and spigot to check that clearance between laying surfaces is within specified tolerance prior to joint assembly.
- 3. Where internal bracing is required, place in pipes prior to joint assembly and maintain internal braces placed in pipes 24 inches and larger until authorized by the OWNER to remove.

D. Sanitation of Pipe Interior

1. When pipe laying is not in progress, close the ends of the pipe by a vermin- and child-proof plug.

3.02 INSTALLATION

A. Placement of Pipe in Trench

- 1. Control water in trench per Section 31 23 00 Excavation and Fill.
- 2. Lay pipes uphill if the pipe slope exceeds $\pm 10\%$ or otherwise hold in place by methods approved by the OWNER.
- 3. Excavate below the subgrade as shown on the construction plans. If in rock, complete excavation to a uniform foundation free of protruding rocks. Complete stabilization of foundation, per Section 31 23 00, then place and compact material specified for the bedding in Section 31 23 00 to bring the trench bottom to grade.
- 4. Place and compact the pipe base as specified in Section 31 23 00.

- 5. Cut a depression to accommodate the pipe bell and application of joint coating and spaces to permit removal of the pipe handling slings.
- 6. Each section of pipe shall be laid in the order and position shown on the pipe schedule as provided by the CONTRACTOR. Lower the pipe onto the pipe base and install it to line and grade along its full length on firm bedding except at the bell and at the sling depressions. Tolerances on grade are 1/4 inch. The tolerance on line is 1 inch.
- 7. When installing beveled pipe, do not deviate the pipe top mark by more than 1/2 inch from a vertical line passing through the pipe center.
- 8. Do not use dogs, clips, lugs or other devices welded to the pipe to force it into position.

B. Operations Incidental to Joint Completion

1. Plan joint completion to accommodate temporary test bulkheads for hydrostatic testing.

C. Flanged Connections

- 1. Inspect gasket seating surfaces, gasket, each stud or bolt, each nut, each washer, and the facing on which the nuts will rotate. Replace any damaged item.
- 2. Lubricate nuts and bolts and flange-to-nut contact surfaces with oil or graphite prior to installation.
- 3. Attach gasket with adhesive as recommended by gasket manufacturer.
- 4. Assemble all bolts in flange, then tighten bolts in the sequence and to the torque as recommended by the manufacturer. Retighten bolts after 24 hours. Replace galled, cracked, or distorted bolts and nuts. Do not reuse bolts or nuts.
- 5. Coat buried flanges with Coating System No. 24 (Division 09).
- 6. Lubricant for stainless-steel bolts and nuts shall be TRX-Synlub by Ramco, Anti-Seize by Ramco, Husk-It Husky Lube O'Seal or equal.

D. Field Welded Joints

- 1. Provide single-welded lap joints, double-welded lap joints, butt-welded joints, and butt-strap joints where detailed on the DRAWINGS. All joints shall be welded unless otherwise shown. The minimum overlap of the assembled bell-and-spigot sections of lap joints shall be as shown on the DRAWINGS. Steel pipe with wall thickness of less than 1/4" shall not be butt-welded.
- 2. Field welding shall be in accordance with AWWA C206 except as modified herein. Welder's qualifications shall be in accordance with Section IX, Part QW, of the ASME Boiler and Pressure Vessel Code. Any welder performing work shall have been qualified for the process involved within the past three years.
- 3. Prior to welding interior joint shade pipe to 60 degrees except at the joints. Complete the interior weld prior to coating the outside joint.
- 4. If joint laying surfaces are rusted or pitted where weld metal is to be deposited, clean them by wire brushing or sand blasting.
- 5. Complete the butt-welded longitudinal seams of butt-straps before completing circumferential fillet welds. Grind the backing bar clear of abutting pipe section prior to completing circumferential fillet welds. Backing bars shall be left in place.

- 6. Completed fillet welds shall be convex with a maximum reinforcement of 1/8 inch. Minimum leg length shall be the sum of the greatest abutting plate thickness plus joint clearance. Equalize joint clearance around entire circumference prior to welding. Remove all tack welds prior to the start of joint welding.
- 7. Preheat the joints to be welded where required in accordance with Table 1 of AWWA C206
- 8. Where weld metal is to be deposited, clean joints by wire brushing or sand blasting. Clean each layer of deposited weld metal prior to depositing the next layer of weld metal, including the final pass, by a power-driven wire brush.
- 9. No welding ground shall be made on the coated part of the pipe.
- 10. In all hand welding, the metal shall be deposited in successive layers so that there will be at least as many passes or beads in the completed weld as indicated in the following table:

	Fillet Weld,
Steel Cylinder	Minimum Number
Thickness (inches)	of Passes
3/16 or less	1
7/32 through 1/4	2
9/32 through 3/8	3
13/32 through 1/2	4
More than $1/2$	1 for each 1/8 inch and any
	remaining fraction thereof

- 11. The plate edges shall be so prepared that there will be sufficient angle in the welding groove to prevent side arcing of the electrode and to permit penetration at the deepest point of the groove. All such welds shall be back-chipped with a round-nosed tool to clean metal on the reverse side from the side of the deepest penetration before any welding is done on said reverse side. Each hand pass and each back-chipped welding groove shall be subject to inspection before the ensuing pass is made. Each hand pass shall be the full width of the weld.
- 12. Not more than 1/8 inch of metal shall be deposited in each pass. Each pass, whether in butt or fillet welds, shall be thoroughly brushed or hammered to remove dirt, slag, or flux before the succeeding bead is applied. Each pass shall be thoroughly fused into the plates at each side of the welding groove or fillet and shall not be permitted to pile up in the center of the weld. Undercutting along either side will not be permitted.
- 13. Complete each pass around the entire circumference of the pipe before commencing the next pass. Use the electrodes recommended by the pipe fabricator. Do not deposit more than 1/8 inch of throat thickness per pass.
- 14. During welding exterior welds, the coating of welded steel pipe shall be protected by draping an 18-inch-wide strip of heat-resistant material over the top half of the pipe on each side of the coating holdback to avoid damage to the coating by hot weld splatter. No welding ground shall be made on the coated part of the pipe.

E. Pipeline Closure Assemblies

1. Use pipeline closure assemblies to unite sections of pipeline laid from opposite directions and to adjust the field length of the pipeline to meet structures, other pipelines, and points

- established by design stations. The minimum length of pipe closure sections shall be 4 feet.
- 2. Use pipeline closure assemblies between butt-welded pipeline sections and double-welded pipeline sections.
- 3. Center the shaped steel butt straps over the ends of the pipe sections they are to join as shown on the DRAWINGS.
- 4. Cement-mortar line closure assemblies to a mortar thickness at least equal to the adjoining standard pipe sections. Clean the steel with wire brushes and apply a cement and water wash coat prior to applying the cement mortar. Where more than a 4-inch joint strip of mortar is required, place welded wire mesh reinforcement in 2-inch by 4-inch pattern of No. 13 gage over the exposed steel.
 - a. Install the mesh so that the wires on the 2-inch spacing run circumferentially around the pipe. Crimp the wires on the 4-inch spacing to support the mesh 3/8 inch from the metal surface. Steel-trowel finish the interior mortar to match adjoining mortar lined pipe sections.
 - b. Coat the exterior of closure assemblies to match adjacent specified pipe joint coating.
- 5. Field trimming of pipe shall be normal to the axis of the pipe only.
- 6. No angular deflections will be allowed at butt strap joints.

F. Completion of Inside Mortar Joints

- 1. Cement mortar used for the joints shall be composed of a minimum of one-part cement to not more than two parts sand, by weight, dry mixed, and moistened with sufficient water to permit packing and troweling without crumbling. Water shall be clean and free from injurious quantities of organic matter, alkali, salts, and other impurities.
- 2. Backfill the trench before applying interior lining at field welded joints.
- 3. Working inside the pipe, remove foreign substances which adhere to the steel joint rings, clean them, and pack cement mortar into each joint. Before placing the joint mortar material against the surfaces of the lining, the surfaces shall be carefully cleaned, have all soap removed, and then be wetted to provide a good bond between the lining and the joint mortar. Finish the surface with a steel trowel to match the adjoining pipes. For pipes of small diameter mortar the joint and pull the mortar across the inside of the joint with an inflated ball to adequately line the pipe.
- 4. Remove excess mortar and other construction debris from the pipe interior.

G. Completion of Exterior Pipe Joint

- 1. Coat the exterior of welded steel and concrete cylinder pipe joints as shown on the DRAWINGS.
- 2. Apply cement mortar coating and reinforcement to field joints as shown on the construction plans per AWWA C205. Before placing the reinforced mortar coating the braces in the bare end of the pipe shall be temporarily removed. Exterior coating at welded joints shall be applied within 1 day after weld testing. Field joints in exterior mortar coating shall be made either by pneumatically applying or by pouring mortar in a suitable diaper. Pneumatically applied mortar at field joints shall have a minimum thickness of 1 inch. Poured mortar at field joints shall overlap the adjacent pneumatically

applied mortar coating a distance of not less than 5 inches, and the thickness of the poured mortar shall be not less than 1-1/4 inches. Diapers shall be polyethylene foamlined fabric with steel strapping of sufficient strength to hold the fresh mortar, resist rodding of the mortar and allow excess water to escape. The foam plastic shall be 100 percent closed cell, chemically inert, insoluble in water and resistant to acids, alkalies and solvents. The ENGINEER may order the diapers to be removed for inspection prior to backfilling.

- 3. Above ground steel pipe shall be Fabricated and Coated in the shop. No field welding is allowed except with special permission from the ENGINEER.
- 4. Start the backfilling operations specified in **Section 31 23 33** immediately after coating the field joints.
- 5. Do not remove the cross bracing in pipe to be encased until the encasement has cured at least seven days and the subsequent backfill is completed.

H. Pipe Backfill

- 1. Provide thrust blocks for rubber gasket joints 16-inches in diameter or less per Standard DRAWINGS.
- 2. Provide sufficient space along each side of the pipe and the trench wall to observe that the backfill material fills all spaces below pipe spring line under the pipe haunches.

I. Protection of Mortar Lining

1. Until the pipeline is filled with water, install bulkheads and apply moisture inside the bulkheaded portions in a manner that will effectively prevent the drying out of the mortar lining.

3.03 TESTING – NONE

SECTION 40 05 13.33 – BRASS, BRONZE, AND COPPER PROCESS PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section covers furnishing, and installing, all copper piping, fittings, accessories, and supports, etc., with the exception of any piping which is an integral part of any equipment assembly which would be furnished by the manufacturer.

1.02 REFERENCED SECTIONS – NONE

1.03 CITED STANDARDS

- A. All copper piping and fittings shall conform to the following standard specifications, of the latest revisions, as applicable:
 - 1. ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings
 - 2. ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
 - 3. ASTM B32 Standard Specification for Solder Metal
 - 4. ASTM B88 Standard Specification for Seamless Copper Water Tube
 - 5. ASTM B 828 Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings

1.04 NOTED RESTRICTIONS

- A. Solder filler metal shall be in accordance with ASTM B32 but shall not be Alloy Sn50.
- B. Approved Manufacturers
 - 1. All materials shall be the appropriate model number of specified on the construction plans as manufactured by the companies listed herein.
 - a. Copper Tubing:
 - 1) Anaconda
 - 2) Phelps-Dodge
 - b. Service Saddle:
 - 1) James Jones J-979 or equal
 - c. Corporation Stop:
 - 1) Mueller 110 H-15013 or equal
 - d. Angle Meter Stop:
 - 1) Mueller 110 H-142258 or equal
 - e. Ninety Bend Coupling:
 - 1) Mueller 110 H-15526 or equal

- f. Insulating Pipe Bushings, Unions, or Couplings:
 - 1) Pipeline Coating and Engineering Co.
 - 2) Smith Blair
 - 3) Pipe Seal and Insulator Company

1.05 QUALITY ASSURANCE

- A. The CONTRACTOR shall furnish and install copper pipe and all associated appurtenances, complete in place, in accordance with the standard DRAWINGS and as described in these specifications.
- B. All piping shall be subject to inspection at the place of manufacture, in accordance with the provisions of the referenced standards, as supplemented by the requirements herein.
- C. During the manufacture of the pipe, the OWNER or ENGINEER shall be given access to all areas where manufacturing and testing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- D. All soldering processes, procedures, and solderers for copper and copper alloy pipe and tube shall be in accordance with ASTM B 828.
- E. Double strap bronze service saddles shall be installed on asbestos-cement or ductile iron pipe.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Pipe and tube required by the applicable standard to be cleaned and capped shall be delivered to the job site with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipe and tube from moisture and dirt. Elevate above grade. When stored inside, do not exceed the structural capacity of the floor.
- C. Protect fittings, flanges, and piping specialties from moisture and dirt.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Copper

- 1. Copper tubing shall conform to the requirements of ASTM B 88 for seamless copper water tube. Copper tubing shall be true, smooth, and clean on both inside and outside and free from any cracks, seams or other defects. It shall be truly cylindrical, of the full specified outside and inside diameters, and of uniform thickness of metal. Piping located aboveground or suspended within vaults shall be Type L. Buried piping shall be Type K.
- 2. Fittings shall be copper conforming to ASTM B 75 and ANSI B16.22, with solder end joints. Fittings 3/8 inch and smaller may have flared end connections only.
- 3. Solder shall be silver solder conforming to ASTM B32, Grade 95TA. Do not use cored solder.

B. Brass Pipe, Nipples, and Fittings

1. Short threaded nipples, brass pipe and fittings shall conform to ASTM B 43, Schedule 40. Threads shall conform to ANSI B2.1.

C. Bronze Appurtenances

- 1. All items specified herein shall be manufactured of bronze conforming to ASTM B 62, "Composition Brass or Ounce Metal Castings."
- 2. All service saddle bodies shall be manufactured of bronze and shall be tapped for an iron pipe thread. The seal with the pipe shall be affected with either a rubber gasket or an O-ring.
 - a. Service saddles shall be the double strap type for all sizes of asbestos-cement or ductile iron pipe. The straps (or bails) shall be flat and shall be manufactured of Everdur or Silnic bronze.
- 3. Corporation stops shall be manufactured of bronze. The inlet fitting shall be a male iron pipe thread when used with saddle and the outlet connection shall be a compression type.
- 4. Angle meter stops shall be manufactured of bronze. The inlet connection shall be a compression type and the outlet fitting shall be a meter flange or meter coupling. The inlet and outlet shall form an angle of 90 degrees on a vertical plane through the centerline of the meter stop. A rectangular lug and lock wing shall be provided on the top of the fitting to operate the shutoff mechanism. Two-inch angle meter stops shall be with "slotted" holes for 1-1/2-inch or 2-inch meters.

D. Flanges, Gaskets, Bolts, and Nuts

- 1. Connect to flanged valves and fittings with bronze flanges conforming to ANSI B16.24, Class 125 or Class 150, to match the connecting flange. Use solder end companion flanges.
- 2. Gaskets shall be full face, 1/8-inch thick, and shall be one of the following non-asbestos materials:
 - a. Cloth-inserted rubber. Products: John Crane Co. Style 777 or equal. Gaskets shall be suitable for a pressure of 200 psi at a temperature of 180°F.
 - b. Acrylic or aramid fiber bound with nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal. Gaskets shall be suitable for a water pressure of 500 psi at a temperature of 400°F.
- 3. When both aboveground adjoining flanges are bronze, use bronze bolts and nuts. Bolts shall conform to ASTM F 468, Grade C65100 or C63000. Nuts shall conform to ASTM F 467, Grade C65100 or C63000.
- 4. When only one of the aboveground adjoining flanges is bronze, use Type 316 stainless steel bolts and nuts conforming to ASTM A 193, Grade B8M for bolts, and ASTM A 194, Grade 8M for nuts.
- 5. Connect to buried ferrous flanges with flange insulation kits. Bolts used in flange insulation kits shall conform to ASTM B 193, Grade B7. Nuts shall comply with ASTM A 194, Grade 2H. If the adjoining buried flange is bronze, use bronze bolts and nuts as described above, without a flange insulation kit.

6. Provide one (1) washer for each nut. Each washer shall be of the same material as the nut.

2.02 JOINING MATERIALS

A. Solder filler metal shall be in accordance with ASTM B32 and shall be Alloy Sn95 or Alloy Sn94; where Tin (Sn) is approximately 95%, and Silver (Ag) is approximately 5%, having 0.10% maximum Lead (Pb) content.

PART 3 - EXECUTION

3.01 PREPARATION – NONE

3.02 INSTALLATION

A. Copper Tubing and Fittings

- 1. Cut tubing square and remove burrs. Clean both the inside and outside of fitting and pipe ends with steel wool and muriatic acid before soldering. Prevent annealing of fittings and tubing when making connections. Do not miter joints for elbows or notch straight runs of pipe for tees.
- 2. Bends in soft copper tubing shall be long sweep. Shape bends with shaping tools. Form bends without flattening, buckling, or thinning the tubing wall at any point.
- 3. Brazing procedures shall be in accordance with Articles XII and XIII, Section IX, of the ASME Boiler and Pressure Vessel Code. Silver solder shall be used. Solder shall penetrate to the full depth of the cup in joints and fittings. Solderers shall comply with ANSI B31.3, paragraph 328.
- 4. Buried piping shall be installed with some slack to provide flexibility in the event of a load due to settlement, expansion or contraction. A MINIMUM COVER OF 36 INCHES BELOW THE FINISHED STREET GRADE SHALL BE ADHERED TO. The tubing is to be bedded and covered with sand or select material as determined by the ENGINEER.
- 5. All 2-inch size services shall be installed with straight lengths of soft copper water tube Type K. Solder or compression fittings are acceptable on only the corporation stop and angle meter stop. All couplings and adapters shall be silver soldered.

B. Service Saddle

- 1. The service saddle shall be no closer than 18 inches to a valve, coupling, joint, or fitting unless it is at the end of the main. The installation of a service saddle on any machined section of ACP will NOT be permitted.
- 2. The surface of the pipe shall be filed to remove all loose material and to provide a hard, clean surface before placing the service saddle.
- 3. The service saddle shall be tightened firmly to ensure a tight seal; however, care shall be used to prevent damage or distortion of either the corporation stop or service saddle by overtightening.
- 4. The tap into the pipe shall be made in accordance with the pipe manufacturer's recommendation.

- C. Installing Flange Bolts and Nuts
 - 1. Lubricate bolt threads with graphite and oil prior to installation.
 - 2. Set flange pipe with the flange bolt holes straddling the pipe horizontal and vertical centerlines.
- D. Insulating Bushings and Unions
 - 1. Pipe or fittings made of nonferrous metals shall be isolated from ferrous metal by nylon insulating pipe bushings, union, or couplings.
- 3.03 TESTING NONE

SECTION 40 05 13.53 – DUCTILE, MALLEABLE, AND CAST IRON ALLOYS PROCESS PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section covers furnishing, installing, and testing (where required), all ductile iron process piping and its appurtenances. Piping shall be erected true to line and grade by skilled mechanics in strict accordance with these specifications and the DRAWINGS.

1.02 REFERENCED SECTIONS – NONE

1.03 CITED STANDARDS

- A. All pipe, fittings and accessories shall conform to the requirements of the following standard specifications, of the latest revisions, as applicable:
 - 1. ASI B16.1 Cast Iron Pipe Flanges
 - 2. ANSI B16.5 Pipe Flanges and Flanged Fittings Steel Nickel Alloy and Other Special Alloys
 - 3. ASTM D 2000 Classification System for Rubber Products in Automotive Applications
 - 4. AWWA C219 Bolted, Sleeve-Type Couplings for Plain End Pipe
 - 5. ANSI/AWWA C104/A21.4 Cement-mortar Lining for Ductile Iron Pipe and Fittings for Water
 - 6. ANSI/AWWA C110/A21.10 Ductile Iron and Gray Iron Fittings, 3-in. through 48-in. for Water and Other Liquids
 - 7. ANSI/AWWA C111/A21.11 Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings
 - 8. ANSI/AWWA C115/A21.15 Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges
 - 9. ANSI/AWWA C150/A21.50 Thickness Design of Ductile Iron Pipe
 - 10. ANSI/AWWA C151/A21.51 Ductile Iron Pipe, Centrifugally Cast for Water
 - 11. ANSI/AWWA C153/A21.53 Ductile Iron Compact Fittings, 3-in. through 24-in. and 54-in. through 64-in. for Water Service
 - 12. ANSI/AWWA C600 Installation of Ductile Iron Water Mains and their Appurtenances
 - 13. ANSI/AWWA C606 Grooved and Shouldered Joints
 - 14. ANSI/AWS D11.2 Guide for Welding Iron Casting

1.04 NOTED RESTRICTIONS – NONE

1.05 QUALITY CONTROL

A. All ductile iron piping and its appurtenances shall include cement-mortar lining in accordance with AWWA C104, and shall satisfy NSF 60 and 61 requirements.

- B. The CONTRACTOR shall furnish and install ductile iron pipe and all appurtenances, complete in place, all in accordance with the standard DRAWINGS and as described in these specifications.
- C. Ductile iron pipe shall conform to AWWA C151, subject to the following supplemental requirements. The pipe shall be of the diameter and class shown, shall include cement-mortar lining, shall be furnished complete with rubber gaskets, and shall be furnished with all specials and fittings as required in the DRAWINGS or specified herein.
- D. The ductile iron pipe, and its fittings shall be provided by American Ductile Iron Pipe (a division of American Cast Iron Pipe Company, Birmingham, Alabama) or an equal approved by the ENGINEER.
- E. Where piping connects to equipment, particular care shall be taken to see that pipe fittings are suitable for connection to the equipment fittings.
- F. Pipe-laying lengths shall be provided in 20-foot nominal lengths with allowable trim-pipe lengths in accordance with AWWA C151 and special shorter lengths provided as required by the DRAWINGS.

PART 2 - PRODUCTS

2.01 PIPING

- A. All ductile iron pipe shall be designed and manufactured in accordance with AWWA C150 and AWWA C151, respectively, for the following minimum operating conditions:
 - 1. The minimum internal design pressure shall be 150 psi with a 100-psi surge allowance, with a safety factor of 2, for a total internal design pressure of 500 psi. No reduction of safety factor for transient pressures shall be allowed.
 - 2. The external loads design criteria shall be a minimum of 4 feet depth of cover at 120 lbs. per cubic feet soil weight, and live load based on one AASHTO H-20 truck load. The thickness design of ductile iron pipe shall be in accordance with AWWA C150.
 - 3. The horizontal deflection of cement-mortar-lined ductile iron pipe resulting from external load conditions shall not exceed three percent of the pipe diameter.

2.02 JOINTS

A. Joints for ductile iron pipe and fittings shall be push-on joints, restrained joints, mechanical joints, flanged, joints, and grooved joints as specified in this section.

B. Restrained Joints

- 1. Restrained joints shall be "Flex-Ring" or "Lok-Ring" restrained joints as manufactured by American Ductile Iron Pipe or an approved equal.
- 2. Field-adaptable restraint shall be provided through the use of "Fast-Grip" or "Field Flex-Ring" as manufactured by American Ductile Iron Pipe or other pre-approved and boltless, push-on restrained devices.

- 3. When restrained joints require factory welding, the CONTRACTOR shall qualify all welding procedures and welders used to produce the product per the requirements of a documented quality assurance system based on ANSI/AWS D11.2.
- 4. Unless otherwise specified, gasket material shall be standard styrene butadiene copolymer (SBR). Restrained joints and restrained joint pipe shall be rated for the pressure rating specified in the Piping Schedule or in the DRAWINGS.
- 5. The CONTRACTOR shall furnish test results showing that restrained joints in the sizes specified have been successfully tested to at least twice the specified pressure rating of the joint without leakage or failure. Tests shall be performed on pipe with nominal metal thickness less than or equal to that specified for the project. Torque-activated restrained joint devices that rely on threaded bolts or set-screws for joint restraint shall not be used.

C. Flanged Joints (Pipe)

- 1. Flanged pipe thread-fabrication shall be Special Thickness Class 53 in accordance with AWWA C115. Threaded companion flanges for ductile iron pipe shall be ductile iron in accordance with AWWA C115, not ANSI B16.1. Flange fittings shall be ductile iron in accordance with AWWA C110or AWWA C153, not ANSI B16.1.
- 2. Bolt circle and bolt holes match those of ANSI B16.1 class 125 and ANSE B16.5 class 150 flanges. The flanges shall be rated for at least 250 psi working pressure.
- 3. The threaded flanges shall be individually fitted and machine tightened on the pipe ends.
- 4. Bolts, gaskets, and installation shall be in accordance with AWWA C115, Appendix A requirements, and flanged gaskets shall be Toruseal gaskets as manufactured by American Ductile Iron Pipe, with a special seal design.
- 5. As noted in the appendices of various ANSI/AWWA standards and AWWA Manual M41, the use of flanged joints underground is generally not recommended because of the rigidity of the joint.
- 6. To insure accountability, all flanged pipe shall be fabricated at the factory by the pipe manufacturer.

D. Expansion Joints

- 1. Flexible expansion joints shall be installed in the locations indicated on the DRAWINGS and shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53. Foundry certification of material shall be readily available upon request.
- 2. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 350 psi (250 psi for flexible expansion joints 2 inch and 30 inches diameter and larger.) A minimum 2:1 safety factor, determined from the published pressure rating, shall apply. Factory Mutual Approval for the 3 inch through 12 inch sizes is required.
- 3. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 20°, 2" 12"; 15°, 14" 36"; 12°, 48" and 4-inches minimum expansion.
- 4. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213 and shall be holiday tested with a 1500 volt spark test conforming to said specification.

- Sealing gaskets shall be constructed of EPDM. The coating and gaskets shall meet ANSI/NSF-61.
- 5. Appropriately sized polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be included for direct buried applications.
- 6. Manufacturer's certification of compliance to the above standards and requirements shall be readily available upon request. The OWNER'S REPRESENTATIVE shall reserve the right to inspect the manufacturer's facility for compliance.
- 7. All flexible expansion joints shall be FLEX-TEND 8" nominal pipe size, flange connected, double ball assembly number 408F22 with minimum 12" extension as manufactured by EBAA Iron, INC., Eastland, TX.

2.03 FLEXIBLE PIPE COUPLINGS

- A. Flexible pipe couplings and flanged coupling adapters shall be installed in the locations indicated on the DRAWINGS and shall be manufactured conforming to the requirements of ASI B16.1, ANSI B16.5, ASTM D 2000 and AWWA C219, as applicable.
- B. Approved Manufacturers for are as follows:
 - 1. Flexible Couplings
 - a. Dresser Industries (Style 38)
 - b. Romac Industries (C400 Series)
 - c. Smith-Blair, Inc. (Style 411)
 - 2. Flanged Coupling Adapters
 - a. Dresser Industries (Style 127 or 128)
 - b. Romac Industries (C400 Series)
 - c. Smith-Blair, Inc. (900 Series)
 - 3. Grooved Type Couplings
 - a. Victaulic Style 77
 - 4. Transition Couplings
 - a. Transition couplings for connecting different pipes having different outside diameters shall be Dresser Style 162 couplings or ENGINEER approved equivalent.

C. Construction

1. Flexible couplings shall be provided where shown, and shall be of steel with stainless steel bolts and nuts (300 Series), without pipe stop, and shall be of sized to fit the pipe and fittings shown. The middle ring shall not be less than 1/4-inch in thickness and shall be at least as thick as that specified for the size of pipe in which the coupling is to be used. Middle ring shall be 7 inches long (minimum) for pipe sizes through 24 inches and shall be 10 inches long (minimum) for pipe sizes larger than 24 inches. The followers shall be single-piece contoured mill sections, welded and cold-expanded as required for the middle rings. They shall be of sufficient strength to accommodate the number of

- bolts necessary to obtain adequate gasket pressure without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket.
- 2. Flexible couplings shall have middle rings made of steel conforming to ASTM A36, A53 (Type E or S), or A512 having a minimum yield strength of 30,000 psi. Follower rings shall be malleable iron (ASTM A47, Grade 32510), Ductile Iron (ASTM A 536), or steel (ASTM A108, Grade 1018 or ASTM A510, Grade 1018 or 1021).
- 3. Flanged coupling adapters shall be provided where shown and shall be cast iron bodied meeting the requirements of ASTM A-126, Class B. Flanges shall be of the size and class shown on the plans and shall mate with a standard cast iron flange meeting the requirements of ANSI B16.1. Flanged coupling adapters shall adapt plain end A.C. pipe or ductile or cast iron to cast iron, ductile iron, and steel flanges.
- 4. Grooved type couplings shall be Victaulic standard couplings, Style 77. Pipe ends at couplings shall be grooved-type for steel pipe and meet the manufacturer's design tolerances. Gaskets shall be molded, Grade E. Couplings shall be installed per the manufacturers printed instructions.

D. Gaskets

- 1. Gaskets for flexible couplings shall be a rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. The rubber in the gasket shall meet the following specifications:
 - a. Color Jet Black
 - b. Surface Non-Blooming
 - c. Durometer Hardness 74 ± 5
 - d. Tensile Strength 1000 psi Minimum
 - e. Elongation 175 Percent Minimum
- 2. The gaskets shall be immune to attack by impurities normally found in water. All gaskets shall meet the requirements of ASTM D 2000, AA709Z, meeting Suffix B13 Grade 3, except as noted above.

E. Bolts and Nuts for Couplings

- 1. Bolts and nuts for flexible couplings, transition couplings, and flanged coupling adapters shall be 316 stainless steel.
- 2. Bolts and nuts for Victaulic couplings shall be 316 Stainless Steel.

F. Gaskets

1. Gaskets for flanged coupling adapters shall be as described in Section 40 05 13.

G. Painting and Coating

- 1. Coat flexible couplings externally and internally with a fusion bonded epoxy coating in accordance with **Section 09 99 00**.
- 2. Flexible couplings shall be coated on their interior and exterior metal surfaces excluding seating areas and bronze and stainless steel pieces. Sandblast surfaces in accordance with SSPC SP-5. Remove all protuberances which may produce pinholes in the lining. Round

all sharp edges to be coated. Remove any contaminants which may prevent ponding of the lining. Coat the interior ferrous surfaces using the following method:

- a. Apply powdered thermosetting epoxy (Scotchkote 134 or equal) per the manufacturer's application recommendations to a thickness of 16 mils.
- 3. All epoxy coatings shall be applied by the coupling manufacturer.

2.04 FITTINGS

- A. Fittings shall be ductile iron in accordance with AWWA C110, AWWA C153, or AWWA C606, latest revisions.
- B. Buried Service Fittings: Fittings, sizes 4" 24", with push-on, restrained push-on, or mechanical joints shall be rated for 350 psi working pressure.
- C. Flanged joints for 12" and smaller sizes may also be rated for 350 psi when used with AMERICAN Toruseal gaskets.

2.05 LINING AND EXTERIOR COATING

- A. For Buried Ductile Iron Pipe: The exterior of ductile iron pipe, special, and fittings shall be coated with a 1-mil asphaltic coating in accordance with AWWA C151, Section 51-9.
- B. Except as otherwise specified, all ductile iron pipe and fittings shall be cement mortar lined in accordance with ANSI A 21.4 (AWWA C 104). Special attention shall be given to the lining of fittings. Lining shall be applied to clean bare metal. All lining shall extend to the faces of flanges, to the end of spigots, or to the shoulder of hubs, as the case may be.
- C. Ductile iron pipe underground shall be protected against external corrosion by loose polyethylene sleeves in accordance with AWWA C 105.
- D. Polyethylene encasement shall be in accordance with AWWA C105. Tears shall be repaired and joints made with double plastic tape wrap. Manufacturers shall be Tape for Tape Wrap: Polyken Pipeline Coatings, Polyken No. 910; The Tapecoat Company, Tapecoat CT; or equal.

2.06 FACTORY TESTING

- A. All Ductile Iron pipe shall be subject to a factory hydrostatic test of at least 500 psi for a period of not less than 10 seconds as specified by AWWA C151.
- B. Suitable controls and recording devices shall be provided so that the test pressure and duration are positively controlled.
- C. Any pipe that leaks or does not withstand the test pressure is rejected.

PART 3 - EXECUTION

3.01 PREPARATION

A. The CONTRACTOR shall install the ductile iron piping in accordance with the requirements of Section 40 05 13 Common Work Results for Process Piping.

B. Pipe Preparation

1. The ends of the pipe, where specified or shown, shall be prepared for flexible steel couplings. Plain ends for use with coupling shall be smooth and round for a distance of 12 inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point, to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.

C. Backfill

- 1. All backfill within 24 inches of pipe couplings shall be clean, washed concrete sand.
- 2. Backfill is to be placed and compacted in accordance with Section 31 23 33 Trenching and Backfilling.

3.02 INSTALLATION

- A. When installing flexible couplings or flanged coupling adapters, care shall be taken that the connecting pipe ends, couplings and gaskets are clean and free of all dirt and foreign matter with special attention being given to the contact surfaces of the pipe, gaskets and couplings. The couplings shall be assembled and installed in conformity with the recommendation and instruction of the coupling manufacturer.
- B. Wrenches used in bolting flexible couplings and flanged coupling adapters shall be of a type and size recommended by the coupling manufacturer. Coupling bolts shall be tightened so as to secure a uniform annular space between the follower rings and the body of the pipe and all bolts tightened approximately the same amount. Diametrically opposite bolts shall be tightened progressively and evenly. Final tightening shall be done with a suitable, approved and calibrated torque wrench set for the torque recommended by the coupling manufacturer. All clamping torque shall be applied to the nut only.
- C. All couplings which are to be buried shall be wrapped with 8-mil polyethylene wrap per AWWA C105.

D. Blocking

- 1. All bends in excess of 10 degrees, plugs, caps, tees, and wye branches along pipelines shall be adequately blocked to prevent the lines from pulling apart under pressure.
- Lugged fittings and tie rods, clamps, collars, restrained joints, and anchoring fittings may
 be substituted in lieu of blocking after having received the approval of the ENGINEER.
 Concrete used for blocking and anchoring pipelines in trenches shall consist of concrete
 as specified elsewhere in these specifications.

END OF SECTION

SECTION 40 05 13.73 – PLASTIC PROCESS PIPING

PART 1 - GENERAL

- 1.01 SECTION INCLUDES
 - A. This section includes a description of Plastic Pipe.
- 1.02 REFERENCED SECTIONS NONE
- 1.03 CITED STANDARDS
 - A. All plastic process piping shall adhere to the following standards, or latest revisions of:
 - 1. ASTM D1784 08 Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
 - 2. ASTM D1785 06 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
 - 3. ASTM D 3034 Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
 - 4. AWWA C900-07, AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution
 - 5. ANSI/AWWA C905-08, AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm), for Water Transmission and Distribution
 - 6. ASTM D 2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
- 1.04 NOTED RESTRICTIONS NONE
- 1.05 QUALITY CONTROL NONE
- 1.06 DELIVERABLES NONE

PART 2 - PRODUCTS

- 2.01 MATERIALS
 - A. PVC (Polyvinyl Chloride) Pressure Pipe, 8-Inches and Smaller, Solvent Welded
 - 1. PVC pressure pipe 8-inches and smaller shall be made from all new rigid un-plasticized polyvinyl chloride and shall be Normal Impact Class 12454-B, Schedule 40, to conform to ASTM D 1785, unless otherwise shown. Elbows and tees shall be of the same material and schedule as the pipe. Unless otherwise shown, joint design shall be for solvent-welded construction. Pressure pipe shall be as specified in this article, as specified in Section 40 06 00 Schedule for Process Integration, or shall be as follows:

- a. Pipe shall meet the requirements of AWWA C900 "Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-Inch through 12-Inch with maximum DR of 18.
- b. Provisions must be made for expansion and contraction at each joint with an elastomeric seal.
- c. The bell shall consist of an integral thickened wall section with an elastomeric seal. The wall thickness in the bell section shall conform to the requirements of Section 6.2 of ASTM D3139, "Standard Specification for Joint for Plastic Pressure Pipes Using Flexible Elastomeric Seals."
- d. When used for potable water systems, pipe shall meet the requirements of ANSI/NSF 61 "Drinking Water System Components Health Effects."
- e. The pipe shall be manufactured to cast iron outside diameters (CIOD) in accordance with AWWA C900.
- f. The seal shall meet the requirement of ASTM F477 "Standard for Elastomeric Seals (Gaskets) for Joining Plastic Pipe."

B. Gravity Sewer Pipe (PVC DR25 18"-24")

- 1. Material: PVC compound shall meet cell class 12454 per ASTM D 1784 and shall be certified to ANSI/NSF Standard 61 for potability.
- 2. Pipe shall meet AWWA C905 and shall be UL listed.
- 3. Elastomeric Seal: Integral bell pipe shall be provided with factory-installed gaskets, which meet the requirements of ASTM F 477.
- 4. Gasketed Joint Assembly shall meet the requirements of ASTM D 3139.

C. Drain Waste Vent Pipe (PVC DR ½" – 8")

1. Pipe shall be schedule 40, extruded from PVC Compound having a minimum Cell Classification 12454B as defined in ASTM D 1784. Belled end shall conform to ASTM D 2672, "Joints for PVC Pipe Using Solvent Cements", and shall conform to ASTM D 2855.

D. Gravity Sewer Pipe (PVC DR25 4"-15")

- 1. Gravity sewer pipe and fittings shall comply with AWWA C900 or be made from polyvinyl chloride compounds which comply with the requirements for a minimum cell classification of 12364A ad defined by ASTM D-1784.
- 2. All pipe joints shall be of the bell and spigot type with electrometric seals and conform to the requirements of AWWA C900 or ASTM D-3212. Gaskets shall be factory installed and chemically bonded to the bell end of the pipe. Gasket material shall conform to the requirements of ASTM F-477.
- 3. All fittings shall be fabricated from pipe meeting the requirements of these standards. Fabricated miter joints shall be reinforced by fusion heat welding.
 - a. There shall be no sign of flaking or disintegration when immersed in anhydrous acetone for 20 minutes as described in ASTM D-2152.
- 4. PVC gravity sewer pipe and fittings shall conform to ASTM D 3034.

5. Each pipe shall be identified with the name of manufacturer, nominal size, cell classification, ASTM designation F-1803, the pipe stiffness designation "PS-46" and manufacture's date code.

PART 3 - EXECUTION

3.01 PREPARATION – NONE

3.02 INSTALLATION

- A. All pipe, fittings, etc. shall be carefully handled and protected against damage, impact shocks and free fall. All pipe handling equipment shall be acceptable to the ENGINEER. Pipe shall not be placed directly on rough ground, but shall be supported in a manner which will protect the pipe against injury whenever stored at the work site. All pipe damaged prior to Substantial Completion shall be repaired or replaced by the CONTRACTOR.
- B. The CONTRACTOR shall inspect each pipe and fitting prior to installation to ensure that there are no damaged portions of the pipe. Damaged pipe shall be replaced with new undamaged sections of pipe.
- C. Before placement of the pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the Work. As pipe laying progresses, the CONTRACTOR shall keep the pipe interior free of all debris. The CONTRACTOR shall completely clean the interior of the pipe of all sand, dirt, rocks and any other debris following completion of pipe laying prior to testing, disinfecting and placing the completed pipeline in service.
- D. Pipe shall be laid directly on the imported bedding material. No blocking will be permitted and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Bell holes shall be formed at the ends of the pipe to prevent joint loading at the bells or couplings.
- E. Where necessary to raise or lower the pipe grade due to unforeseen obstructions or other causes, the ENGINEER may change the alignment and/or the grades. Such change shall be made by the deflection of joints or by the use of additional fittings. However, in no case shall the deflection in the joint exceed the maximum deflection recommended by the pipe manufacturer.
- F. No pipe shall be installed upon a foundation into which frost has penetrated or any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench will be backfilled before the formation of ice and frost occurs.
- G. Immediately before jointing bell and spigot pipe, both the bell and spigot end of the pipe shall be thoroughly cleaned and lubricated with an approved vegetable-based lubricant. The spigot end of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper alignment. Tilting of the pipe to insert the spigot into the bell will not be permitted.

- H. Solvent-welded and heat-fused joints shall be carefully and thoroughly cleaned immediately before joining the pipe. Particular care shall be taken in making solvent-welded joints to ensure a uniform, homogeneous and complete bond.
- I. Testing None

END OF SECTION

SECTION 40 71 13 – MAGNETIC FLOW METERS

GENERAL

1.01 SCOPE OF WORK

- A. This section covers the Magnetic Flowmeters to be provided where indicated on the Drawings. The flowmeters shall consist of two parts with manufacturer supplied interconnecting wiring, the field installed flow element and the flow indicating transmitter.
- B. Related work specified elsewhere includes, but is not limited to section 26 00 00 Electrical. Also, refer to requirements of Contract Documents for testing, adjusting and balancing of systems.

1.02 QUALITY ASSURANCE

A. Equipment to be furnished under this section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the Contractor from responsibility for the proper installation and functioning of the work.

1.03 SUBMITTALS

- A. The following material shall be submitted to the Engineer prior to installation, in accordance with Section 26 00 00, and as required elsewhere in the Contract Documents:
 - 1. Where applicable, provide complete manufacturer's part number, identifying scaling, operating range, housing and wetted parts materials, NEMA rating, product options, consumable materials, and other pertinent information.
 - 2. Prior to Final Acceptance of the work, the Contractor shall provide Operations and Maintenance Manuals, in accordance with the Contract Documents.

PART 2 - PRODUCTS

2.01 MAGNETIC FLOWMETERS:

- A. Acceptable Manufacturers:
 - 1. ABB model FEV
 - 2. No equal.

B. Materials:

1. All mounting hardware shall be 316 stainless steel, the instrument enclosure shall be rated NEMA 4X, the flow sensor liner shall be polypropylene lined, and the electrode material shall be 316 stainless steel.

C. Design and Fabrication:

- 1. Utilize characterized field principle of electromagnetic induction to produce signal directly proportional to flow rate.
- 2. Provide flanged end connections per ANSI B16 rated for piping system operating and test conditions.
- 3. Operating pressure: 100 psi.
- 4. Operating temperature: 122 DegF.

- 5. Grounding requirements:
 - a. Nonmetallic or lined pipe:
 - 1) Inlet and outlet grounding rings of same material as electrode.
 - b. Conductive piping:
 - 1) Conductive path between the meter and the piping flanges.
- 6. Provide cable between magnetic flowmeter and transmitter.
- 7. Pulsed DC magnetic field excitation.
- 8. Automatic zero
- 9. Adjustable low flow cutoff.
- 10. 16-character alphanumeric display shall indicate user-defined flow units and total flow. All menu advice and commands shall be viewed on this display.
- 11. Minimum signal lock (empty tube zero) to prevent false measurement when tube is empty.
- 12. Accuracy:
 - a. \pm -0.5 percent of rate above 1 fps.
 - b. ± -0.01 fps below 1.0 fps.
 - c. 4-20 mA DC isolated output into maximum 800 ohms.
 - d. Scaled frequency output, 24 VDC.
 - e. Power supply: 117 V +/- 10 percent, 60 HZ.
 - f. Meter operable as specified in liquids with 5.0 micromho/cm or more conductivity.
- 13. Electrodes shall be self-cleaning.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Equipment and materials specified in this section shall be installed and connected as specified, and as shown on the Drawings. The Contractor shall coordinate the installation with the other trades, to insure proper installation of the flow element, transmitter, and associated conduit and cables.
- B. The Contractor shall calibrate the instruments to the proper ranges, as required by the Owner and the Engineer. Where analog signals are connected to local, or remote monitoring equipment, the Contractor shall verify that the calibrated ranges and scaling of the local and remote indicators are correct.

3.02 ACCEPTANCE

A. Prior to final acceptance of the work, the Contractor shall certify the equipment and installation included under this section to be free of defects, and suitable for trouble-free operation under the conditions set forth in these specifications. This requirement is in addition to the manufacturer's guarantee.

3.03 SPARE PARTS

A. Provide the Owner with a list of the manufacturers' recommended spare parts.

End of Section

SECTION 40 73 26 - LIQUID PRESSURE PROCESS MEASUREMENT TRANSMITTERS

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes furnishing Pressure Transmitters as shown on the Drawings and specified herein.
- B. Related work specified elsewhere includes, but is not limited to Section 26 00 00, electrical. Also refer to requirements of Contract Documents for testing, adjusting and balancing of systems.

1.02 QUALITY ASSURANCE

A. Equipment to be furnished under this section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the Contractor from responsibility for the proper installation and functioning of the work.

1.03 SUBMITTALS

- A. The following material shall be submitted to the Engineer prior to installation, in accordance with Section 26 00 00, and as required elsewhere in the Contract Documents:
 - 1. Where applicable, provide complete manufacturer's part number, identifying scaling, operating range, housing and wetted parts materials, NEMA rating, product options, consumable materials, and other pertinent information.
 - 2. Prior to Final Acceptance of the work, the Contractor shall provide- Operations and Maintenance Manuals, in accordance with the Contract Documents.

1.04 MANUFACTURERS

A. Pressure transmitter manufacturers shall be Endress Hauser, Rosemount, or approved equal.

PART 2 - PRODUCTS

2.01 PRESSURE TRANSMITTER

- A. Provide pressure transmitters with 1/2 inch NPT process connection, block and bleed valve, and local LCD indicator scaled in engineering units.
- B. Transmitters shall be of a two-wire type, 24 VDC powered, producing a 4 to 20 mA output proportional to the calibrated pressure range of the instrument. Transmitters shall be capable of driving a 500 ohm loop load.
- C. Instrument accuracy shall be within plus or minus 0.5 percent of span, and a 0.2 percent repeatability. Dead band shall be within 0.1 percent of span.

- D. Transmitters shall have external zero and span adjustment for field calibration. Instrument enclosure shall be NEMA 4, with 316 stainless steel wetted parts.
- E. Diaphragm seals shall be manufactured by Ashcroft, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment and materials specified in this section shall be installed, connected, and tested in accordance with the manufacturers' recommendations, and as shown on the Drawings. Contractor shall coordinate with other trades to insure proper connection to piping and other mechanical equipment.

3.02 ACCEPTANCE

A. Prior to final acceptance of the work, the Contractor shall certify the equipment and installation included under this section to be free of defects, and suitable for trouble-free operation.

END OF SECTION

SECTION 40 73 36 - LIQUID PRESSURE PROCESS MEASUREMENT SWITCHES

PART 1 - GENERAL

1.01 SCOPE

- A. This section covers Pressure Switches and Differential Pressure Switches as shown on the Drawings.
- B. Related work specified elsewhere includes, but is not limited to Section 26 00 00, Electrical Requirements. Also refer to requirements of General Conditions for testing, adjusting and balancing of systems.

1.02 QUALITY ASSURANCE

- A. Equipment to be furnished under this section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for and guarantee performance of the equipment furnished. However, this shall not be construed as relieving the Contractor from responsibility for the proper installation and functioning of the equipment.
- B. Reference standards shall be the latest edition, including addenda, supplements, and revision. Applicable reference publications include the following:

NEC NEMA

1.03 SUBMITTALS

- A. Submit product information cut sheets containing manufacturer's specifications, Operations and Maintenance data, instrument enclosure type, installation location, and process pressure range to be supplied. Indicate product part number in full.
- B. Provide submittals in accordance with Section 26 00 00, and elsewhere in the Contract Documents.

PART 2 - PRODUCTS

2.01 PRESSURE SWITCHES

- A. Pressure switches shall be capable of dual control with independent set points and adjustable deadbands. Differential pressure switches shall be capable of single control with adjustable set points and adjustable deadband. Switches shall be snap action, single-pole, double-throw switching elements with an electrical rating of at least 10 amperes at 120 VAC. Pressure switches shall be enclosed in a NEMA 4 or weatherproof housing.
- B. Operating pressures and set points shall be determined in the field, unless otherwise indicated on the Drawings.

- C. Set points shall be fully adjustable and shall be in the middle of the working range. Set point adjustments shall be made with adjustment screws or thumbwheels. Accuracy shall be plus or minus one percent of adjustable range.
- D. For pressures up to 150 PSIG pressure sensing element shall be of the diaphragm or bourdon tube type, and shall have a proof pressure of at least twice the maximum working pressure. For pressures above 150 PSIG, sensing element shall be bourdon tube type. Diaphragms or bourdon tubes shall be stainless steel.
- E. Pressure switches shall be installed with individual ball valves for isolation. Valve material shall be compatible with the process piping and process fluid. In addition, process piping up to the sensor shall be insulated to protect against freezing.
- F. Pressure switches shall be as manufactured by Barksdale Controls Series D2H, Mercoid Controls Series DAW, Ashcroft, Dwyer, Omega, or equal.
- G. Differential pressure switches shall be as manufactured by Barksdale Controls Series DPD1T, Mercoid Controls Series DPAW, Ashcroft Instruments GDA-Series, or equal.
- H. Diaphragm seals shall be manufactured by Ashcroft, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment and materials specified in this section shall be installed and connected as specified and shown on the drawings. Contractor shall coordinate with Mechanical and Piping to insure proper connection to piping and/or other mechanical equipment.

3.02 ACCEPTANCE

A. As a condition precedent to final acceptance of the work, the Contractor shall certify the equipment and installation included under this section to be free of defects, and suitable for trouble-free operation under the conditions set forth in these specifications. This requirement is in addition to the manufacturer's guarantee.

END OF SECTION

SECTION 40 75 53 - TURBIDITY ANALYZER

PART 1 - GENERAL

1.01 SCOPE

- A. This section includes furnishing a turbidity transmitter/sensor for in-process measurement.
- B. Equipment listed for this section includes the controller and turbidimeter sensor.

1.02 QUALITY ASSURANCE

- A. Equipment to be furnished under this section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed a relieving the Contractor from responsibility for the proper installation and functioning of the work.
- B. Manufacturing facilities certified to the quality standards of ISO Standard 9001 Quality Systems Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

1.03 SUBMITTALS

- A. Furnish complete Product Data, Shop Drawings, Test Reports, Operating Manuals, Record Drawings, Manufacturer's certifications, Manufacturer's Field Reports
 - 1. Product Data.
 - 2. Dimensional Drawings.
 - 3. Materials of Construction.
 - 4. Measurement range.
 - 5. Classification Rating.
 - 6. Power.
 - 7. Output options.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store all instruments in a dedicated structure with space conditioning to meet the recommended storage requirements provided by the manufacturer.
- B. Any instruments that are not stored in strict conformance with the manufacturer's recommendations shall be replaced.

1.05 PROJECT OR SITE CONSIDERATIONS

A. Provide instruments suitable for the installed site conditions including but not limited to material compatibility, site altitude, process and ambient temperature, and humidity conditions.

1.06 CALIBRATION AND WARRANTY

- A. Sensors shall arrive pre-calibrated and ready for installation. No post-installation calibration is to be required. Calibration information is to be stored in the sensor for automatic download to the transmitter, once connected.
- B. The manufacturer's warranty does not cover normal wear and tear, damage to the sensor due to improper storage or handling, or any other mode of failure or reduced sensor life that is not a direct consequence of a manufacturing defect.
- C. The sensor and transmitter system shall have standard one year warranty from date of shipment and if the meter is commissioned by a factory certified technician, the warranty is extended to three years from the date of shipment.

1.07 MAINTENANCE

A. Provide all parts, necessary for maintenance and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.

1.08 LIFECYCLE MANAGEMENT

A. Instrument documentation, like original calibration certificates, manuals and product status information shall be accessed via a web enabled system with a license. The instrument-specific information shall be accessed via its serial number. When services are provided by an authorized service provider the services information like subsequent field calibrations shall be archived and accessible via this web enabled system.

PART 2 PRODUCTS

2.01 SYSTEMS/ASSEMBLIES

- A. Turbidity Analyzer shall be Hach Model 1720E low range turbidimeter with Hach Model sc200 LXV404.99.00502 controller and 5796000 power cable. No equal.
- B. Performance Criteria (Sensor)
 - 1. Measurement Range:
 - a. Turbidity: 0.001-100 NTU.
 - b. Accuracy +/- 2%
 - c. Response Time: 15 seconds for full-scale step change.
 - d. Temperature range: Sensor dependent; 32 to 122 °F.
 - e. Sample flow rate: 3.1 to 11.9 gal/hour.
- C. Certifications
 - 1. CE marked.
- D. Environmental
 - 1. Acceptable sensor temperature range: 32 to 122 °F.
 - 2. Operating humidity: 5 to 95% non-condensing.
 - 3. Cable length (between sensor and transmitter): 25 feet (7.7 m).
 - 4. Power: 120 VAC.

2.02 MANUFACTURED UNITS

A. Transmitter

- 1. Shall be a microprocessor-based controller.
- 2. Programmed computations and features resident in nonvolatile memory.
- 3. Transmitter firmware shall be upgradable in the field by the user or a factory technician, without removing the transmitter from service.
- 4. Transmitter shall be available in a Nema 4X field housing with integral display or a DIN rail-mount version for cabinet mounting with remote display.
- 5. Digital communications provided for plug and play for all sensor configurations.
- 6. Shall be capable of modification for new or extended functions by use of modular components that are easily retrofitted in the field without the aid of tools, and without the need to power down the transmitter or re-boot the system.
- 7. Transmitter shall have an option for relay outputs, analog inputs, and discrete input/outputs.
- 8. Transmitter shall have one isolated 4-20 mA analog output.
- 9. Option for integral web-server for remote operation, diagnostics and configuration.

B. Sensor

- 1. The sensor shall be manufactured by the same company as the transmitter,
- 2. Sensor does not require replacement parts.

2.03 SAFETY

- A. All electrical equipment shall meet the requirements of ANSI/NFPA 70, National Electric Code latest addition.
- B. All devices shall be suitable for operation in a non-hazardous area.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Contractor will install the transmitter (controller) and sensor in strict accordance with the manufacturer's instructions and recommendation.
- B. The standard one-year warranty against manufacturing defects shall be extendable to three-years on covered equipment if paid start-up service is accomplished on that covered equipment by an authorized service provider.
- C. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances for proper installation of instruments.
 - 1. General contractor
 - 2. Electrical or Instrumentation contractor
 - 3. Factory trained authorized service provider or representative
 - 4. Site (owner/operator) personnel
 - 5. Engineer

3.02 FIELD QUALITY CONTROL

- A. Each instrument shall be tested before commissioning and the ENGINEER shall witness the interface capability in the PLC control system and associated registers.
 - 1. Each instrument shall provide direct programming capability through the PLC
 - 2. Each instrument shall be supported with a device profile permitting direct integration in the PLC

3.03 ADJUSTING

A. Verify factory setup of all instruments in accordance with the Manufacturer's instructions.

3.04 PROTECTION

- A. All instruments shall be fully protected after installation and before commissioning. Replace any instruments damaged before commissioning.
 - 1. The ENGINEER shall be the sole party responsible for determining the corrective measures.

END OF SECTION

SECTION 40 91 23.35 – FLOW PROCESS MEASUREMENT SWITCHES

PART 1 - GENERAL

1.01 SCOPE

A. This section covers flow switches to be furnished as indicated on the Drawings.

1.02 QUALITY ASSURANCE

A. Equipment to be furnished under this section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance, of equipment furnished. However, this shall not be construed as relieving the Contractor from their responsibility for the proper installation and functioning of the work.

1.03 SUBMITTALS

A. The following material shall be submitted to the Engineer in accordance with the Contract Documents, and Section 26 00 00.

PART 2 - PRODUCTS

2.01 FLOW SWITCHES

A. Discharge flow switch shall be Class 1, Division 1 compliant. Flow switches shall be Magnetrol or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment and materials specified in this section shall be installed as shown on Drawings.

3.02 GUARANTEE

A. Contractor shall fully guarantee all work under this section for a period of one year from date of final acceptance by the owner against faulty workmanship and failure or malfunction of materials and/or equipment due to faulty or imperfect workmanship. This guarantee shall be given in writing to the owner at the time of issuing final certificate. Work, materials or equipment found to be defective within this period shall be replaced without cost to the owner.

3.03 ACCEPTANCE

A. As a condition precedent to final acceptance of the work, the Contractor shall certify the equipment and installation included under this section to be free of defects, and suitable for trouble-free operation under the conditions set forth in these specifications. This requirement is in addition to the manufacturer's guarantee.

End of Section

SECTION 40 91 23.44 – LEVEL PROCESS MEASUREMENT DEVICES – ULTRASONIC SOUNDING TUBE

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. This section covers the Ultrasonic Level Transmitters for sounding tubes to be provided where indicated on the Drawings. The level transmitter shall consist of two parts with manufacturer supplied interconnecting wiring, the field installed flow element and the flow indicating transmitter.
- B. Related work specified elsewhere includes but is not limited to section 26 00 00 Electrical. Also, refer to requirements of Contract Documents for testing, adjusting and balancing of systems.

1.02 QUALITY ASSURANCE

A. Equipment to be furnished under this section shall be the product of firms regularly engaged in the design and manufacture of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the Contractor from responsibility for the proper installation and functioning of the work.

1.03 SUBMITTALS

- A. The following material shall be submitted to the Engineer prior to installation, in accordance with Section 26 00 00, and as required elsewhere in the Contract Documents:
 - 1. Where applicable, provide complete manufacturer's part number, identifying scaling, operating range, housing and wetted parts materials, NEMA rating, product options, consumable materials, and other pertinent information.
 - 2. Prior to Final Acceptance of the work, the Contractor shall provide Operations and Maintenance Manuals, in accordance with the Contract Documents.

PART 2 - PRODUCTS

2.01 ULTRASONIC LEVEL TRANSMITTER:

- A. Acceptable Manufacturers:
 - 1. Eno Scientific Well Watch 700 utilizing a 710 controller and 730 probe, no equal.
- B. Design and fabrication
 - 1. Utilize ultrasonic sound technology to produce a digitized echo profile proportional to water level in a well sounding tube from the signal provided by the transducer
 - 2. Operating pressure: ambient atmospheric up to 100 psi.

- 3. Operating temperature: minus 20 Deg F to plus 175 Deg F.
- 4. Operating humidity: 5 to 95% non-condensing
- 5. Provide cable between transmitter and transducer.
- 6. Transmitter to provide 4-20 mA output directly proportional to wetwell level.
- 7. RS485 serial port utilizing Modbus TCP or ethernet protocol.
- 8. Controller to provide user-configurable digital contact output. Contact rated 250 VAC, 0.25 amp.
- 9. Probe enclosure: Type 304 stainless steel housing for indoor/outdoor use.
- 10. Controller enclosure: Controller to be in ABS housing and mounted within Nema 4 enclosure.
- 11. Range: Up to 7000 feet.
- 12. Accuracy:
 - a. \pm -0.1 foot accuracy.
 - b. \pm -0.05 feet resolution.
 - c. 4-20 mA DC isolated output into maximum 750 ohms.
- 13. Power requirements: 12 to 36 VDC.
- 14. Power supply: loop-powered.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Equipment and materials specified in this section shall be installed and connected as specified, and as shown on the Drawings. The Contractor shall coordinate the installation with the other trades, to insure proper installation of the flow element, transmitter, and associated conduit and cables.
- B. The Contractor shall calibrate the instruments to the proper ranges, as required by the Owner and the Engineer. Where analog signals are connected to local, or remote monitoring equipment, the Contractor shall verify that the calibrated ranges and scaling of the local and remote indicators are correct.

3.02 ACCEPTANCE

A. Prior to final acceptance of the work, the Contractor shall certify the equipment and installation included under this section to be free of defects, and suitable for trouble-free operation under the conditions set forth in these specifications. This requirement is in addition to the manufacturer's guarantee.

3.03 SPARE PARTS

A. Provide the Owner with a list of the manufacturers' recommended spare parts.

End of Section

SECTION 40 94 45 – SCADA SYSTEM REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

- 1. Furnishing and installing Programmable Logic Controller (PLC) cabinet used for monitoring and control of process variables and for communicating process status to a remote Supervisory Control and Data Acquisition System (SCADA) via external radio (General Electric iNet 900) or other communication path.
- 2. Programming of the Programmable Logic Controller (PLC) within cabinet.
- 3. Programming of the Operator Interface Terminal (OIT) within cabinet.
- 4. Programming of the existing Supervisory Control and Data Acquisition (SCADA) system to monitor and control the I/O points within the PLC cabinet.
- 5. Installation of all control and instrumentation wiring from field devices to PLC cabinet.

1.02 REFERENCES

A. Not required for this specification.

1.03 DEFINITIONS

- A. RTU Remote Telemetry Unit
- B. PLC Programmable Logic Controller
- C. OIT Operator Interface Terminal
- D. SCADA Supervisory Control and Data Acquisition System
- E. HMI Human Machine Interface
- F. FAT Factory Acceptance Test

1.04 SYSTEM DESCRIPTION

- A. System Integrator for this project shall be Prime System Industrial Automation. Integrator address is 6236 River Crest Drive, Suite B, Riverside, California, 92507. For further information contact Marc Smith at cellphone 951-237-7916, marc@psia.biz.
- B. Client (Three Valleys Municipal Water District) shall acquire the services of the system integrator separately from this construction contract. Contractor shall not be responsible for the installation of any equipment or programming within the PLC (SCADA) cabinet identified on the construction drawings. In some cases the PLC (SCADA) cabinet will be an un-bussed section of the motor control center.

- C. Contractor is not responsible for the software programming of the PLC or other SCADA equipment located within the PLC cabinet.
- D. Contractor is not responsible for the software programming of the Operator Interface Terminal (OIT) within the PLC cabinet.
- E. Contractor is not responsible for the software programming of the main SCADA control system located at the client's central control location.
- F. Contractor shall be responsible for pulling and terminating all power, control, and instrumentation cable originating in field to PLC cabinet. Contractor not responsible for any internal wiring within the PLC cabinet.
- G. Contractor shall be responsible for providing support to the system integrator in the final checkout and acceptance testing of the control system. This support may include the retermination of field cables and/or providing fake input signals to mimic actual field inputs to the control system.

End of Section