CONSTRUCTION OF THE WEST LILAC, RANCHO AMIGOS, & DENTRO DE LOMAS (DENTRO) PUMP STATIONS (Project Number: 600013)

TECHNICAL SPECIFICATIONS

RAINBOW MUNICIPAL WATER DISTRICT
3707 OLD HIGHWAY 395
FALLBROOK, CALIFORNIA 92028

SEPTEMBER 2023

Hoch Consulting
804 Pier View Way, #100
Oceanside, CA 92054

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FOR

WEST LILAC, RANCHO AMIGOS, AND DENTRO PUMP STATION CONSTRUCTION

FOR

RAINBOW MUNICIPAL WATER DISTRICT

SEPTEMBER 2023

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804 Pier View Way #100
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SECTION 01010 – SUMMARY OF THE WORK

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

The project includes construction of the West Lilac, Rancho Amigos, and Dentro Pump Stations, three owner-furnished, factory-built pump stations, to be installed at different locations.

- West Lilac Pump Station: The West Lilac Pump Station is located at 7220 West Lilac Road, Bonsall, CA 92003 and includes the installation of an owner-provided pump station with three 250 hp pumps. Additional equipment and site improvements are described below with details provided in the technical specifications and construction drawings.

- Rancho Amigos Pump Station: The Rancho Amigos Pump Station is located at 31267 Rancho Amigos, Bonsall, CA 92003 includes the installation of an owner-provided pump station with three 250 hp pumps. The Rancho Amigos site also includes construction and startup of an owner-furnished engine driven generator for emergency power. The work also includes receipt, off-loading, and temporary storage for the owner-provided generator unit until placement and installation. Additional equipment and site improvements are described below with details provided in the technical specifications and construction drawings.

- Dentro Pump Station: The Dentro Pump Station is located at 990 Dentro De Lomas, Bonsall, CA 92003 and includes the installation of an owner-provided pump station with three 200 hp pumps. Additional equipment and site improvements are described below with details provided in the technical specifications and construction drawings.

The work at each site includes receipt, off-loading, placement and installation of each pump station. The District will deliver the owner-provided equipment to the project site(s) for unloading by the contractor. Contractor shall provide all equipment and labor required to unload and set the pump station and generator equipment. Temporary storage of equipment may also be required based on equipment delivery schedules as described in Spec Section 01040 – Project Coordination. Site Work includes all civil sitework and improvements, suction and discharge piping and appurtenances, connections to existing force mains, dewatering, on-site and off-site electrical improvements, and instrumentation & controls improvements as indicated in the design drawings and specifications. San Diego Gas & Electric (SDGE) designs for all off site electrical improvements are included in the Attachment. The Contractor shall coordinate with SDGE and the District to install all off-site electrical improvements and obtain the required permits for new services. Programming and controls integration to the Districts existing SCADA system will be contracted with the Districts integrator Freedom Automation (See Specification Section 17000). Also included is all related traffic control, encroachment permits, jobsite cleanup, coordination with property owner, and material supply and other items depicted and described in the Contract Documents. The CONTRACTOR will furnish all tools, equipment, materials, supplies, and manufactured articles and furnish all labor, transportation and services, including fuel, power, water, and essential communications, and performing all work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The Work shall be complete, and all work, materials, and services not expressly indicated or called for in the Contract Documents which may be necessary for the complete and proper construction of the Work in good faith shall be provided by the Contractor as though originally so indicated, at no increase in cost to the Owner.

1.02 WORK UNDER THIS CONTRACT

The official title for this project is:

West Lilac, Rancho Amigos, & Dentro Pump Station Construction.

All work described above and in the Contract Documents. Work shall conform to current Rainbow Municipal Water District (RMWD) Specifications and Standard Specifications for Public Works Construction, County of San Diego Standards, other referenced standards, and other jurisdictional authority's standards.

1.03 LAND FOR CONSTRUCTION PURPOSES

The Contractor shall coordinate and supply their own construction staging area(s), as necessary. The Contractor shall use these areas at their own risk and shall not be entitled to extensions of time or additional compensation caused by loss of materials stored or maintained at these sites. Additionally, the Contractor shall not interfere in the normal operation of any ancillary or other facilities, either District-owned or not, during the completion of the Work. The Contractor shall maintain full access at all times to all homes, businesses, equipment or other facilities for the conduct of normal or emergency operations.

On Private Property. Easements across private property are indicated on the Drawings. Contractor shall stay within the boundaries of construction easements across private property. The Contractor shall not enter any private property outside the easement boundaries without written permission from the Owner of the property and RMWD.

1.04 NOTICES TO OWNERS AND AUTHORITIES

The Contractor shall, as provided in the General Conditions, notify Owners of adjacent property and utilities five (5) working days prior to prosecution of the Work which may affect them.

When it is necessary to temporarily deny access to property, or when any utility service connection must be interrupted, the Contractor shall give notices ten (10) working days in advance to enable the affected persons to provide for their needs. Written notices will conform to any applicable local ordinance and will include appropriate information concerning the interruption and instructions on how to limit their inconvenience. All interruptions caused by the Contractor or the Work shall be coordinated and pre-approved by the District, without exception. Failure to acquire prior District approval shall result in the Contractor being liable for all costs associated with the interruption of services.

Any notifications to be issued to residents must be reviewed by RMWD prior to issuance.

1.05 UNFAVORABLE CONSTRUCTION CONDITIONS

During unfavorable weather, wet ground, or other unsuitable construction conditions, the Contractor shall confine their operations to Work which will not be affected adversely by such conditions. No portion of the Work shall be constructed under conditions which would adversely affect the quality or efficiency thereof, unless special means or precautions are taken by the Contractor to perform the Work in a proper and satisfactory manner.

1.06 PRE-CONSTRUCTION CONFERENCE

Prior to the commencement of Work a pre-construction meeting shall be held. The pre-construction meeting shall not occur until the District reviews and approves all progress schedules and schedule of values. The pre-construction meeting will be held at a mutually agreed time at the Districts Headquarters (3707 Old Highway 395, Fallbrook, CA 92028), which shall be attended by the Contractor's Project Manager, superintendent, and subcontractors, as appropriate. Other attendees will be RMWD. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished to the Contractor prior to the meeting date. RMWD will preside at the pre-construction conference and will arrange for keeping and distributing the minutes to all persons in attendance.

1.07 CLEANING UP

The Contractor shall keep the premises free at all times from accumulations of waste materials and rubbish. The Contractor shall provide adequate trash receptacles about the site and shall promptly empty the containers when filled.

Volatile wastes shall be properly stored in covered metal containers and removed daily in accordance with all applicable disposal regulations.

Wastes shall not be buried or burned on the site or disposed of into storm drains, sanitary sewers, streams, or waterways. All wastes shall be removed from the site and disposed of in a manner complying with applicable local ordinances and anti-pollution laws.

Adequate cleanup will be a condition for recommendation of progress payment applications.

1.08 TRAFFIC CONTROL

The Contractor shall coordinate with the appropriate District representatives or other agencies having jurisdiction while working in streets, roads, or other traveled way. If required by the District, County or other agency, a traffic control plan shall be developed and submitted for approval by RMWD, County, and any other agency having jurisdiction over the Work, at no additional cost to the RMWD.

1.09 CONFINED SPACE PROGRAM

The Contractor shall develop and implement a confined space program meeting the requirements of 29 CFR 1910.146 and California Title 8, Art. 108, Sec. 5157. This program shall be submitted to the District for review, within ten (10) days after the Notice to Proceed.

1.10 COOPERATION AND COLLATERAL WORK

The Contractor shall be responsible for ascertaining the nature and extent of any simultaneous, collateral, and essential work by others. The Owner, its workers and contractors, and others shall have the right to operate within or adjacent to the Work site during performance of such Work. The Owner, the Contractor, and each of such workers, contractors and others, shall coordinate their operations and cooperate to minimize interference.

The Contractor shall include in their Bid all costs involved as a result of coordinating their Work with others. The Contractor shall not be entitled to additional compensation from RMWD for damages resulting from such simultaneous, collateral, and essential work. If necessary to avoid or minimize such damage or delay, the Contractor shall re-deploy its work force to other parts of the Work. Should the Contractor be delayed by the Agency, and such delay could not have been reasonably foreseen or prevented by the Contractor, RMWD will determine the extent of the delay, the effect on the project, and any extension of time. The decision of RMWD shall be final.

1.11 MAINTENANCE OF SYSTEM OPERATIONS

The Contractor shall maintain all District facilities in operation during the progress of the Work. All costs incurred as a result of the Contractor's disabling of system operations prior to the approval of RMWD shall be the sole responsibility of the Contractor, including any fines or other mitigatory costs resulting from the Contractor's actions.

1.12 SUMMARY OF CONSTRUCTION PROCEDURES

The Contractor shall provide to RMWD at the pre-construction meeting a schedule denoting the sequence of construction to be followed during the project. The Contractor shall revise their construction sequence based on this review at no additional cost to RMWD to avoid potential coordination impacts. This review is for the benefit of the Contractor and shall in no way relieve the Contractor of their responsibilities discussed in Paragraph 1.10 of these Specifications.

1.13 CONSTRUCTION SEQUENCING

See Spec Section 01040 – Project Coordination.

PART 2 – PRODUCTS (Not used)

PART 3 – EXECUTION (Not used)

-END OF SECTION-

SECTION 01011

DRAWINGS AND SPECIFICATIONS

PART 1 - GENERAL

1.01 SUMMARY

A. It is intended that the information pertaining to conditions that may affect the cost of the Work will be shown on the Drawings or indicated in the Specifications; however, RMWD does not warrant the completeness or accuracy of such information. The Contractor shall ascertain the existence of conditions that would affect the cost of the Work which would have been disclosed by a reasonable examination.

B. Existing improvements visible at the jobsite for which no specific disposition is made on the Drawings, but which could reasonably be assumed to interfere with the satisfactory completion of the improvements contemplated by the Drawings shall be removed and disposed of by the Contractor.

C. Where details of foundations and anchorages for miscellaneous equipment and material items, both Contractor-furnished and RMWD-furnished, are not shown on the Drawings, the Contractor shall prepare and submit designs of the foundations and anchorages for the equipment as part of the equipment submittal.

D. RMWD will furnish to the Contractor electronic copies of Drawings and Specifications in accordance with the following:

1. Specifications
2. Drawings

1.02 REVISED DRAWINGS AND SPECIFICATIONS

A. If revisions to the Drawings or Specifications or additional detailed Drawings are made during the progress of the Work, RMWD will provide copies in accordance with the schedule stated above.

B. The latest revision of a Drawing or Specification shall supersede all previous copies of the Drawing or Specification. The Contractor shall make certain that the latest revised Drawings and Specifications are used on the Project.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

-END OF SECTION-

SECTION 01015

GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

This Section covers general provisions and requirements for the Work and is supplementary to the Conditions of the Contract.

A. Requirements Included in this Section. Principal items include:

1. Applicable Codes
2. Abbreviations
3. Project Meetings
4. Temporary Facilities and Controls

1.02 APPLICABLE CODES

This article summarizes, without limitation, the laws and codes by which the Work has been designed and to which the Contractor shall conform in the prosecution of the Work. The Contractor shall make available for use at the site such copies of laws, regulations, or codes applicable to the Work as RMWD may request of them.

A. Laws and Regulations. As specified in the General Provisions.

B. Codes.

1. Uniform Building Codes, Latest Editions.

2. Title 8, Industrial Relations, California Administrative Code, Chapter 4, Division of Industrial Safety, Safety Orders.

3. Title 19, Public Safety, California Administrative Code, State Fire Marshal.

4. Title 22, Environmental Health, California Administrative Code, Chapter 3, Division 4, Water Reclamation Criteria.

5. Title 24, California Administrative Code, Electrical Safety Orders.

6. Local Plumbing Code, latest edition.

7. The National and Local Electrical Codes, latest edition.

8. National Fire Protection Association, latest edition.

9. Applicable State and Local Public Health Codes.

C. Specifications.

1. Standard Specifications for Public Works Construction ("Greenbook"), Latest Edition.

2. These Specifications.

3. Rainbow Municipal Water District Standard Specifications, 2016.

1.03 ABBREVIATIONS

Abbreviations used in the Contract Documents shall be interpreted according to their recognized and well-known technical or trade meanings. Such abbreviations include, but are not limited to, the following:

AASTHO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AGA	American Gas Association
AISC	American Institute of Steel Construction, Inc.
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
APWA	American Public Works Association
ASA	American Standards Association
ASCE	American Society of Civil Engineering Managers
ASME	American Society of Mechanical Engineering Managers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CLFMI	Chain Link Fencing Manufacturers Institute
CS	Commercial Standard, US Department of Commerce
FedSpec	Federal Specification
HI	Hydraulics Institute
IEEE	Institute of Electrical and Electronic Engineering Managers
IPCEA	Insulated Power Cable Engineering Managers Association
MIL-	Military Specification (leading symbol)
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
OSHA	Occupational Safety and Health Administration, US Department of Labor, as defined in the General Conditions
PCA	Portland Cement Association

PS Product Standard, US Department Commerce UBC Uniform Building Code
UL Underwriter's Laboratories, Inc.

PART 2 - PRODUCTS (Not applicable to this Section)

PART 3 - EXECUTION

3.01 PROJECT MEETINGS

A. Attendees. Unless otherwise required by the District, meetings shall be attended by the RMWD, the Contractor and their Superintendent. Subcontractors may attend when involved in the matters to be discussed or resolved, but only when requested by the RMWD or Contractor.

B. Meeting Records. RMWD will record minutes of each meeting and will furnish copies to the Contractor within ten (10) working days thereafter. If the Contractor does not submit written objection to the contents of such minutes within ten (10) days after presentation to them, it shall be understood and agreed that the Contractor accepts the minutes as a true and complete record of the meeting.

C. Meeting Schedule. The dates, times and locations for the various meetings shall be agreed upon. Thereafter, changes to the schedule shall be by agreement between the RMWD and the Contractor.

3.02 PRECONSTRUCTION CONFERENCE

A. See Spec Section 01200 – Project Meetings.

3.03 REGULATORY AGENCIES

When requested, the Contractor shall attend meetings held or required by Governmental Regulatory Agencies having jurisdiction over the Work.

3.04 POST CONSTRUCTION CONFERENCE

A post construction conference shall be held prior to final inspection of the Work to discuss and resolve all unsettled matters. Bonds and insurance are to remain in force, and other documents required to be submitted by the Contractor will be reviewed and any deficiencies determined. Schedules and procedures for the final inspection process, and for the correction of defects and deficiencies, shall be discussed and agreed upon.

3.05 TEMPORARY FACILITIES AND CONTROLS

A. Storage and Parking Areas. The Contractor shall coordinate and arrange for their own storage and parking areas necessary to complete the Work.

B. Construction Utilities. The Contractor shall furnish temporary piping, wiring, and other services necessary to distribute utilities to the places where Work is performed. The Contractor shall install construction lighting where Work is performed at night or under deficient daylight conditions to ensure correct performance and to provide for inspection and safe working conditions.

C. Construction Aids. The Contractor shall comply with all OSHA requirements and applicable laws, ordinances, rules, regulations, and orders pertaining to construction machinery and equipment, hoists, cranes, scaffolding, staging, materials handling facilities, tools, appliances and other construction aids. Where OSHA requirements are in conflict with other applicable regulations, OSHA requirements shall govern, where mandatory; otherwise the Contractor shall comply with the most stringent applicable requirements.

D. Transportation Facilities. The Contractor shall investigate the availability of transportation facilities and make necessary arrangements for delivery of materials to the site.

E. Noise Control. The Contractor shall comply with all OSHA requirements concerning allowable noise levels throughout construction. All internal combustion engines in vehicles and construction equipment shall be equipped with effective mufflers to produce a maximum sound level of 70 dBA at 50 feet from the source. Noise disturbance to adjoining property owners shall be minimized in accordance with all applicable federal, state and local regulations.

F. Dust Control. The Contractor shall provide dust control during construction operations and shall be responsible for all damage resulting from dust produced by construction operations.

G. Water Control. The Contractor shall perform grading and other operations to maintain site drainage. Surface water shall not be allowed to accumulate in excavations or under structures. Surface water shall be controlled by means of ditches, dams, temporary pumps and piping, and other necessary methods. The Contractor shall legally dispose of surface and subsurface water. Mud, silt, or debris shall not be allowed to flow on or into adjoining or public property.

H. Air Pollution Control. The Contractor shall comply with all applicable federal, state and local laws, ordinances, rules, regulations, and orders pertaining to air pollution.

I. Sanitary Facilities

1. Toilet and Washing Facilities. The Contractor shall provide temporary chemical toilets for the use of all workers at the site as necessary for completion of the Work.

2. Drinking Water. The Contractor shall maintain a supply of cool, pure drinking water at the site, readily available to workers, with individual disposal drinking cups or a sanitary bubbler fountain as necessary for completion of the Work.

J. Preservation of Property. The Contractor shall exercise care to avoid injury to existing improvements, adjacent property, and trees and shrubbery. Trees and shrubbery that are not to be moved, poles, fences, signs, property corners, all underground pipe and conduit, and other improvements within or near the Work shall be protected from injury or damage. If such objects, or improvements, are injured or damaged by reason of the Contractor's operations, they shall be

replaced or restored, at the Contractor's expense, to a condition equal to or better than the condition prior to construction operations.

The Contractor shall not disturb any monuments or survey markers without permission from the District Representative or the Owner and shall bear the expense of resetting any monuments or survey markers which may be disturbed without permission in accordance with applicable federal, state and local requirements.

K. Historical and Archaeological Resources. Should any items having historical or archaeological significance be discovered in the course of any construction activities, Work shall be halted, and the District Representative shall be notified immediately. Under direction of the District Representative, an archaeologist shall make an on-site inspection. The on-site inspection shall be used to make recommendations to the Owner and other agencies having jurisdiction for determination of mitigation actions to be taken.

L. Telephone. The Contractor shall furnish and pay for telephone service at the site and elsewhere as required for the prosecution of the Work.

3.06 UTILITIES

The location and existence of substructures were determined from a search of records maintained by their respective owners. No guarantee is made or implied that the information is complete or accurate. It shall be the Contractor's responsibility alone to determine the exact location of substructures of every nature and to protect them from damage.

It shall also be the Contractor's responsibility to locate and protect service laterals, conduits, and appurtenances of any underground facility, the presence of which can be inferred from the presence of visible facilities such as buildings, meters, and junction boxes, prior to doing any work that may damage any such facilities, or interfere with their service.

-END OF SECTION-

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.01 SUMMARY

A. This Section defines the Lump Sum Prices, Unit Prices, and Allowances listed in the Bid Schedules, and the manner in which they will be used to determine measurement and payment for all items included in the Bid Schedules.

B. Upon Contract award, the accepted Bid Schedules will become the Payment Schedule.

1.02 BID PROPOSAL

A. Measurement and payment will be made for each Payment Schedule item independently and in accordance with the provisions as follows:

1. Lump Sum Prices: The Contractor shall provide Lump Sum Prices in the Bid Schedule for all Work in the Contract Documents, except items of Work listed in the Bid Schedule as Unit Price Items. For Lump Sum items, only the total amount shall be provided.

2. Unit Price Items: Unit Price Items are provided for additive or deductive Work not presently quantified in the Contract Documents. Each unit price shall contain all costs and charges, including, without limitation, materials, labor, fabrication, delivery, installation or application, supervision, tools, equipment, incidentals, subcontractors, indirect costs, bonds, insurance, overhead, profit, and taxes. Unit Prices shall be the exact amount per unit to be applied to the units of Work actually provided or not provided for the purpose of modifying the Contract Price or establishing the payment due the Contractor, as applicable.

   a. Unit Prices provided shall be held good and in effect until the Work is completed and accepted by RMWD. Contractor proposed Unit Prices which are so unbalanced as to be detrimental to the RMWD's interest may be rejected or cause rejection of the Bidder's entire bid at the discretion of the RMWD.

   b. All Unit Price Items are included in the scope of the Contract without specific locations for the Work provided. RMWD reserves the right to direct that these items of Work be performed when they are encountered, and the Contractor is obligated to accommodate this Work within the original contract duration. The Contractor will not be entitled to additional time regardless of where Work is encountered.

c. Allowance Quantities are provided by RMWD as an estimate. RMWD reserves the right to vary the total individual item total cost by +/- 25% by varying the Allowance Quantities.

d. When RMWD's use of a Unit Price item exceeds 200% of the Payment Item Allowance Quantity, the Contractor or RMWD may demand that the Unit Price Item be renegotiated for quantities in excess of 200%, whether the price is stipulated or bid. This provision is to prevail over any conflicting General Condition provision.

3. Retention: Payment for all bid items is subject to the retention provisions.

1.03 BID ITEM DESCRIPTIONS

In addition to the bid items described in the Standard Specifications, the following bid item descriptions shall apply to the Bid Schedules.

A. Bid Schedule A – West Lilac Pump Station

1. MOBILIZATION, BONDS, PERMITS, CLEAN-UP AND DEMOBILIZATION - Payment for this bid item shall be made at the contract price complete and in accordance with the Contract Documents. The contract price shall include, but is not limited to the following principal items: mobilizing labor force, equipment and construction facilities; providing field offices and storage yard; securing construction water supply; providing all temporary construction fencing and safety barriers; providing traffic control, providing on-site sanitary facilities; providing project signs; obtaining groundwater discharge permits or waivers; procuring encroachment permits, obtaining staging areas, posting OSHA requirements and establishing safety programs; clean-up and site restoration; preparing the Schedule of Values prior to the pre-construction meeting; preconstruction video and photographs; work not specified for payment in any other bid item; and all incidentals. Payment for this bid item shall be limited to 5 percent of the total contract amount.

2. STORMWATER AND NON-STORMWATER POLLUTION CONTROL - Payment for this bid item shall be made at the contract price complete, in accordance with the Contract Documents and as directed by the Owner. The contract price for work under this bid item shall include, but is not limited to, furnishing all labor, material, tools, and equipment and performing all work required for the preparation of a project-specific water pollution control plan that is specific to the Contractor's construction operations and complies with National Pollutant Discharge Elimination System (NPDES) requirements including the installation and maintenance (and removal where required) of temporary Best Management Practices (BMPs) throughout construction. This includes but is not limited to preparation of all required plans and regulatory agency submittals, forms, and certifications; the operation and protection of the site drainage systems; sampling, monitoring, and reporting; amending the water pollution control plan; and installation and maintenance of all BMPs including fiber rolls, silt fences, gravel bags, berms, stabilized construction entrances,

hydroseeding of disturbed soil areas, or other measures as described in the project-specific water pollution control plan and as necessary to comply with all jurisdictional requirements. Where the BMP requirements applicable to the Contractor's operations differ from the opinion of the Owner, additional BMPs are required to prevent water pollution control based on the Contractor's operations, such BMPs shall be installed and maintained and the water pollution control plan shall be amended by the Contractor for compliance with the NPDES regulations. No additional compensation shall be made for such revisions or amendments.

3. EXCAVATION SUPPORT SYSTEM - Payment for this bid item shall be made at the contract price complete and in accordance with the Contract Documents. The contract price shall include, but is not limited to obtaining and complying with all permits and regulations of the California Occupational Safety and Health (Cal/OSHA); preparing and submitting plans by a licensed Engineer and obtaining State Division of Industrial Safety permit(s) for excavations that are 5 feet deep or greater; sheeting; shields; shoring; sloping or benching of excavation side slopes; or other protective systems necessary for the support of trench excavations or for worker protection from materials or equipment that could pose a hazard by falling or rolling into excavations and all incidental items of work.

4. HAUL ROUTE IMPROVEMENTS – Payment for this bid item shall be made at the contract price complete and in accordance with the Contract documents, which shall include but is not limited to, all labor, materials, tolls, and equipment to perform roadway improvements and/or restoration activities for impacted roads resulting from delivery of the pump station to the site. Contractor shall evaluate the structural integrity of any bridge crossings, conduct a thorough analysis of preliminary haul routes to identify potential bottlenecks, safety hazards, and areas of improvement. Develop a detailed plan outlining recommended route modifications, realignments, and potential alternative routes to minimize disruptions. Work shall include implementation of necessary upgrades to roadways, intersections, bridges, and culverts along the haul routes. Preliminary haul routes, as delineated by the pump station manufacturer, are provided in Attachment G1. Payment for this item includes pavement repairs, resurfacing, widening, and strengthening of critical structures to accommodate heavy loads and ensure the safe passage of vehicles. Additional work shall include environmental mitigation, safety enhancements, and engineering services evaluation of crossings. Required roadway improvements shall be made prior to pumpstation delivery and repairs shall be made after.

5. SITE WORK - Payment for this bid item will be paid for at the contract price, complete, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required for performing the clearing and grubbing, excavation, over excavation, grading, and compaction as described in the Contract Documents.

   Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required to furnish and accomplishing the paving and aggregate base as

described in the Contract Documents.

Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required for decomposed granite installation as described in the Contract Documents. Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required to install all site improvements not included in other bid item including fencing, and gates; guard posts; retaining walls, masonry, drainage swales; excavation; dewatering; pipe bedding; backfilling; compaction; restoration of non-improved areas to original condition, and all other items necessary to construct all site work improvements as described in the Contract Documents. Also included in this bid item is the import of material from an off-site location.

6. CONCRETE FOUNDATION AND SLABS - Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required to furnish and install the concrete foundations and slabs as described in the Contract Documents.

7. YARD PIPING - Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required for installing the all yard piping, valves, appurtenances, and related materials as described in the Contract Documents. This bid item includes dewatering efforts required for tie-ins to existing water lines.

8. INSTALLATION OF OWNER PROVIDED FACTORY BUILT BOOSTER PUMP STATION – Payment for this bid item will be paid for at the contract price, complete, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required for installation of the owner-provided booster station including, receipt and offloading, temporary storage (if applicable to Contractor schedule), connections to yard piping and electrical & controls services. Work shall also include all labor, materials, tools and equipment for the installation of any equipment and materials required for the complete installation of the factory built booster station as identified in the submittal package from the manufacture (See Attachment) including but not limited to all above ground piping, pumps and motors, mechanical equipment, HVAC equipment, valves, flow meters, pressure indicators, architectural hardware, or any other items required for complete installation. Shop drawings are provided in Attachment.

9. NOT USED

10. OFF-SITE ELECTRICAL – Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment required to furnish and install all electrical equipment and service

lines for new service. Payment for this bid item shall include all electrical improvements required by San Diego Gas & Electric (SDGE) as identified in the SDGE design drawings (See Attachment) and per SDGE Standards for new service. This bid item includes coordination with SDGE and acceptance of improvements by SDGE. Contractor shall submit an arc flash study for each site.

11. ON-SITE ELECTRICAL – Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment required to furnish and install all electrical, telemetry, and instrumentation as required by the Contract Documents. Payment for this bid item shall include all electrical conduit; wire; cabling; electrical panels; switches; enclosures; controls; lighting; instrumentation; coordinating operation of radios; antennas; intrusion alarms connection; and all other electrical and instrumentation equipment as described within the Contract Documents.

12. INSTRUMENTATION & CONTROLS – Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required to finish the construction and assistance to the District's integrator for testing of the pump station. Work shall include installation of all analytical equipment and instrumentation. The contractor shall provide a telemetry panel and antenna per the drawings and specifications. Programming shall be by Freedom Automation (See Bid Item 13)

    Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required to install and erect antenna masts and antenna connections to buildings as indicated in the Contract Documents.

13. PROGRAMMING – Payment for this bid item shall be paid at the contract price, complete in place, in accordance with the Contract documents for programming services from the Districts integrator Freedom Automation. A quote has been included in Attachment K.

    Freedom Automation under contract to the District's as its SCADA integrator. They have the skill set necessary to work with the District's SCADA equipment and the programming involved in setting up its SCADA equipment. They are knowledgeable in the District's processes, protocols, and procedures, as well as the different networking configurations and formatting involved. Freedom Automation will provide the make and model of the network switches, radios, and programmable logic controller (PLC). Once the equipment has been purchased, mounted, and connected, Freedom Automation will program and configure the network switches, radios and PLC's. As a result no equals will be considered or accepted.

14. STARTUP AND TESTING – Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and

equipment and performing all work required to finish the construction and testing of the pump station. This work includes coordination with EFI personnel for startup and testing of the pump station. If the project is not ready for startup, in EFI's sole opinion, for their efforts during startup, the Contractor is responsible for all costs associated with additional trips required by EFI. A Sequencing Plan shall be submitted as Park of the Startup and Testing Schedule for approval by the Owner in accordance with Spec Section 01040 Part 1.07.

15. FIELD ORDERS – Field orders are to facilitate minor changes to the contract approved by the Owner in the field. The Owner is authorized to approve field orders for changes necessary for the successful completion and function of the project and withing the dollar limit established in the bid schedule. The Owner will prepare a field order form for each approved change. The field order form shall describe the reason the change is required, the work to be performed and the amount of compensation to be paid to the Contractor. The form shall be authorized by signatures from both the Owner and the Contractor acknowledging that the compensation constitutes full payment for the work to be performed.

ALLOWANCES: ALLOWANCE ITEMS NOT INCLUDED IN THE CONTRACT DOCUMENTS BUT INCLUDED IN THE CONTRACT SCOPE FOR THIS PROJECT. THE QUANTTIES ARE AN ESTIMATE FOR THE PURPOSES OF COMPARING BIDS ONLY AND DETERMINING LOW BIDDER. PAYMENT OF THESE ITEMS WILL BE BASED ON ACTUAL QUANTITIES FURNISHED, INSTALLED, DISPOSED OR CONSTRUCTED IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.

16. CULTRAL & ENVIRONMENTAL MITIGATION – The District will file a Notice of Exemption (NOE) for the identified reference categories including Biological Resource Requirements for Diegan Coastal Sage Scrub, Coastal California Gnatcatcher, Least Bell's Vireo, MBTA Compliance; and Cultural Resource Requirements including cultural/tribal cultural resources and human remains following Award. If required, the contractor shall work with the District to assist with any mitigation efforts required. The District will obtain qualified monitoring agencies for biological and cultural monitoring. Cost for any mitigation effort will be negotiated during construction and paid through this bid item.

17. ROCK REMOVAL & DISPOSAL (Unit Price Item) - Measurement shall be made on a cubic yard (CY) basis for the bank yards or theoretical plan quantity of rock removed from the site as authorized and measured by the District.

    The Unit Price for rock removal and disposal shall include but not be limited to the following principal items: all labor, equipment, and material necessary for removing and disposing of rock necessary for the installation of pipe or appurtenances, procurement, delivery and installation of imported backfill per specifications for all removed rock including any over-excavation caused by rock fractures and resultant additional surface restoration. The District reserves the right to vary the quantity of the Unit Priced Item from 0% to 200% of that quantity specified in the Bid Schedule. This item is considered incidental to the Contract and may be adjusted or deleted in its entirety.

B. Bid Schedule B – Rancho Amigos Pump Station.

1. MOBILIZATION, BONDS, PERMITS, CLEAN-UP AND DEMOBILIZATION - Payment for this bid item shall be made at the contract price complete and in accordance with the Contract Documents. The contract price shall include, but is not limited to the following principal items: mobilizing labor force, equipment and construction facilities; providing field offices and storage yard; securing construction water supply; providing all temporary construction fencing and safety barriers; providing traffic control, providing on-site sanitary facilities; providing project signs; obtaining groundwater discharge permits or waivers; procuring encroachment permits, obtaining staging areas, posting OSHA requirements and establishing safety programs; clean-up and site restoration; preparing the Schedule of Values prior to the pre-construction meeting; preconstruction video and photographs; work not specified for payment in any other bid item; and all incidentals. Payment for this bid item shall be limited to 5 percent of the total contract amount.

2. STORMWATER AND NON-STORMWATER POLLUTION CONTROL - Payment for this bid item shall be made at the contract price complete, in accordance with the Contract Documents and as directed by the Owner. The contract price for work under this bid item shall include, but is not limited to, furnishing all labor, material, tools, and equipment and performing all work required for the preparation of a project-specific water pollution control plan that is specific to the Contractor's construction operations and complies with National Pollutant Discharge Elimination System (NPDES) requirements including the installation and maintenance (and removal where required) of temporary Best Management Practices (BMPs) throughout construction. This includes but is not limited to preparation of all required plans and regulatory agency submittals, forms, and certifications; the operation and protection of the site drainage systems; sampling, monitoring, and reporting; amending the water pollution control plan; and installation and maintenance of all BMPs including fiber rolls, silt fences, gravel bags, berms, stabilized construction entrances, hydroseeding of disturbed soil areas, or other measures as described in the project-specific water pollution control plan and as necessary to comply with all jurisdictional requirements. Where the BMP requirements applicable to the Contractor's operations differ from the opinion of the Owner, additional BMPs are required to prevent water pollution control based on the Contractor's operations, such BMPs shall be installed and maintained and the water pollution control plan shall be amended by the Contractor for compliance with the NPDES regulations. No additional compensation shall be made for such revisions or amendments.

3. EXCAVATION SUPPORT SYSTEM - Payment for this bid item shall be made at the contract price complete and in accordance with the Contract Documents. The contract price shall include, but is not limited to obtaining and complying with all permits and regulations of the California Occupational Safety and Health (Cal/OSHA); preparing and submitting plans by a licensed Engineer and obtaining State Division of Industrial Safety permit(s) for excavations that are 5 feet deep or greater; sheeting; shields; shoring; sloping or benching of excavation side slopes; or other protective systems necessary for the support

of trench excavations or for worker protection from materials or equipment that could pose a hazard by falling or rolling into excavations and all incidental items of work.

4. HAUL ROUTE IMPROVEMENTS – Payment for this bid item shall be made at the contract price complete and in accordance with the Contract documents, which shall include but is not limited to, all labor, materials, tolls, and equipment to perform roadway improvements and/or restoration activities for impacted roads resulting from delivery of the pump station to the site. Contractor shall evaluate the structural integrity of any bridge crossings, conduct a thorough analysis of preliminary haul routes to identify potential bottlenecks, safety hazards, and areas of improvement. Develop a detailed plan outlining recommended route modifications, realignments, and potential alternative routes to minimize disruptions. Work shall include implementation of necessary upgrades to roadways, intersections, bridges, and culverts along the haul routes. Preliminary haul routes, as delineated by the pump station manufacturer, are provided in Attachment G1 along with a Bridge Assessment Technical Memorandum from PSE Structural Engineers for Moody Bridge (Attachment G2). Payment for this item includes pavement repairs, resurfacing, widening, and strengthening of critical structures to accommodate heavy loads and ensure the safe passage of vehicles. Additional work shall include environmental mitigation, safety enhancements, and engineering services evaluation of crossings. Required roadway improvements shall be made prior to pumpstation delivery and repairs shall be made after.

5. SITE WORK - Payment for this bid item will be paid for at the contract price, complete, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required for performing the clearing and grubbing, excavation, over excavation, grading, and compaction as described in the Contract Documents.

   Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required to furnish and accomplishing the paving and aggregate base as described in the Contract Documents.

   Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required for decomposed granite installation as described in the Contract Documents. Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required to install all site improvements not included in other bid item including fencing, and gates; guard posts; retaining walls, masonry, drainage swales; excavation; dewatering; pipe bedding; backfilling; compaction; restoration of non-improved areas to original condition, and all other items necessary to construct all site work improvements as described in the Contract Documents. Also included in this bid item is the import of material from an off-site location.

6. CONCRETE FOUNDATION AND SLABS - Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required to furnish and install the concrete foundations and slabs as described in the Contract Documents.

7. YARD PIPING - Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required for installing the all yard piping, valves, appurtenances, and related materials as described in the Contract Documents. This bid item includes dewatering efforts required for tie-ins to existing water lines.

8. INSTALLATION OF OWNER PROVIDED FACTORY BUILT BOOSTER PUMP STATION – Payment for this bid item will be paid for at the contract price, complete, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required for installation of the owner-provided booster station including, receipt and offloading, temporary storage (if applicable to Contractor schedule), connections to yard piping and electrical & controls services. Work shall also include all labor, materials, tools and equipment for the installation of any equipment and materials required for the complete installation of the factory built booster station as identified in the submittal package from the manufacture (See Attachment) including but not limited to all above ground piping, pumps and motors, mechanical equipment, HVAC equipment, valves, flow meters, pressure indicators, architectural hardware, or any other items required for complete installation. Shop drawings are provided in Attachment.

9. ENGINE GENERATOR - Payment for this bid item will be paid for at the contract price, complete, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required for the complete installation of the owner-provided engine driven generator, including but not limited to receipt and offloading, temporary storage (if applicable to Contractor schedule), electrical connections, mechanical piping and appurtenances, and startup and testing. Cost for this item shall include all permits to transport and startup and operate the generator.

10. OFF-SITE ELECTRICAL – Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment required to furnish and install all electrical equipment and service lines for new service. Payment for this bid item shall include all electrical improvements required by San Diego Gas & Electric (SDGE) as identified in the SDGE design drawings (See Attachment) and per SDGE Standards for new service. This bid item includes coordination with SDGE and acceptance of improvements by SDGE. Contractor shall submit an arc flash study for each site.

11. ON-SITE ELECTRICAL – Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and

equipment required to furnish and install all electrical, telemetry, and instrumentation as required by the Contract Documents. Payment for this bid item shall include all electrical conduit; wire; cabling; electrical panels; switches; enclosures; controls; lighting; instrumentation; coordinating operation of radios; antennas; intrusion alarms connection; and all other electrical and instrumentation equipment as described within the Contract Documents.

12. INSTRUMENTATION & CONTROLS – Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required to finish the construction and assistance to the District's integrator for testing of the pump station. Work shall include installation of all analytical equipment and instrumentation. The contractor shall provide a telemetry panel and wall mounted antenna per the drawings and specifications. Programming shall be by Freedom Automation (See Bid Item 13)

    Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required to install and erect antenna masts and antenna connections to buildings as indicated in the Contract Documents.

13. PROGRAMMING – Payment for this bid item shall be paid at the contract price, complete in place, in accordance with the Contract documents for programming services from the Districts integrator Freedom Automation. A quote has been included in Attachment K.

    Freedom Automation under contract to the District's as its SCADA integrator. They have the skill set necessary to work with the District's SCADA equipment and the programming involved in setting up its SCADA equipment. They are knowledgeable in the District's processes, protocols, and procedures, as well as the different networking configurations and formatting involved. Freedom Automation will provide the make and model of the network switches, radios, and programmable logic controller (PLC). Once the equipment has been purchased, mounted, and connected, Freedom Automation will program and configure the network switches, radios and PLC's. As a result no equals will be considered or accepted.

14. STARTUP AND TESTING – Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required to finish the construction and testing of the pump station. This work includes coordination with EFI personnel for startup and testing of the pump station. If the project is not ready for startup, in EFI's sole opinion, for their efforts during startup, the Contractor is responsible for all costs associated with additional trips required by EFI. A Sequencing Plan shall be submitted as Park of the Startup and Testing Schedule for approval by the Owner in accordance with Spec Section 01040 Part 1.07.

15. FIELD ORDERS – Field orders are to facilitate minor changes to the contract approved by the Owner in the field. The Owner is authorized to approve field orders for changes necessary for the successful completion and function of the project and withing the dollar limit established in the bid schedule. The Owner will prepare a field order form for each approved change. The field order form shall describe the reason the change is required, the work to be performed and the amount of compensation to be paid to the Contractor. The form shall be authorized by signatures from both the Owner and the Contractor acknowledging that the compensation constitutes full payment for the work to be performed.

ALLOWANCES: ALLOWANCE ITEMS NOT INCLUDED IN THE CONTRACT DOCUMENTS BUT INCLUDED IN THE CONTRACT SCOPE FOR THIS PROJECT. THE QUANTTIES ARE AN ESTIMATE FOR THE PURPOSES OF COMPARING BIDS ONLY AND DETERMINING LOW BIDDER. PAYMENT OF THESE ITEMS WILL BE BASED ON ACTUAL QUANTITIES FURNISHED, INSTALLED, DISPOSED OR CONSTRUCTED IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.

16. CULTRAL & ENVIRONMENTAL MITIGATION – The District will file a Notice of Exemption (NOE) for the identified reference categories including Biological Resource Requirements for Diegan Coastal Sage Scrub, Coastal California Gnatcatcher, Least Bell's Vireo, MBTA Compliance; and Cultural Resource Requirements including cultural/tribal cultural resources and human remains following Award. If required, the contractor shall work with the District to assist with any mitigation efforts required. The District will obtain qualified monitoring agencies for biological and cultural monitoring. Cost for any mitigation effort will be negotiated during construction and paid through this bid item.

17. ROCK REMOVAL & DISPOSAL (Unit Price Item) - Measurement shall be made on a cubic yard (CY) basis for the bank yards or theoretical plan quantity of rock removed from the site as authorized and measured by the District.

    The Unit Price for rock removal and disposal shall include but not be limited to the following principal items: all labor, equipment, and material necessary for removing and disposing of rock necessary for the installation of pipe or appurtenances, procurement, delivery and installation of imported backfill per specifications for all removed rock including any over-excavation caused by rock fractures and resultant additional surface restoration. The District reserves the right to vary the quantity of the Unit Priced Item from 0% to 200% of that quantity specified in the Bid Schedule. This item is considered incidental to the Contract and may be adjusted or deleted in its entirety.

C. Bid Schedule C – Dentro Pump Station.

1. MOBILIZATION, BONDS, PERMITS, CLEAN-UP AND DEMOBILIZATION - Payment for this bid item shall be made at the contract price complete and in accordance with the Contract Documents. The contract price shall include, but is not limited to the following principal items: mobilizing labor force, equipment and construction facilities; providing field offices and storage yard; securing construction water supply; providing all temporary construction fencing and safety barriers; providing traffic control, providing on-site sanitary facilities; providing project signs; obtaining groundwater discharge permits or waivers; procuring encroachment permits, obtaining staging areas, posting OSHA requirements and establishing safety programs; clean-up and site restoration; preparing the Schedule of Values prior to the pre-construction meeting; preconstruction video and photographs; work not specified for payment in any other bid item; and all incidentals. Payment for this bid item shall be limited to 5 percent of the total contract amount.

2. STORMWATER AND NON-STORMWATER POLLUTION CONTROL - Payment for this bid item shall be made at the contract price complete, in accordance with the Contract Documents and as directed by the Owner. The contract price for work under this bid item shall include, but is not limited to, furnishing all labor, material, tools, and equipment and performing all work required for the preparation of a project-specific water pollution control plan that is specific to the Contractor's construction operations and complies with National Pollutant Discharge Elimination System (NPDES) requirements including the installation and maintenance (and removal where required) of temporary Best Management Practices (BMPs) throughout construction. This includes but is not limited to preparation of all required plans and regulatory agency submittals, forms, and certifications; the operation and protection of the site drainage systems; sampling, monitoring, and reporting; amending the water pollution control plan; and installation and maintenance of all BMPs including fiber rolls, silt fences, gravel bags, berms, stabilized construction entrances, hydroseeding of disturbed soil areas, or other measures as described in the project-specific water pollution control plan and as necessary to comply with all jurisdictional requirements. Where the BMP requirements applicable to the Contractor's operations differ from the opinion of the Owner, additional BMPs are required to prevent water pollution control based on the Contractor's operations, such BMPs shall be installed and maintained and the water pollution control plan shall be amended by the Contractor for compliance with the NPDES regulations. No additional compensation shall be made for such revisions or amendments.

3. EXCAVATION SUPPORT SYSTEM - Payment for this bid item shall be made at the contract price complete and in accordance with the Contract Documents. The contract price shall include, but is not limited to obtaining and complying with all permits and regulations of the California Occupational Safety and Health (Cal/OSHA); preparing and submitting plans by a licensed Engineer and obtaining State Division of Industrial Safety permit(s) for excavations that are 5 feet deep or greater; sheeting; shields; shoring; sloping or benching of excavation side slopes; or other protective systems necessary for the support of trench excavations or for worker protection from materials or equipment that

could pose a hazard by falling or rolling into excavations and all incidental items of work.

4. HAUL ROUTE IMPROVEMENTS – Payment for this bid item shall be made at the contract price complete and in accordance with the Contract documents, which shall include but is not limited to, all labor, materials, tolls, and equipment to perform roadway improvements and/or restoration activities for impacted roads resulting from delivery of the pump station to the site. Contractor shall evaluate the structural integrity of any bridge crossings, conduct a thorough analysis of preliminary haul routes to identify potential bottlenecks, safety hazards, and areas of improvement. Develop a detailed plan outlining recommended route modifications, realignments, and potential alternative routes to minimize disruptions. Work shall include implementation of necessary upgrades to roadways, intersections, bridges, and culverts along the haul routes. Preliminary haul routes, as delineated by the pump station manufacturer, are provided in Attachment G1. Payment for this item includes pavement repairs, resurfacing, widening, and strengthening of critical structures to accommodate heavy loads and ensure the safe passage of vehicles. Additional work shall include environmental mitigation, safety enhancements, and engineering services evaluation of crossings. Required roadway improvements shall be made prior to pumpstation delivery and repairs shall be made after.

5. SITE WORK - Payment for this bid item will be paid for at the contract price, complete, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required for performing the clearing and grubbing, excavation, over excavation, grading, and compaction as described in the Contract Documents.

   Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required to furnish and accomplishing the paving and aggregate base as described in the Contract Documents.

   Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required for decomposed granite installation as described in the Contract Documents. Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required to install all site improvements not included in other bid item including fencing, and gates; guard posts; retaining walls, masonry, drainage swales; excavation; dewatering; pipe bedding; backfilling; compaction; restoration of non-improved areas to original condition, and all other items necessary to construct all site work improvements as described in the Contract Documents. Also included in this bid item is the import of material from an off-site location.

6. CONCRETE FOUNDATION AND SLABS - Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract

Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required to furnish and install the concrete foundations and slabs as described in the Contract Documents.

7. YARD PIPING - Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required for installing the all yard piping, valves, appurtenances, and related materials as described in the Contract Documents. This bid item includes dewatering efforts required for tie-ins to existing water lines.

8. INSTALLATION OF OWNER PROVIDED FACTORY BUILT BOOSTER PUMP STATION – Payment for this bid item will be paid for at the contract price, complete, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required for installation of the owner-provided booster station including, receipt and offloading, temporary storage (if applicable to Contractor schedule), connections to yard piping and electrical & controls services. Work shall also include all labor, materials, tools and equipment for the installation of any equipment and materials required for the complete installation of the factory built booster station as identified in the submittal package from the manufacture (See Attachment) including but not limited to all above ground piping, pumps and motors, mechanical equipment, HVAC equipment, valves, flow meters, pressure indicators, architectural hardware, or any other items required for complete installation. Shop drawings are provided in Attachment.

9. NOT USED.

10. OFF-SITE ELECTRICAL – Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment required to furnish and install all electrical equipment and service lines for new service. Payment for this bid item shall include all electrical improvements required by San Diego Gas & Electric (SDGE) as identified in the SDGE design drawings (See Attachment) and per SDGE Standards for new service. This bid item includes coordination with SDGE and acceptance of improvements by SDGE. Contractor shall submit an arc flash study for each site.

11. ON-SITE ELECTRICAL – Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment required to furnish and install all electrical, telemetry, and instrumentation as required by the Contract Documents. Payment for this bid item shall include all electrical conduit; wire; cabling; electrical panels; switches; enclosures; controls; lighting; instrumentation; coordinating operation of radios; antennas; intrusion alarms connection; and all other electrical and instrumentation equipment as described within the Contract Documents.

12. INSTRUMENTATION & CONTROLS – Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract

Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required to finish the construction and assistance to the District's integrator for testing of the pump station. Work shall include installation of all analytical equipment and instrumentation. The contractor shall provide a telemetry panel and antenna per the drawings and specifications. Programming shall be by Freedom Automation (See Bid Item 13)

Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required to install and erect antenna masts and antenna connections to buildings as indicated in the Contract Documents.

13. PROGRAMMING – Payment for this bid item shall be paid at the contract price, complete in place, in accordance with the Contract documents for programming services from the Districts integrator Freedom Automation. A quote has been included in Attachment K.

    Freedom Automation under contract to the District's as its SCADA integrator. They have the skill set necessary to work with the District's SCADA equipment and the programming involved in setting up its SCADA equipment. They are knowledgeable in the District's processes, protocols, and procedures, as well as the different networking configurations and formatting involved. Freedom Automation will provide the make and model of the network switches, radios, and programmable logic controller (PLC). Once the equipment has been purchased, mounted, and connected, Freedom Automation will program and configure the network switches, radios and PLC's. As a result no equals will be considered or accepted.

14. STARTUP AND TESTING – Payment for this bid item will be paid for at the contract price, complete in place, in accordance with the Contract Documents, which shall include, but is not limited to, all labor, materials, tools, and equipment and performing all work required to finish the construction and testing of the pump station. This work includes coordination with EFI personnel for startup and testing of the pump station. If the project is not ready for startup, in EFI's sole opinion, for their efforts during startup, the Contractor is responsible for all costs associated with additional trips required by EFI. A Sequencing Plan shall be submitted as Park of the Startup and Testing Schedule for approval by the Owner in accordance with Spec Section 01040 Part 1.07.

15. FIELD ORDERS – Field orders are to facilitate minor changes to the contract approved by the Owner in the field. The Owner is authorized to approve field orders for changes necessary for the successful completion and function of the project and withing the dollar limit established in the bid schedule. The Owner will prepare a field order form for each approved change. The field order form shall describe the reason the change is required, the work to be performed and the amount of compensation to be paid to the Contractor. The form shall be authorized by signatures from both the Owner and the Contractor acknowledging that the compensation constitutes full payment for the work to be performed.

<u>ALLOWANCES:</u> ALLOWANCE ITEMS NOT INCLUDED IN THE CONTRACT DOCUMENTS BUT INCLUDED IN THE CONTRACT SCOPE FOR THIS PROJECT. THE QUANTTIES ARE AN ESTIMATE FOR THE PURPOSES OF COMPARING BIDS ONLY AND DETERMINING LOW BIDDER. PAYMENT OF THESE ITEMS WILL BE BASED ON ACTUAL QUANTITIES FURNISHED, INSTALLED, DISPOSED OR CONSTRUCTED IN ACCORDANCE WITH THE CONTRACT DOCUMENTS.

16. CULTRAL & ENVIRONMENTAL MITIGATION – The District will file a Notice of Exemption (NOE) for the identified reference categories including Biological Resource Requirements for Diegan Coastal Sage Scrub, Coastal California Gnatcatcher, Least Bell's Vireo, MBTA Compliance; and Cultural Resource Requirements including cultural/tribal cultural resources and human remains following Award. If required, the contractor shall work with the District to assist with any mitigation efforts required. The District will obtain qualified monitoring agencies for biological and cultural monitoring. Cost for any mitigation effort will be negotiated during construction and paid through this bid item.

17. ROCK REMOVAL & DISPOSAL (Unit Price Item) - Measurement shall be made on a cubic yard (CY) basis for the bank yards or theoretical plan quantity of rock removed from the site as authorized and measured by the District.

    The Unit Price for rock removal and disposal shall include but not be limited to the following principal items: all labor, equipment, and material necessary for removing and disposing of rock necessary for the installation of pipe or appurtenances, procurement, delivery and installation of imported backfill per specifications for all removed rock including any over-excavation caused by rock fractures and resultant additional surface restoration. The District reserves the right to vary the quantity of the Unit Priced Item from 0% to 200% of that quantity specified in the Bid Schedule. This item is considered incidental to the Contract and may be adjusted or deleted in its entirety.

1.04 MEASUREMENT AND PAYMENT

A. This article defines the manner and method to develop the Lump Sum, Unit Price, and Allowance bid amounts of all items identified in the Payment Schedule. Bid items and amounts shall include all plant, equipment, tools, materials, labor, service, and all other items required to complete the Work included in the Contract unless specifically excluded by this Section.

B. Payment for all items of the Payment Schedule, whether lump sum or unit price, shall include all compensation to be received by the Contractor for furnishing all labor, materials, tools, equipment, supplies, transportation, subcontract work, incidentals, indirect costs, overhead, consulting services, manufactured articles, plant establishment and operations, taxes, insurance, bonds, profit, permits, and costs of compliance with public agency regulations having jurisdiction over the Work.

C. No separate payment will be made for any item that is not specifically set forth in the Payment Schedule. All costs shall be included in the individual bid items

identified in the Payment Schedule for the various items of Work.

D. Work required for which no separate bid item is identified will be considered as a subsidiary obligation of the Contractor, and the cost therefore shall be included in the most applicable bid item.

E. Compensation for completion of the Work will be determined by the updated construction schedule. Payment amounts for each item will be the basis for development of budget values for activities included in the updated construction schedule.

F. All quantities shall be measured in accordance with industry standard practices, and as specified herein. The Contractor shall compute all quantities of Work performed for payment purposes. The District Representative will verify measurements. Except for time, all quantities shall be measured to the nearest rounded off whole number. Time shall be measured to the nearest tenth of an hour.

G. The following quantities shall not be included for payment:

1. Quantities of material wasted or disposed of in a manner not called for under the Contract or a consequence of the construction method used to perform the Work.

2. Rejected loads of material, including material rejected after it has been placed, by reasons of the failure of the Contractor to comply with the Contract provisions.

3. Materials placed outside the Contractor's storage and staging area stated on the Drawings or lines established by the District Representative.

4. Materials not incorporated into the final Work.

5. Materials remaining after the completion of Work.

H. No payment will be made for loading, hauling, and disposing of rejected materials.

I. Final payment for Work covered by Unit Price Items will be made on the basis of the actual measured quantities accepted by the District Representative multiplied by the Unit Price in the Payment Schedule.

PART 2 - PRODUCTS

2.01 PROGRESS PAYMENT REQUIREMENTS

A. Monthly progress payment requests are due on a certain day of each month (to be determined by RMWD). Payment requests will be accepted prior to the submittal date; however, payment request processing will not begin until this date for purposes of meeting RMWD's pay request processing obligations under the California Public Contract Code. Failure of the Contractor to submit pay requests

by the submittal date may be cause for rejection of the payment request. If rejected, the Contractor may have to resubmit their payment request the next month. Should the submittal date fall on a holiday or weekend day during the month the Contractor shall consider the next work day as the due date.

B. Partial payment for Work performed shall be in accordance with the updated construction schedule. The District Representative will verify measurements and quantities. Each activity necessary to manage and complete the Work is identified on the construction schedule. Each activity will be assigned its respective value, a portion of the contract price.

C. Payment for all Lump Sum item costs and services incurred on this Contract shall be based on the earned value of Work accomplished during the reporting period. Earned value is determined by the completion percentage of each activity applied to the total value of the activity. No construction activity shall be deemed 100% complete until the Contractor has completed the Work and the Work has been inspected and approved by the District Representative.

D. Unit Price items will be paid based on quantities installed.

E. Earned value is derived from the current status of the updated construction schedule as determined by the monthly schedule status submittal. Each schedule status submittal is reviewed and approved by the RMWD prior to the Contractor obtaining approval for the Summary of Earned Values or quantities installed and the Payment Application.

F. The Contractor shall not take advantage of any apparent error or omission on the Contract Documents, Drawings, or Specifications. The RMWD shall be permitted to make corrections and interpretations as may be deemed necessary for fulfillment of the intent of the Contract Documents at no additional cost to the RMWD.

2.02 PAYMENT APPLICATION

A. The Payment Application shall be submitted according to the format and instructions provided by RMWD and is based on Work completed through the last day of the previous month or through the date established by the District Representative.

B. Two copies of the Payment Application shall be submitted. (One hard copy to RMWD and one electronically).

C. Payment Application shall be submitted monthly.

D. The Payment Application shall contain all necessary references and attachments that substantiate the invoice for progress payment, (e.g., certified payrolls, labor reports, updated construction progress schedule, and Summary of Earned Values).

E. Payment Application shall be submitted with updated construction schedule and project status report.

PART 3 - EXECUTION

3.01 MONTHLY REVIEW OF PAYMENT APPLICATION

A. Monthly review meetings between the Contractor and RMWD will be held within 7 days prior to the payment application date designated by the RMWD.

B. Prior to the monthly review meeting, the Contractor shall submit an updated construction schedule and a Payment Application showing a Summary of Earned Values for the reporting and payment period. RMWD will compare Contractor submitted earned values to available data.

C. The Contractor shall make any adjustments to the updated construction schedule and Payment Application, as deemed necessary based on the RMWD's review. Upon the Contractor's completion of the adjustments, RMWD will forward the Payment Request to RMWD. RMWD will determine payment amounts if agreement with Contractor is not reached.

3.02 PAYMENT FOR PRODUCTS STORED ON SITE

A. The Contractor may request payment for products (material and/or equipment) which will be incorporated in the Work and which will be delivered and stored on-site.

B. Payments for products stored at the site shall be based upon the cost of all acceptable materials and equipment not incorporated in the Work but delivered and suitably stored at the site; provided each such individual item has a value of more than $5,000 and will become a permanent part of the Work.

C. The Payment Application shall contain a bill of sale, invoice, or other documentation warranting that the Contractor has received the materials and equipment free and clear of all liens, charges, secured interests, and encumbrances and evidence that the materials and equipment are covered by appropriate property insurance as specified in the insurance provisions and other arrangements to protect the RMWD's interest.

-END OF SECTION-

SECTION 01040

PROJECT COORDINATION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes provisions related to overall project coordination. Additional provisions are included within specific technical Specifications Sections.

1.02 SUBMITTALS

A. Submittals shall be made in accordance with Specifications Section 01300, Contractor Submittals, and the following special provisions provided herein.

B. The Contractor shall submit a statement of qualifications of its proposed superintendent to RMWD for review. The statement of qualifications shall include the superintendent's name, the name of each project that is the basis of the qualifications, each project site location, a brief description of each project, and the name and mailing address for each project owner.

1.03 SUPERINTENDENT

A. The Contractor shall assign a duly authorized and competent person continually on the sites during the Work. The superintendent shall have not less than 4 years' experience as a contractor's general superintendent on similar projects with complexity and configuration comparable to the Work described in the Contract Documents.

B. If the superintendent is not deemed qualified or if the superintendent's performance on the Project is determined to be unsatisfactory by RMWD, the superintendent shall be immediately removed from the Project pursuant to the Specifications Division 0, General Conditions.

C. The Contractor shall furnish to RMWD a written statement of the qualifications of the proposed substitute superintendent if a substitute superintendent is required.

D. A substitute superintendent shall meet the same requirements and shall be subject to approval by the RMWD.

1.04 CONCURRENT CONSTRUCTION AND OPERATIONS

A. RMWD facilities shown on the Drawings are operating facilities that are necessary to continue RMWD's function of delivering water to RMWD's service area. It is necessary that these facilities be kept operational at all times except as may be scheduled for tie-ins or other work. Concurrent with work performed under this Contract, RMWD will perform routine operation and maintenance activities in and around the site. The Contractor shall maintain the work area to provide full access to all facilities so as not to compromise the ability of RMWD to operate the facilities and so that the operators and maintenance personnel may perform their duties.

B. The Contractor shall cooperate with other contractors and RMWD forces

performing work at the site, shall conduct its operations in a manner to prevent unnecessary delay or hindrance to their work, and shall coordinate its work with theirs to permit proper and timely completion of all projects in the area.

1.05 RESTRICTED AREAS

A. The Contractor's personnel, agents, and subcontractors shall be restricted from entry to existing buildings and structures except as may be required by the Work.

1.06 PUMP STATION DELIVERY AND STORAGE

A. The District will deliver the owner-provided (EFI) pump stations to the project site for unloading by the contractor. The pump stations will be delivered on a flatbed trailer and will be delivered to the general vicinity of the pump station sites. It is not guaranteed the contractor can lift the pump station off the flatbed and set the pump station directly on the support slab. The pump station may need to be unloaded, set down and then the crane repositioned to set the pump station in its final position. The Contractor shall provide cranes and other equipment material and labor to unload and set the pump stations. Contractor assumes responsibility of pump station upon delivery to the site. Contractor to be aware that each of the three pump station delivery will be two but not more than four loads per station per site and will not occur on the same day. The pump station building, generator building, and roof section will come as separate pieces. The Contractor is responsible for obtaining all traffic control permits required for delivery and unloading. The Contractor to be ready for delivery as early as the beginning of March but the delivery may be delayed by the District with no additional compensation to be provided to the contractor for this delay other than a no cost time extension to the contract. If the contractor is not ready for delivery of the EFI Pump Station(s) and the District is unable to delay delivery, the contractor will be responsible for storage of the EFI pump station(s) at the RWMD yard. The contractor will be responsible for all costs to unload, load and transport the pump station(s) to the yard and to the job sites including any traffic control and haul route permits. For the Rancho Amigos Pump Station Site, all access shall only be via Rancho Amigos Road for all construction activities.

1.07 CONSTRUCTION SEQUENCING

A. Construction on all three (3) pump station sites shall be concurrent so all sites will be ready to accept the EFI pump station delivery at a similar time.

B. The Contractor shall submit a sequencing schedule for review and approval by the District as part of the Startup and Testing of each pump station. A preliminary startup and testing sequencing plan may include but is not limited to:

a. Pump Station Startup:
    1. West Lilac Pump Station
    2. Rancho Amigos Pump Station
    3. Dentro Pump Station

b. Sequencing of Individual pump stations shall generally follow:
    1. Run Pump 1 to make sure it runs properly. Run time may vary for each pump depending on maintenance needs and observations of impact to the Districts system.
    2. Turn off Pump 1 and Run Pump 2. Run time may vary for each pump depending on maintenance needs and observations of impact to the Districts system.
    3. Turn off Pump 2 and Run Pump 3. Run time may vary for each pump depending on maintenance needs and observations of impact to the Districts system.
    4. Run Pump 1 and 2 to evaluate impacts to system.
    5. Run Pump 1, 2, and 3 to evaluate impacts to system.

C. After each pump station has been commissioned each individual pump at the West Lilac, Rancho Amigos, and Dentro Pump Stations stall be started one at a time to evaluate and observe the impacts to the Districts system of all nine pumps online simultaneously.

1.08 COMMUNITY OUTREACH

A. Contractor shall be responsible for notifying residents about the project/schedule/road closures either by letter and/or door hanger within at 1 mile radius of project site and all residents along Rancho Amigos with language material approved by the District.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

-END OF SECTION-

SECTION 01050

CONSTRUCTION SURVEYING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes provision required by the Contractor for construction surveying as specified herein for the construction of the Work.

B. Contractor shall be responsible for any monumentation and/or benchmarks which will be disturbed or destroyed by performing the Work. Such points shall be referenced and replaced with appropriate monumentation by a Licensed Surveyor or Registered Civil Engineer authorized to practice Land surveying in the State of California. A Corner Record or Record of Survey, as appropriate, shall be filed by the Licensed Land Surveyor or Registered Civil Engineer as required by the Land Surveyor's Act.

C. Contractor shall provide all surveying necessary for completion of Work as defined by the Contract Documents.

1.02 DEFINITIONS

Surveyor: The Surveyor will be an approved licensed Land Surveyor or Registered Civil Engineer authorized to practice Land Surveying in the State of California.

1.03 CONTROL - See Drawings.

1.04 QUALITY CONTROL

All surveying work will be performed under the direction and supervision of an approved licensed Land Surveyor or licensed Civil Engineer authorized to practice Land Surveying in the State of California, employed or retained by the Contractor.

1.05 SUBMITTALS

A. Submittals shall be made in accordance with Specifications Section 01300, Contractor Submittals, and the following special provisions provided herein.

B. Prior to beginning any phase of the survey Work, the Contractor shall submit to RMWD for approval in accordance with Section 01300, the Contractor's projected requirements for construction surveying of the Project, including timetable for required survey data.

C. All survey data will be recorded in accordance with standard methods approved by the District Representative. All original field notes, computations, and other records for the purposes of layout will be recorded in field books, or other methods acceptable to the District Representative. All “Cut Sheets” will be forwarded to the District Representative prior to staking and/or excavation. Any changes to the cut sheets shall be recorded as changes and a complete set of “Record Cut Sheets” shall be submitted to RMWD.

D. The Surveyor will submit to the RMWD, full descriptions and surveying, location, and elevation information for all monuments established as a part of the Project.

PART 2 - MATERIALS – (Not Used)

PART 3 - EXECUTION

3.01 LINE AND GRADE

A. All Work shall conform to the lines, elevations, and grades shown on the Drawings.

B. Three (3) consecutive points set on the same slope shall be used together so that any variation from a straight grade can be detected. Any such variation shall be reported to the District Representative. In the absence of such report, the Contractor shall be responsible for any error in the grade of the finished Work.

C. Grades for underground conduits will be set at the surface of the ground. The Contractor shall transfer them to the bottom of the trench.

-END OF SECTION-

SECTION 01060

SAFETY, ENVIRONMENTAL, AND REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. The Contractor shall submit a site-specific Injury and Illness Prevention Program (IIPP) covering all Work and Contractor and subcontractor employees at the site.

B. Permits: The Contractor shall submit copies of permits required by regulatory authorities and shall retain copies of the permits at the site.

1.02 REGULATORY REQUIREMENTS

A. The citation or listing of specific laws, ordinances, or regulations in this and other sections of the Specifications is not a complete inventory of the laws, ordinances, or regulations that apply to those engaged or employed on the Work, materials used in the Work, the conduct of the Work, or the safety and protection of persons, property, and the environment. These citations shall not limit or diminish the Contractor's responsibility to keep fully informed of and observe and comply with laws, regulations, ordinances, codes, orders, rules, standards, or decrees of public bodies having jurisdiction.

B. In the event a law, regulation, ordinance, code, order, rule, standard, or decree conflicts with a requirement of the Drawings or Specifications, the Contractor shall make a written request for direction from the RMWD.

1.03 PUBLIC SAFETY

A. Whenever the Contractor's operations create a condition hazardous to the public, flagmen and guards shall be furnished as necessary to give adequate warning to the public of the hazard. The Contractor shall furnish, erect, and maintain fences, bridges, railings, barriers, lights, signs, and other devices as necessary to prevent accidents and avoid damage or injury to the public.

1.04 AIR QUALITY

A. The Contractor shall perform the Work in accordance with the requirements of all federal, state, and local regulatory agencies including:

1. San Diego Air Pollution Control District (County of San Diego)

2. California Air Resources Board (CARB)

B. Whenever abrasive blasting is to be performed, blast media shall be certified for use by CARB for unconfined blasting pursuant to CCR Title 17.

1.05 SAFETY, HEALTH, AND PROTECTION

A. The Contractor shall comply with safety standards established within the Cal/OSHA CCR Construction Safety Orders (CSO) and General Industry Safety Orders (GISO) that are applicable to the Work. The Contractor shall have a complete copy of the CSO at the work site.

B. A copy of the Contractor's IIPP and Code of Safe Practices, prepared in accordance with CCR Title 8 shall be kept at the site. Upon request, such documents shall be made available to RMWD for review.

1. The Contractor shall identify in writing to RMWD the Contractor's "competent person" responsible for performing inspections of excavations and protection at excavations required by CCR Title 8.

2. The Contractor shall revise the IIPP and Code of Safe Practices during the Work as often as necessary to fit the operations and possible hazards.

C. The Contractor shall ensure the safety of RMWD employees. RMWD's employees will not be permitted to enter unsafe places for the purpose of making inspections except where an inspection is required to determine if previously detected unsafe conditions have been corrected. Where Work is required to be inspected by the RMWD and the inspection is not performed due to the existence of an unsafe condition, the Work shall be subject to rejection, or the Work may be suspended in accordance with Section 13(a) of Document 00700, "General Conditions."

D. The Contractor shall be responsible for preventing health hazards arising from work related activities of employees.

E. When possible, the Contractor shall notify RMWD in advance of safety inspections by OSHA or other governmental safety agencies. RMWD will attend safety inspections when notice is given sufficiently in advance to be present. When RMWD is not present during a safety inspection, the Contractor shall immediately report to RMWD that a safety inspection has taken place and shall advise the RMWD of violations, citations, or salient events arising from the inspection and of the Contractor's abatement actions.

F. The Contractor shall ensure the availability of emergency medical services to workers on the site.

1. Appropriately Trained Personnel: The Contractor shall ensure that a suitable number of appropriately trained personnel are available to render first aid. The names of these persons shall be made available to the RMWD upon request.

2. First Aid Kit: The Contractor shall provide and maintain adequate first aid kits for the use of all persons employed on the Work. The first aid supplies shall be in accordance with CCR Title 8 as a minimum.

G. Material Safety Data Sheets (MSDSs) shall be in accordance with Federal Standard 313C.

H. Head Protection: All persons shall be required to wear ANSI-standard hard-hats while at the work site; no bump caps will be permitted.

1.06 ACCIDENT REPORTING

A. The Contractor shall report in writing to the RMWD on or before the 10th of each month stating:

1. The number and character of all accidents during the previous month that resulted in loss of work time.
2. The total workforce employed on the Contract during the previous calendar month.
3. Other information that may be required by the RMWD relating to project injuries or accidents.

B. Accidents or incidents that cause property damage or personal injury shall be reported to the District Representative in writing as soon as possible, but in every case less than 24 hours after the incident.

1.07 VENTILATION - (Not Used)

1.08 ENVIRONMENTAL PROTECTION

A. Hazardous Materials Storage: Hazardous materials shall be stored in covered, leak-proof containers when not in use, away from storm drains and heavy traffic areas, and shall be protected from rainfall infiltration. Hazardous materials shall be stored separate from nonhazardous materials, on a surface that prevents spills from permeating the ground surface, and in an area secure from unauthorized entry at all times. Incompatible materials shall be stored separately from each other.

1.09 PERMITS

A. The Contractor shall obtain all other permits and pay permit fees and inspection costs required by agencies and authorities having jurisdiction. The costs for the permits and inspections shall be included in the price entered in the Bidding Sheet.

B. When the terms of permits obtained by either the Contractor or RMWD require inspections by agencies or authorities other than RMWD, the Contractor shall schedule the inspections and notify the RMWD a minimum of 24 hours prior to the inspection being performed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

-END OF SECTION-

SECTION 01200

PROJECT MEETINGS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes provisions for project meetings to be regularly conducted during the performance of the Work.

1.02 PRE-CONSTRUCTION MEETING

A pre-construction conference shall be held at a location, date and time in accordance with Section 01010. In addition to the attendees named herein, the meeting shall be attended by the representatives of regulatory agencies having jurisdiction of the Project, if required, and such other persons RMWD may designate. RMWD shall be the person who coordinates with the representatives of the regulatory agencies.

A. After notification of award and prior to the start of any Work, a pre-construction meeting will be held at a time and place selected by RMWD to discuss the Work, construction schedule, mobilization for the start of Work, and details of administrative procedures to be used during the progress of the Work.

B. Attending the meeting will be RMWD representatives, the Contractor's site superintendent, Contractor’s QA/QC Manager, and any other key members of the Contractor's staff, subcontractors and any other parties that may be deemed necessary by RMWD. In addition to the attendees named herein, the meeting may be attended by representatives of regulatory agencies having jurisdiction of the Project, if required, and such other persons the RMWD may designate. RMWD coordinate with the representatives of the regulatory agencies.

C. At the pre-construction meeting, RMWD will discuss details of procedures for access to the sites, operational necessities at the facilities, procedures for payment applications, safety, schedule of project meetings, and other subjects as determined by RMWD or requested by the Contractor.

D. The Contractor shall submit to the RMWD emergency telephone numbers listing where the Contractor can be reached day or night, including weekends and holidays.

E. At the pre-construction meeting the Contractor shall submit a copy of the "Notice to Proceed" as issued by RMWD and show proof that all permits incidental to the Work or made necessary by their operations have been successfully secured.

F. Agenda matters to be discussed or resolved and the instructions and information to be furnished or given by the Contractor at the pre-construction conference include, but are not limited to, the following:

1. Project meeting schedule.

2. Construction plans, progress schedule, and schedule of values.

3. Communication procedures between the parties.

4. The names and titles of all persons authorized by the Contractor to represent and execute documents on behalf of the Contractor.

5. The names, addresses, and telephone numbers of all those authorized by the Contractor to act on the Contractor's behalf in emergencies.

6. Construction permit requirements and procedures.

7. Access and rights-of-way to be furnished by RMWD.

8. Forms and procedures for the Contractor's submittals.

9. Change Order forms and procedures.

10. Payment procedures.

11. First-aid and medical facilities to be furnished by the Contractor.

12. Construction equipment and methods proposed by the Contractor.

13. Other administrative and general matters, as necessary.

1.03 PROJECT MEETINGS

A. To enable orderly review of progress during the performance of the Work and to provide for systematic discussion of problems, RMWD will conduct regularly scheduled project meetings throughout the performance of the Work. Project meetings as needed at the jobsite in accordance with a mutually acceptable schedule. More frequent meetings may be called after due notice to the Contractor.

B. The purpose of the project meetings is to analyze and resolve problems that might arise relative to execution of the Work, to discuss potential impact the Contractor's operations may have on facility operations, and to review the Contractor's look-ahead schedule. The Contractor shall advise RMWD at least 24 hours in advance of the project meeting regarding items the Contractor would like added to the agenda.

C. Attendees. Unless otherwise required by RMWD, meetings shall be attended by RMWD, the Contractor, the Contractor's Construction Manager, and the Contractor's Superintendent. Subcontractors may attend when involved in the matters to be discussed or resolved, but only when requested by the RMWD or Contractor. Persons designated by the Contractor to attend and participate in project meetings shall have the authority to commit the Contractor to the resolution of problems as agreed upon in the project meetings.

D. Subcontractors, materials suppliers, and others may be invited to attend project meetings when their aspects of the Work are involved, but the Contractor shall remain wholly responsible for its obligations under the Contract.

E. The meeting agenda will include a review, evaluation, and discussion of each construction schedule item and Contractor submittals.

F. The Contractor shall designate persons to attend these schedule meetings who are familiar with the construction schedule, current construction problems and activities, and with the logic of the Work sequences used in preparing the construction schedule and updates.

G. Project Meeting Records. RMWD will prepare meeting minutes of each meeting and will furnish copies to the Contractor within (5) work days thereafter. If the Contractor does not submit written objection and proposed corrections to the contents of such meeting minutes within (5) work days after distribution, it shall be understood and agreed that the Contractor accepts the meeting minutes as a true and complete record of the meeting.

1.04 REGULATORY AGENCIES

When requested, the Contractor shall attend meetings held or required by governmental or regulatory agencies having jurisdiction over the Work.

1.05 OTHER MEETINGS

Occasionally, as dictated by the Work progress and concerns, RMWD may call separate meetings to discuss specific topics. The Contractor's authorized representative is required to attend these meeting as requested by RMWD.

1.06 POST-CONSTRUCTION CONFERENCE

A post-construction conference shall be held prior to final inspection of the Work for each site to discuss and resolve all unsettled matters. Bonds and insurance are to remain in force, and other documents required to be submitted by the Contractor will be reviewed and any deficiencies determined. Schedules and procedures for the final inspection process and for the correction of defects and deficiencies shall be discussed and agreed upon.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

-END OF SECTION-

SECTION 01300

CONTRACTOR SUBMITTALS

PART 1 - GENERAL

1.01 GENERAL

A. All submittals by the Contractor shall be submitted to the RMWD.

B. Contractor shall present submittals for the items listed at the preconstruction meeting.

C. Contractor shall submit a list of all permits and licenses the Contractor is required to obtain, indicating the agency required to grant the permit, the expected date of submittal for the permit, and required date for receipt of the permit.

D. The Contractor is responsible for identifying and delivering all submittals and/or permits required by the Contract Documents.

E. The more stringent section shall take precedence over the General Conditions (Section 00700) in the event of conflicting requirements.

1.02 SHOP DRAWINGS

A. Wherever called for in the Contract Documents, the Contractor shall furnish to the RMWD for review electronic copies 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, catalog sheets, data sheets, and similar items. The Contractor shall submit, as applicable, the following for all mechanical and plumbing equipment:

1. Complete manufacturers specifications, including materials description and coatings.

2. Requirements for storage and protection prior to installation.

3. Installation procedures.

4. List of all requested exceptions to the Contract Documents and/or variations from the specified equipment.

B. All shop drawing submittals shall be accompanied by RMWD’s standard submittal transmittal form. Any submittal not accompanied by such a form, or where all applicable items on the form are not completed, will be returned for resubmittal.

1. Sequentially number the transmittal forms. Resubmittals shall have original number with an alphabetic suffix.

2. Identify Contract, Contractor, Subcontractor and/or Supplier, pertinent drawing sheet and detail number(s), and specification section number, as appropriate. On standard drawings or data sheets, clearly indicate model and option being proposed and strike out all non-relevant data.

C. Normally, a separate transmittal form shall be used for each specific item 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 be permitted only when the items taken together constitute a manufacturer's "package" or are so functionally related that expediency indicates review of the group or package as a whole. A multiple-page submittal shall be collated into sets, and each set shall be stapled or bound, as appropriate, prior to transmittal to RMWD.

D. Except as may otherwise be indicated herein, RMWD will return electronic copies of each submittal to the Contractor with comments noted within twenty (20) calendar days following their receipt by the RMWD. It is considered reasonable that the Contractor shall make a complete and acceptable submittal to RMWD by the second submission of a submittal item. Additional submittal reviews will be conducted at the Contractor's expense as outlined in the General Conditions (Section 00700) of these Specifications. Alternatively, the Owner reserves the right to withhold monies due the Contractor to cover additional costs of RMWD's review beyond the second submittal. The RMWD's maximum review period for each submittal, will be twenty (20) days per submittal and the Contractor's resubmittal shall be made within twenty (20) days. Therefore, for a submittal that requires a second submittal before it is complete, the maximum period for that submittal could be seventy (70) days.

E. If a submittal is returned to the Contractor marked "NO EXCEPTIONS TAKEN," formal revision and resubmission of said submittal will not be required.

F. If a submittal is returned to the Contractor marked "MAKE CORRECTIONS NOTED," formal revision and resubmission of said submittal will not be required, unless specifically requested.

G. If a submittal is returned to the Contractor marked "REJECTED-RESUBMIT," the Contractor shall revise said submittal and shall resubmit the originally required number of copies of said revised submittal to RMWD.

H. Fabrication and procurement of an item shall be commenced only after the RMWD has reviewed the pertinent submittals and the RMWD has returned copies to the Contractor marked either "NO EXCEPTIONS TAKEN" 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 for changes to the contract requirements.

I. All Contractor shop drawing submittals shall be carefully reviewed by an authorized representative of the Contractor, prior to submission to the RMWD. Each submittal shall be dated, signed, and certified by the Contractor, as being correct and in strict conformance with the Contract Documents. In the case of shop drawings, each sheet shall be so dated, signed, and certified. No consideration for review by the RMWD of any Contractor submittals will be made for any items which have not been so certified by the Contractor. All non-certified submittals will be returned to

the Contractor without action taken by RMWD, and any delays caused thereby shall be the total responsibility of the Contractor.

J. RMWD's review of Contractor shop drawing 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. Neither review nor approval of shop drawings or submittals by RMWD shall relieve the Contractor from responsibility for errors, omissions, or deviations from the Contract Documents, unless such deviations were specifically called to the attention of RMWD in the letter of transmittal.

K. RMWD may schedule a submittal conference to provide for a rapid review of a submittal, should the project schedule warrant such a review. RMWD, Contractor, and a qualified manufacturer's representative shall attend the submittal conference.

1.03 CONTRACTOR'S SCHEDULE

The Contractor's construction schedules and reports shall be prepared and submitted to RMWD in accordance with the General Provisions.

1.04 SAMPLES

A. Whenever, in the Specifications, samples are required, the Contractor shall submit not less than two (2) samples of each such item or material to RMWD for review.

B. Samples, as required herein, shall be submitted for acceptance a minimum of thirty (30) 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 submitted to the RMWD shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and the Manufacturer's name for identification. Upon receiving acceptance of RWD, one (1) sets of the samples will be resumed to the Contractor by RMWD. One set of samples will be retained by the RMWD.

D. Unless indicated otherwise, all colors and textures of specified items presented in sample submittals shall be from the manufacturer's standard colors and standard materials, products, or equipment lines. If the samples represent non-standard colors, materials, products, or equipment lines and their selection will require an increase in contract time or price, the Contractor shall clearly indicate same on the transmittal page of the submittal.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 SCHEDULING FOR SUBMITTALS

The Contractor is to recognize the time and sequence related to the submittals required by the Contract Documents. Therefore, the Contractor shall demonstrate competency in preparing and delivering submittals. The Contractor will not be allowed additional Contract time or compensation due to delays associated with submittals. In addition, the costs associated with expedited review of a submittal or a submittal conference may be withheld from monies due the Contractor by the Owner to cover additional costs of the RMWD's review.

-END OF SECTION-

SECTION 01312

CONSTRUCTION SCHEDULES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes provisions for Contractor developed and maintained construction schedules.

1.02 SUBMITTALS

A. Submittals shall be made in accordance with Specifications Section 01300, Submittals, and the following special provisions provided herein.

B. Construction schedule submittals shall consist of electronic copies.

C. Baseline Construction Schedule

1. The Contractor shall submit the baseline construction schedule within 10 work days after receipt of the Notice to Proceed.

2. RMWD will meet with the Contractor to review and discuss the proposed construction schedule within 10 work days after receipt of the submittal. At this meeting, RMWD will inform the Contractor if the construction schedule is acceptable or if it must be revised and resubmitted.

3. In the event that correction of the baseline construction schedule is required, the Contractor shall resubmit the revised construction schedule within 10 work days of the meeting. RMWD will meet with the Contractor to review and discuss the revised construction schedule within (10) work days after receipt of the resubmittal. At this meeting, RMWD will inform the Contractor if the construction schedule is acceptable or if it must be revised and resubmitted.

D. Construction Schedule Updates

An updated construction schedule shall be submitted to RMWD at the end of each month, with the Contractor’s progress payment application.

E. Narrative Progress Report

A written narrative progress report shall be submitted to the RMWD at the end of each month, with the Contractor’s progress payment application.

F. Failure to submit each package by the required date may result in a reduction in progress payment by RMWD for the corresponding month.

G. Look-Ahead Schedule: Look Ahead Schedule shall be submitted weekly and a regular agenda item in the project coordination meetings. The Contractor shall submit the Look Ahead Schedule at least 24 hours prior to the project coordination meeting. The number of copies submitted, and the layout and format of the look-ahead schedule shall be acceptable to RMWD.

1.03 CONSTRUCTION SCHEDULE

A. The Contractor shall provide a computer-generated construction schedule using, Primavera P6, or equal software, that has the capability of producing a Gantt chart and identify critical path.

B. The construction schedule shall show in detail the Contractor's plan for performing the Work. The degree of detail shall be to the satisfaction of the RMWD and shall include, as a minimum:

1. The means, methods, and sequences for performing the Work.

2. Mobilization of plant and equipment.

3. Submission and approval of all submittals.

4. Fabrication and delivery of critical equipment and materials.

5. Approvals and permits required by regulatory agencies or other third parties.

6. Access to and availability of work areas.

7. Identification of interfaces and dependencies with preceding, concurrent, and follow-on subcontractors.

8. Specified project phasing, milestones, and completion dates.

9. Testing.

10. The activities of the RMWD that may affect progress or affect required dates for completion of all or part of the Work, including delivery of RMWD furnished equipment.

11. RMWD startup, testing, and dewatering.

C. Revisions to the Baseline Construction Schedule

1. The Contractor shall immediately advise RMWD of proposed or required changes in the construction schedule logic or delays to the progress of the Work.

2. The Contractor shall furnish a revised schedule within (10) work days of the adoption of a change. The revised schedule shall be accompanied with a written narrative description of the change, the necessity for the change, the impact of the change to the specified schedule milestones, and the cost to RMWD if the revised schedule is accepted.

3. The Contractor shall furnish a revised schedule within 10 work days of the award by RMWD of an adjustment in the time of completion of the Work.

D. Monthly Construction Schedule Updates

1. The Contractor shall update the current construction schedule monthly to indicate:

a. Actual activity-start dates

b. Actual activity-completion dates

c. Estimated duration, in work days, to complete each activity that is started but not completed

d. Actual total progress achieved to date on each activity in percent

e. Non-work days granted by the RMWD.

1.04 NARRATIVE PROGRESS REPORT

A. As part of the monthly update process, the Contractor shall prepare a narrative progress report. The report shall describe the physical progress during the report period, the Contractor's plans for continuing the Work during the forthcoming report period, and actions planned to correct Work that is behind schedule. The report shall also provide a discussion of potential delays and problems and their impact on performance and the overall project completion date.

B. If the Project falls behind schedule by more than 20 work days, the report shall contain proposed alternatives for schedule recovery.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

-END OF SECTION-

SECTION 01400

INSPECTION OF WORK

PART 1 - GENERAL

1.01 SUMMARY

This Section includes provisions for RMWD's inspection of the Work.

1.02 SUBMITTALS

A. Submittals shall be made in accordance with Specifications Section 01300, Submittals, and the following special provisions provided herein.

B. When requested by RMWD, the Contractor shall furnish the RMWD such additional information as may reasonably be required regarding the character of the materials and the progress of their procurement, including copies of invoices, bills of lading, and shipping lists on all articles and materials for use on the Work.

1.03 RESPONSIBILITIES

A. The Contractor shall be responsible for full compliance with every requirement of the Contract Documents, Specifications, and Drawings and shall ensure that the Work is in full accordance with the Contract Documents, Specifications, and Drawings. At all times, the Contractor's Work will be subject to rigid inspection by RMWD. Whether discovered by the Contractor or RMWD, nonconforming Work shall be corrected or replaced by the Contractor, at no additional cost to RMWD.

B. For convenience, items, materials or equipment to be incorporated in the Work may be designated in the Specifications or Drawings by a trade name or the name of a manufacturer and the manufacturer's catalog item number information. Materials, articles, or equipment, even if supplied by a manufacturer designated in the Specifications or Drawings, shall be accepted only if the items meet all other Specification requirements.

C. The Contractor shall furnish all tools, equipment, materials, supplies, and manufactured articles necessary or required for the performance and completion of the Work included in the Contract Documents, except for materials and equipment specified to be furnished by RMWD. The materials, articles, and equipment provided for permanent installation in the Work shall be new and shall be in accordance with the Specifications and Drawings.

D. The Contractor shall perform quality control on suppliers, manufacturers, products, services, site conditions, and workmanship to ensure that Work conforms to the Contract Documents. The Contractor shall document their quality control activities.

E. The Contractor shall require and ensure conformance with specified standards as a minimum quality for the Work. When more stringent tolerances, codes, or specified requirements are required by a particular manufacturer or a particular Work item, the higher standards or more precise workmanship shall be provided.

F. RMWD's inspections and tests are for the sole benefit of RMWD and shall not:

1. Relieve the Contractor of responsibility for providing adequate quality control measures.

2. Relieve the Contractor of responsibility for damage to or loss of the material before acceptance.

3. Relieve the Contractor of the responsibility for proper execution of the Work in accordance with the Contract Documents, Specifications, and Drawings.

4. Constitute or imply acceptance.

5. Affect the continuing rights of RMWD after acceptance of completed Work.

G. The Contractor shall be responsible for adjustments, corrections, or repairs found necessary after the delivery or installation of materials and articles.

H. Unidentified materials shall not be used in the Work, including work at fabrication plants.

I. RMWD will be responsible for performing all inspections on a timely basis to not impede the Contractor's Work.

1.04 SEQUENCING AND SCHEDULING OF INSPECTIONS AND TESTS

A. The Contractor shall fully advise RMWD regarding progress of the Work in its various parts.

B. The Contractor shall furnish and prepare the required samples and test specimens ready for testing in time for the necessary tests and analysis.

C. RMWD shall be given timely notice of the Contractor's readiness for inspection and testing. The length of advance notice shall be appropriate for the complexity of the inspection or test, the availability of the RMWD and the location of the inspection or testing, but in no case shall less than 24 hours advance notice be given.

1.05 TESTING

A. Materials and articles that are to be included in the Work shall be subject to testing for conformance with the Specifications and Drawings.

B. The Contractor shall be responsible for conducting, costs, and coordination of all testing stated in the Specifications or Drawings, unless specifically stated otherwise.

C. When not otherwise specified, sampling and testing shall be in accordance with the methods prescribed in the current standards of ASTM applicable to the class and nature of the articles or materials considered. However, RMWD will have the right to use any generally accepted method of testing that will ensure that the quality of materials, articles, or Work is in full accord with the Specifications and Drawings.

D. RMWD will have the right to select, test, and analyze, at the expense of the Contractor, additional test specimens of the materials to be used. Results of these tests and analyses will be considered with the results of other tests or analyses, whether performed by RMWD or the Contractor, to determine compliance with the applicable specifications or standards for the materials.

1.06 INSPECTION BY RMWD

A. Materials and articles that are to be included in the Work shall be subject to rigid inspection by RMWD for conformance with the Specifications and Drawings. The Contractor's schedule shall allot for the inspections to be continuous, repetitive, and detailed.

B. Any Work or testing done in the absence of RMWD may be subject to rejection.

C. Orders for materials, articles, and equipment shall note that the articles, materials, and equipment are subject to inspection and acceptance by RMWD, both during manufacture or fabrication and after delivery to the site.

D. When practicable and convenient for RMWD, inspections will be made during the manufacture of the articles and equipment.

E. The location, alignment, grade, plumb, and other physical characteristics of formwork for concrete, items to be embedded in concrete and permanent improvements will be subject to rigid survey verification.

F. Materials or articles shall not be incorporated in the Work until they have been inspected and approved by RMWD.

G. The Contractor shall not proceed with any subsequent phase of work until the previous phase has been inspected and approved by RMWD.

H. After testing, Work shall be covered or backfilled only with the approval of RMWD.

I. Inspection of the Work as well as other required services will be provided by the RMWD between the hours of 6:30 a.m. and 4:00 p.m., Monday through Friday only. Any inspections or other services provided by RMWD requested by or made necessary as a result of the actions of the Contractor beyond the hours stated above shall be paid for by the Contractor at the prevailing rate of 1 ½ times the regular hourly rate plus any applicable equipment or incidental costs. Additional RMWD inspection services shall be designated on monthly payment applications as credits to RMWD.

J. Inspections or other services by RMWD requested by or made necessary as a result of the actions of the Contractor on Sundays or Holidays must be scheduled and approved by the RMWD.

K. The need for overtime inspection or other services shall be determined by the RMWD whose decision shall be final.

1.08 FACILITIES FOR INSPECTION AND TESTING

A. The Contractor shall furnish the facilities, utilities, and assistance necessary for the safe and convenient performance of inspections and tests required by the Specifications or by the RMWD.

B. The Contractor shall provide adequate lighting, access, and ventilation for a safe working environment for inspections and tests.

C. The Contractor shall cooperate with RMWD personnel in the performance of their respective duties and the Contractor shall provide qualified personnel to assist with the performance of tests and inspections by RMWD.

D. The Contractor shall provide qualified personnel to perform required tests or inspections.

1.09 REJECTION OF WORK

A. RMWD will have the right, at all times and in all places, to reject articles or materials to be furnished for the Project that fail to meet the requirements of the Contract Documents, Specifications, or Drawings. This shall be regardless of whether the defects in these articles or materials are detected at the point of manufacture or after completion of the Work at the sites.

B. RMWD will be the sole judge as to the acceptable quality of materials, articles, and Work. Compliance with the requirements of the Contract Documents Specifications, and Drawings is distinctly a duty of the Contractor and said duty shall not be avoided by any act or omission on the part of RMWD. Where the RMWD through an oversight or otherwise, accepts material, articles, or Work that is defective or that is contrary to the Specifications, the material, article, or Work, no matter in what stage or condition of manufacture, delivery, or erection, may be rejected by the RMWD.

C. Promptly after notification of rejection by the RMWD, the Contractor shall remove rejected portions or items of materials, articles, or Work to a satisfactory distance from the vicinity of accepted items and shall replace them.

D. All costs of removal and replacement of rejected articles or materials as specified herein shall be borne by the Contractor.

E. Rejected or non-conforming work must be corrected within 72 (seventy-two) hour notice.

1.010 FINAL INSPECTIONS AND ACCEPTANCE

A. Final inspections for acceptance of materials, articles, equipment, and Work will be made at the completion of all Work.

B. A minimum of 10 (ten) work days prior to the estimated completion of Work at each site, the Contractor shall notify the RMWD in writing of the pending completion of Work. The Contractor shall include with the “Application for Acceptance of Work” a complete list of Work items remaining to be completed.

C. On or about the Contractor's estimated completion date, RMWD will make a thorough inspection of all Work. Defects and deficiencies noted during this inspection will be reported to the Contractor in writing.

D. The Contractor shall notify RMWD in writing when all items on the defect and deficiency list are corrected. RMWD will make a thorough final inspection of Work.

E. If RMWD determines the Work to be complete, it will be accepted. If defects and deficiencies are noted during this inspection, they will be reported in writing to the Contractor. When the Contractor notifies RMWD of the correction of these items, another final inspection will be scheduled.

F. If, in the RMWD’s judgment, all Work has been completed and is ready for acceptance the RMWD will generate a Notice of Completion for recording the date the Work was completed. This will be the date when the Contractor is relieved from responsibility to protect the Work for the respective site.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

-END OF SECTION-

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.01 SUMMARY

This Section includes provisions for the construction facilities and temporary controls to be provided and maintained by the Contractor.

1.02 SUBMITTALS

A. Submittals shall be made in accordance with Specifications Section 01300, Contractor Submittals, and the following special provisions provided herein.

B. The Contractor shall submit drawings showing the methods of temporary support and protection, along with calculations for the types of support structures of pipelines, utilities, temporary shoring, and structures to remain in place or whose initial or subsequent alignment will be temporarily changed during construction.

1.03 CONTRACTOR'S WORK AND STORAGE YARD AREA

A. The Contractor shall provide, at their own expense, a storage area, approved by RMWD, at each site for storage and staging all materials and equipment.

B. The Contractor shall locate offices, employee parking, storehouses, and storage areas for materials and equipment in the work and storage area.

C. The Contractor shall be responsible for the care of materials and equipment stored in the work and storage yard areas, and for the proper maintenance of fencing and structures.

D. Construction equipment shall not be stored at the work and storage area before its actual use on the Work nor for more than 5 work days after it is no longer needed. Time necessary for repair or assembly of equipment may be authorized by RMWD.

E. Construction materials shall not be stored in streets, roads, or highways.

F. Construction materials and equipment shall be stored in currently developed or disturbed areas outside of sensitive vegetation communities.

1.04 SURFACE AND STORM WATER CONTROL

A. The Contractor shall conform to the applicable requirements of the San Diego County Grading, Clearing, and Watercourses Ordinance, San Diego County Code, Title 8, Division 7 (Sections 87.701 and following) as amended.

B. The Contractor shall divert or otherwise control surface water and waters flowing from existing projects or structures from coming onto its work areas. The method of diversions or control shall be adequate to ensure the safety of stored materials and of personnel using these areas. Following completion of Work under the

Contract, ditches, dikes, or other ground alterations made by the Contractor shall be removed and the ground surfaces shall be returned to their former condition, or as near as practicable, in RMWD's opinion.

C. Surface and storm water that enters the Contractor's work area shall be controlled, treated, and disposed in a lawful manner.

D. The Contractor shall conform to the applicable requirements of the California Regional Water Quality Control Board, San Diego Region, Order No. R9-2002-0020 for Discharges of Hydrostatic Test Water and Potable Water to Surface Waters and Storm Drains or Other Conveyance Systems.

E. Water drained from pipelines and water used for flushing during cleaning operations shall be piped or conveyed into local drainage inlet catch basins, or storm drains where practical. Water will be allowed to flow in the street only in areas where drainage facilities do not exist and only under approved energy dissipation measures. The Contractor shall obtain a discharge permit from the Regional Water Quality Control Board (RWQCB), San Diego Region, for discharge of water. Water shall be dechlorinated in accordance with RWQCB permit requirements.

1.05 FIRE PROTECTION AND PREVENTION

A. All parts of the Work shall be adequately protected against damage by fire. Hose connections and hose, water casks, chemical equipment, and other equipment required by local jurisdictions shall be provided for fighting fires.

B. The exhaust pipes of internal combustion engines used in the Work shall be equipped with approved spark arresters.

1.06 DUST CONTROL

A. The Contractor shall provide effective measures to prevent operations from producing dust in amounts damaging to personnel, property, RMWD operations, plants, or animals, and to prevent causing a nuisance to persons living or occupying buildings in the vicinity.

B. Areas used by the Contractor for construction roads or other purposes in connection with the Work shall be given an approved dust inhibiting surface treatment to avoid production of dust. This surface condition shall be continuously maintained during the entire construction period. The Contractor's construction facilities shall be operated in a manner ensuring minimum dust production.

C. Trucks transporting soil, or cement, or debris shall be covered or moistened with water to suppress the dispersion of dust.

D. During construction operations the Contractor shall take each of the following actions to reduce fugitive dust emissions:

1. Replace ground cover in disturbed areas as quickly as possible.

2. Enclose, cover, water daily or apply non-toxic soil binders according to manufacturers’ specifications, to exposed piles (i.e., gravel, sand, dirt) with five percent or greater silt content.

3. Water active sites at least twice daily.

4. All trucks hauling dirt, sand, soil, or other loose material are to be covered or should maintain at least two feet of freeboard (i.e., minimum vertical distance between top of the lop and the top of the trailer) in accordance with requirements of CVC Section 23114.

5. Apply water three times daily along unpaved roads or apply non-toxic soil stabilizers according to manufacturers' specifications to all unpaved staging areas and unpaved road surfaces.

6. Traffic speeds on all unpaved roads to be reduced to 15 miles per hour or less.

1.07 LIGHT ABATEMENT – (Not Used)

1.08 AIR POLLUTION CONTROL

A. The Contractor shall not discharge smoke, dust, or other air contaminants into the atmosphere in a quantity as will violate the regulations of any legally constituted authority.

B. The Contractor shall maintain equipment in proper mechanical adjustment to minimize the volume of exhaust emissions.

1.09 WATER POLLUTION CONTROL

A. The Contractor shall exercise every reasonable precaution to protect channels, storm drains, and bodies of water from pollution and shall conduct and schedule their operations so as to minimize or avoid muddying and silting of said channels, drains, and waters. Water pollution control work shall consist of constructing those facilities which may be required to provide prevention, control, and abatement of water pollution.

1.010 NOISE CONTROL

A. The Contractor shall conduct operations to abate noise wherever possible and to minimize noise where complete abatement is not possible. The Work shall be carried on as quietly as possible to prevent possible annoyance to adjacent residential properties. Unnecessary noise shall be avoided at all times.

B. The Contractor shall maintain all construction vehicles and equipment in proper working order for the duration of the construction activities.

C. All equipment shall have effective muffling/silencing devices in good working order.

D. The Contractor shall restrict work hours to the requirements of RMWD and permits for each jurisdiction, whichever is more stringent.

E. The Contractor shall comply with the noise requirements of any jurisdictional agencies. Particular consideration shall be given to allowable working hours.

1.011 ENVIRONMENTAL NOISE CONTROL

A. Portions of the project may be in or adjacent to sensitive receptors.

B. The Contractor shall provide noise control provisions during the breeding seasons and in accordance with the provisions below. RMWD will conduct nesting surveys and monitor noise levels.

C. The gnatcatcher breeding season is from February 15th to August 31st. During this timeframe, RMWD will conduct focused surveys to determine if the gnatcatcher is nesting within suitable habitat onsite or within 500 feet of the Work. If nesting gnatcatchers are within 500 feet of the Work, the Contractor shall provide noise control provisions to limit the noise levels at the coastal sage scrub habitat to not exceed an average of 60 decibels per hour. Noise control measures may include straw bales and/or plywood backed with foam core.

1.012 CLEAN UP

A. During all phases of construction, including suspensions of Work, and until final acceptance Work, the Contractor shall keep the sites clean and free from rubbish and debris and shall promptly remove from any portion of the sites, or from property adjacent to the sites, all unused materials, surplus earth and debris. The Contractor shall provide for the disposal of all surplus materials, waste products, debris, etc., and shall make necessary arrangements for such disposal. The Contractor shall obtain written permission from RMWD to disposing of any surplus materials, waste products, debris, etc. on private property, and shall obtain the approval of RMWD prior to such disposal.

B. After completion of all Work, and before making application for acceptance of the Work, the Contractor shall clean the sites of their operations, including all areas under the control of RMWD that have been used by the Contractor in connection with the Work, and shall remove all debris, surplus material, and equipment, and all temporary construction or facilities of whatever nature, unless otherwise approved by RMWD. Final acceptance of the Work by RMWD will be withheld until the Contractor has satisfactorily complied with the foregoing as well as the following requirements for final cleanup of the project area.

C. If the Contractor fails to maintain the premises in a neat and clean condition or fails to remove and dispose of rubbish or materials at the completion of the Project, the areas may be cleaned and materials, equipment, and rubbish may be removed and disposed of by RMWD at the Contractor's expense.

D. Surplus and all material removed which is not suitable for reuse in this Project shall be disposed of by the Contractor in a manner and at a location in accordance with the regulations of legally constituted authorities.

E. The Contractor shall not be permitted to use RMWD trash bins for disposal of trash or rubbish. The Contractor shall provide containers for collection and disposal of waste materials, debris and rubbish.

1.013 PROTECTION OF NEW AND EXISTING IMPROVEMENTS

A. The general locations of existing utility installations shown on the Drawings are those that are known to exist, but this listing shall not be construed as a complete listing.

B. The Contractor shall be responsible for the safeguarding of all utilities. At least 2 work days before beginning Work, the Contractor shall call the Underground Service Alert (USA) in order to determine the location of substructures. The Contractor shall immediately notify RMWD and the utility owner if the Contractor disturbs, disconnects, or damages any utility or substructure.

C. Where existing piping, utilities, and structures are to remain in place, these facilities shall be temporarily supported and protected until the Work has been completed and compacted backfill has been placed to fully support said improvements. Facilities adjacent to the Work shall be protected in place when excavating in their vicinity. The support system shall prevent movement, dislocation, and deflection of the piping, utilities, and structures at all times. Supports and protection shall be designed, stamped, and signed by a civil engineer currently registered in the State of California and shall be acceptable to the owner of the improvement.

D. The Contractor shall pothole to determine depth and location of existing pipelines and utilities underground. The Contractor shall determine clearance for aboveground utilities. The Contractor shall be responsible for coordinating the potholing with RMWD. No extension of time or additional compensation will be made for delays caused by the failure of the Contractor to complete the potholing in a timely manner.

E. The Contractor shall provide a typed pothole report. The report shall include a separate line item for each potholed utility identifying the utility, the utility size, the utility depth and the exact station of the potholed utility based on the stationing of the surveyed pipeline alignment.

F. All costs incurred in exposing and locating the existing utilities including all labor, tools, equipment for excavation, backfill and restoring existing surface improvements, shall be included in the bid price. The Contractor shall bear the cost of repairing or replacing any existing utility damaged by potholing work.

G. Except as otherwise specified, the pipelines and utilities whose initial or subsequent alignment will be temporarily changed during construction shall be supported and maintained in operation throughout the Work period for the specific pump station site.

H. The Contractor shall cover and protect finished surfaces of new or existing improvements with plywood, falsework, or other protective temporary works, as necessary.

1.014 RESTORATION OF IMPROVEMENTS

A. Upon completion of the Work, the Contractor shall reconstruct existing roads to a condition equivalent to that which existed before the start of Work.

B. The Contractor shall broom clean paved surfaces; rake clean other surfaces or grounds.

1.015 SECURITY

A. The Contractor shall be responsible for providing security within the Work sites as the Contractor deems necessary for the protection of its own equipment, materials,

or Work from vandalism or theft. RMWD will not be responsible for theft or damage to the Contractor's equipment, materials, or Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

-END OF SECTION-

SECTION 01505

MOBILIZATION

PART 1 - GENERAL

1.01 GENERAL

A. Mobilization shall include the acquisition of all permits; moving onto the site of all equipment, 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. Installing temporary construction power, wiring, and lighting facilities.

2. Developing construction water supply as required.

3. Providing all on-site communication facilities, including telephones and radios for Contractor personnel.

4. Providing on-site sanitary facilities and potable water facilities for Contractor personnel.

5. Arranging for and erection of Contractor's storage yard as required.

6. Obtaining all required permits.

7. Having all OSHA required notices and establishment of safety programs.

8. Submitting initial submittals.

1.02 CONSTRUCTION FACILITIES PLAN

A. Prior to commencement of any field work, the Contractor shall submit a Construction Facilities Plan to RMWD for approval. Said plan shall show the layout, equipment, materials and procedures that Contractor proposes for construction of temporary electrical, telephone, lighting, water, sanitation, field offices and sheds, and other similar site facilities.

B. The Contractor's construction facilities shall be of a temporary nature. The Contractor shall be wholly responsible for the security of its lay down area, and for all its materials, equipment and tools at all times.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

-END OF SECTION-

SECTION 01510

TEMPORARY UTILITIES

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

A. The Contractor shall make arrangements with the appropriate utility agencies for temporary connections to the utilities. The Contractor is responsible for extending any utility services to the required point of use.

B. Type of Services: The types of utility services required for general temporary use at the project site, may include, but are not limited to, the following:

1. Sanitary Sewer
2. Electrical Power
3. Potable Water
4. Trash
5. Telephone/Internet

C. Scheduled Uses: The Contractor shall schedule the implementation and termination of service for each temporary utility or facility.

PART 2 - PRODUCTS

2.01 MATERIALS

The Contractor shall provide either new or used materials and equipment, which are in substantially undamaged condition and without significant deterioration and which are recognized in the construction industry, by compliance with appropriate standards, as being suitable for intended use in each case. Where a portion of a temporary utility is provided for the Contractor by a utility company, the Contractor shall provide the remainder with matching and compatible materials and equipment and shall comply with recommendations of the utility company.

PART 3 - EXECUTION

3.01 INSTALLATION OF TEMPORARY UTILITY SERVICES

General: Wherever feasible, the Contractor shall engage the utility company to install temporary service to the project, or as a minimum, to make connection to existing utility service; shall locate services where they will not interfere with total project construction work, including installation of permanent utility services; shall maintain temporary services as installed for required period of use; and shall relocate, modify or extend as necessary from time to time during that period as required to accommodate total project construction work.

3.02 ELECTRICAL SERVICE

A. Contractor Operations: The Contractor shall pay all costs for electrical system installation and usage charges associated with its operations.

B. Approval of Electrical Connections: All temporary connections for electricity shall be subject to approval of RMWD and the power company representative and shall be removed in like manner at the Contractor's expense prior to final acceptance of the Work.

C. Separation of Circuits: Unless otherwise permitted by RMWD, circuits separate from lighting circuits shall be used for all power purposes.

D. Construction Wiring: All wiring for temporary electric light and power shall be properly installed and maintained and shall be securely fastened in place. All electrical facilities shall conform to the requirements of Title 8, Division 1 Industrial Relations, Chapter 4, Subchapter 5, Electrical Safety Orders, California Administrative Code; and Subpart K of the OSHA Safety and Health Standards for Construction (29 CFR 1926).

3.03 INSTALLATION OF POWER DISTRIBUTION SYSTEM

A. Power: The Contractor shall provide all necessary power required for its operations under the Contract, at no additional cost to RMWD.

B. Temporary Power Distribution: The Contractor shall provide a weatherproof, grounded, temporary power distribution system sufficient to accommodate performance of entire Work of the Contract, including but not necessarily limited to operation of test equipment and test operation of systems which cannot be delayed until permanent power connections are operable; temporary operation of other temporary facilities, including permanent equipment and systems which must be placed in operation prior to use of permanent power connections (pumps and similar equipment); and power for temporary operation of existing facilities (if any) at the site during change-over to new permanent power system. Provide circuits of adequate size and proper power characteristics for each use; run circuits wiring generally overhead, and rise vertically in locations where it will be least exposed to possible damage from construction operations, and result in least interference with performance of the Work; provide rigid steel conduit or equivalent raceways for wiring which must be exposed on grade, floors, decks, or other recognized exposures to damage or abuse.

C. Provide power outlets for the Contractor's operations, with transformers, branch wiring and distribution boxes located safely and conveniently for the proposed construction activities. Provide flexible power cords as required.

D. Maintain main service disconnect and overcurrent protection at source distribution equipment.

3.04 INSTALLATION OF LIGHTING

A. Construction Lighting: All work conducted at night or under conditions of deficient daylight shall be suitably lighted to ensure proper work and to afford adequate facilities for inspection and safe working conditions.

B. Temporary Lighting: The Contractor shall provide a general, weatherproof, grounded temporary lighting system in every area of construction work, as soon as is practically feasible and provide sufficient illumination for safe work and traffic conditions; and run circuit wiring generally overhead, and rise vertically in locations where it will be least exposed to possible damage from construction operations on grade, floors, decks, or other recognized areas of possible damage or abuse.

C. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.

D. Maintain lighting and provide routine repairs.

3.05 INSTALLATION OF SANITARY FACILITIES

A. Toilet Facilities: Fixed or portable chemical toilets shall be provided by the Contractor wherever needed for the use of Contractor's employees. Toilets at construction job site shall conform to the requirements of Subpart D of 29 CFR Section 1926.51 of the OSHA Standards for Construction.

B. Sanitary and Other Organic Wastes: The Contractor shall establish a regular daily collection of all sanitary and organic wastes. 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 away from the site in a manner satisfactory to the District Representative and in accordance with all laws and regulations pertaining thereto.

3.06 OPERATIONS AND TERMINATIONS

A. Inspections: Prior to placing temporary utility services into use, the Contractor shall inspect and test each service and arrange for governing authorities' required inspection and tests and obtain required certifications and permits for use thereof.

B. Protection: The Contractor shall maintain distinct markers for underground lines and protect from damage during excavating operations.

C. Termination and Removal: When need for a temporary utility service or a substantial portion thereof has ended, or when its service has been replaced by use of permanent services, or not later than time of substantial completion, the Contractor shall promptly remove installation unless requested by the District Representative to retain it for a longer period. The Contractor shall complete and restore the Work which may have been delayed or affected by installation and use of temporary utilities, including repairs to construction and grades and restoration and cleaning of exposed surfaces.

-END OF SECTION-

SECTION 01520

SECURITY

PART 1 - GENERAL

1.01 SUMMARY

This Section includes provisions for the Contractor's security provisions.

1.02 GENERAL

A. The Contractor shall safeguard all Work, materials, equipment and property from loss, theft, damage and vandalism. Contractors' duty to safely guard property shall include RMWD's property and other private property from injury or loss in connection with the performance of the Work.

B. The Contractor shall employ on-site security personnel, as needed, to provide the required security and prevent unauthorized entry.

C. The Contractor shall make no claim against RMWD for damage resulting from trespassing, vandalism, or theft.

D. The Contractor shall be responsible for security and shall be liable for damage to RMWD property and damage to other parties, arising from failure to provide adequate security.

E. If existing fencing or barriers are breached or removed for purposes of construction, the Contractor shall provide and maintain temporary security fencing equal to the existing in a manner satisfactory to the RMWD.

F. Security measures taken by the Contractor shall be at least equal to those provided by RMWD to protect the existing facilities during normal operation.

G. A security program shall be maintained throughout construction until final acceptance of the Work.

1.03 CONTRACTOR'S ACCESS TO THE SITE

A. Access to the sites for Contractor's employees, material, tools, and equipment shall be as directed by RMWD.

B. The Contractor shall ensure that all employees, representatives, material suppliers and others acting for the Contractor shall be subject to the following:

1. No Contractor employee personal vehicles shall be allowed to park anywhere other than the Contractor designate parking area(s) designated by RMWD. The Contractor shall prepare and maintain this area as required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

-END OF SECTION-

SECTION 01530

PROTECTION OF EXISTING UTILITIES

PART 1 - GENERAL

1.01 GENERAL

A. The Contractor shall protect all existing utilities and improvements not designated for removal and shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than they were prior to such damage or temporary relocation, all in accordance with requirements of the Contract Documents.

B. The Contractor shall verify the exact locations and depths of all utilities shown and the Contractor shall make exploratory excavations of all utilities that may interfere with the Work. All such exploratory excavations shall be performed as soon as practicable after award of the contract and, in any event, a sufficient time in advance of construction to avoid possible delays to the Contractor's work. When such exploratory excavations show the utility location as shown to be in error, the Contractor shall so notify RMWD.

C. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the utility.

1.02 PROTECTION OF STREET OR ROADWAY MARKERS

The Contractor shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced. All survey markers or points disturbed by the Contractor shall be accurately restored after all street or roadway resurfacing has been completed.

1.03 RESTORATION OF PAVEMENT

A. General: All paved areas, including asphaltic concrete berms cut or damaged during construction, shall be replaced with similar materials and of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract Documents or in the requirements of the agency issuing the permit. All temporary and permanent pavement shall conform to the requirements of the affected pavement Owner. All pavements which are subject to partial removal shall be neatly saw cut in straight lines.

B. Temporary Resurfacing: Wherever required by the public authorities having jurisdiction, the Contractor shall place temporary surfacing promptly after backfilling and shall maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.

C. Permanent Resurfacing: To obtain a satisfactory junction with adjacent surfaces, the Contractor shall saw cut back and trim the edge so as to provide a clean,

sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement. Damaged edges of pavement along excavations and elsewhere shall be trimmed back by saw cutting in straight lines. All pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement.

D. Restoration of Sidewalks or Private Driveways: Wherever sidewalks or private roads have been removed for purposes of construction, the Contractor shall place suitable temporary sidewalks or roadways promptly after back filling and shall maintain them in satisfactory condition for the period of time fixed by the authorities having jurisdiction over the affected portions before proceeding with the final restoration or, if no such period of time is so fixed, the Contractor shall maintain said temporary sidewalks or roadways until the final restoration thereof has been made.

1.04 EXISTING UTILITIES AND IMPROVEMENTS

A. General: The Contractor shall protect all Underground Utilities and other improvements which may be impaired during construction operations. It shall be the Contractor's responsibility to ascertain the actual location of all existing utilities 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. The Contractor shall take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.

B. Utilities to be Moved: In case it shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of the Contractor, be notified by the District Representative to move such property within a specified reasonable time. When utility lines that are to be removed are encountered within the area of operations, the Contractor shall notify the RMWD a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.

C. Where the proper completion of the Work requires the temporary or permanent removal and/or relocation of an existing utility or other improvement which is indicated, the Contractor shall remove and, without unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to the RMWD and the Owner of the facility. In all cases of such temporary removal or relocation, restoration to former location shall be accomplished by the Contractor in a manner that will restore or replace the utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.

D. Owner's Right of Access: The right is reserved to the Owner and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the Work of this Contract.

E. Underground Utilities Indicated: Existing utility lines that are indicated or the locations of which are made known to the Contractor prior to excavation and that are to be retained, and all utility lines that are constructed during excavation

operations shall be protected from damage during excavation and back filling and, if damaged, shall be immediately repaired or replaced by the Contractor.

F. Underground Utilities Not Indicated: In the event that the Contractor damages any existing utility lines that are not indicated or the locations of which are not made known to the Contractor prior to excavation, a written report thereof shall be made immediately to RMWD. If directed by RMWD, repairs shall be made by the Contractor under the provisions for changes and Extra Work contained in the General Conditions.

G. All costs of locating and repairing damage not due to failure of the Contractor to exercise reasonable care, and removing or relocating such utility facilities not shown in the Contract Documents with reasonable accuracy, and for equipment on the project which was actually working on that portion of the Work which was interrupted or idled by removal or relocation of such utility facilities, and which was necessarily idled during such Work will be paid for as Extra Work in accordance with the provisions of the General Conditions.

H. Approval of Repairs: All repairs to a damaged utility or improvement are subject to inspection and approval by an authorized representative of the utility or improvement owner before being concealed by backfill or other Work.

I. Maintaining in Service: All oil and gasoline pipelines, power, and telephone or the communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the Work shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the District Representative are made with the Owner of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, or wire or cable. The Contractor shall be responsible for and shall repair all damage due to its operations, and the provisions of this Section shall not be abated even in the event such damage occurs after back filling or is not discovered until after completion of the back filling.

1.05 NOTIFICATION BY THE CONTRACTOR

Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television 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) days nor more than seven (7) days prior to excavation so that a representative of said owners or agencies can locate the utilities and be present during such Work, if they so desire.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

-END OF SECTION-

SECTION 01540

LOAD RESTRICTIONS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes provisions for load restrictions during construction activities.

1.02 REFERENCES

A. The publications and standards referenced herein form a part of this Specification.

B. When a date is given for reference standards, that edition shall be used. Where no date is given, the latest edition shall be used.

1.03 SUBMITTALS

A. Submittals shall be made in accordance with Specifications Section 01300, Contractor Submittals, and the following special provisions provided herein.

B. Specifications for equipment to be used at existing or newly constructed pipelines, utilities, and structures shall be submitted to and approved by RMWD before use.

C. If the Contractor desires to exceed the specified load restrictions, the Contractor shall submit the request to the District Representative for approval. The Contractor shall provide supporting technical data and engineering calculations prepared, stamped, and signed by a civil engineer currently registered in the State of California.

D. The Contractor shall provide design of all temporary supports in accordance with Section 01500, Construction Facilities and Temporary Controls. The Contractor shall not exceed the specified load restrictions until the District Representative has reviewed and approved the request.

1.04 LOADING

A. The Contractor shall use caution in performing the Work and shall use methods that avoid the imposition of heavy loads and surcharges on new or existing pipelines, utilities, and structures.

1. Loads shall not be placed upon or against recently completed concrete structures until the concrete has attained its full design strength.
2. The Contractor shall furnish shoring and bracing that is required to prevent collapse, deflection, deformation, or other damage to structures, conduits, earthen slopes, or pipelines during construction and/or backfill operations.
3. Shoring and bracing shall not be removed until the Work requiring their

use has been completed and the District Representative has approved the removal.

B. Excavation and backfill in the vicinity of existing piping, utilities, and structures shall be performed only by methods and with equipment approved by the District Representative.

1. Pipeline and Utility Load Restrictions

a. Within a lateral distance from the outside edge of a pipeline or utility that is equal to the depth from the ground surface to the invert of the pipe, loads imposed by the construction work or by equipment shall be governed by the restrictions shown below.

Height of Fill Over Pipe	Maximum Loading
< 2 feet	Hand-guided equipment
2 feet – 4 feet incl.	Tractor equipment to 25,000 lbs
4 feet – 5feet incl.	AASHTO H-20
> 5 feet	Cat 633E

b. For crossings, vehicle path shall be maintained in a smooth condition with no breaks in grade for 3 vehicle lengths on each side of the pipeline.

3. Structure Load Restrictions: For backfill on new structures, or for excavations adjacent to existing structures, loads imposed on structures by construction work or equipment adjacent to backfilled or partially backfilled structures shall not exceed AASHTO H-20 loading. Load restrictions shall be limited to those areas within a lateral distance from the outside face of buried structures equal to the backfill depth.

C. The Contractor shall use caution in performing the Work and shall use methods that avoid the imposition of heavy loads and surcharges on private roadways and bridges. Furthermore, the Contractor shall employ a licensed civil engineer to evaluate existing private bridges and provide additional temporary shoring and bracing for all routes anticipated to be used by the Contractor AND the company delivering the prefabricated pump stations. Anticipated haul routes for delivery of the prefabricated pump stations are shown in Attachment G1.

1. The Contractor shall furnish shoring and bracing that is required to prevent collapse, deflection, deformation, or other damage to private roads and bridges during hauling activities.

2. Shoring and bracing shall not be removed until the Work requiring their use has been completed and the District Representative has approved the removal.

1.05 DAMAGE

The Contractor shall be liable for damage caused by excessive loads and shall repair or restore damaged facilities at no additional cost to RMWD.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

-END OF SECTION-

SECTION 01550

ACCESS, PARKING, AND TRAFFIC

PART 1 - GENERAL

1.01 SUMMARY

This Section includes provisions for the Contractor's site access, parking and traffic controls.

1.02 REFERENCES

A. The publications and standards referenced herein form a part of this Specification.

B. When a date is given for reference standards, that edition shall be used. Where no date is given, the latest edition shall be used.

1.03 SUBMITTALS

Submittals shall be made in accordance with Specifications Section 01300, Contractor Submittals, and the following special provisions provided herein.

1.04 ACCESS TO THE WORK SITE

The Contractor shall confine its activities and operations within the work areas shown on the Drawings, except as otherwise permitted by RMWD.

1.05 TRAFFIC CONTROL

A. The Contractor shall be responsible for the safe movement of vehicular traffic to and from the worksites, including traffic control measures required to ensure safe passage of vehicles and equipment and delivery of materials.

B. Traffic control shall be in accordance with CCR Title 8.

1. At least (1) flagger shall be provided at each intersection during periods when the Contractor's vehicular activity may conflict with other traffic along roads.

2. The flagger shall ensure that the right-of-way is granted to loaded vehicles and shall provide for safety of all users of the road.

C. Traffic control and signage shall be in accordance with Manual of Traffic Controls for Construction and Maintenance Work Zones.

1.06 HAUL ROUTES

A. If a permit is required by local authorities for off-site hauling of materials or material deliveries, the Contractor shall prepare the truck-routing plans, obtain the permits, and submit copies of permits to RMWD before construction begins.

B. The plan shall include provisions for cleaning debris and sediment from the truck routes.

C. Consideration shall be given to weight restrictions on all roads.

D. The Contractor shall obtain approval of the local authority for construction signage along the haul routes to notify the public of the potential for delays.

E. The Contractor shall inform the RMWD and local authorities when hauling operations are to begin and end.

F. The Contractor shall provide improvements to private roads as indicated in Attachment G1 to facilitate delivery of the prefabricated pump stations to the project sites. Subsequent to delivery of the prefabricated pump stations, the Contractor shall restore the private roads to the pre-construction condition. All temporary improvements to facilitate delivery of the prefabricated pump stations and any Contractor required equipment and materials shall be at no additional cost to the Owner.

1.07 ACCESS ROADS – (Not Used)

1.08 PUBLIC & PRIVATE ROADS

A. The Contractor shall be responsible for repairs to all damage induced to public or private roads as a result of performing the Work.

B. Repairs to damaged public or private roads shall be performed in accordance with Section 02555, Asphalt Concrete Pavement.

1.09 PARKING

On-site parking areas for Contractor personnel shall be limited to the Contractor's storage and staging areas.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

-END OF SECTION-

SECTION 01560

TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 – GENERAL

1.01 EXPLOSIVES AND BLASTING

See Specification Section 02228.

1.02 AIR QUALITY

A. General: The Contractor shall not create significant direct air quality impacts during the performance of the work. The Contractor shall take corrective measures, as required by RMWD, to prevent significant air quality impacts during the Work.

B. Dust Control: The Contractor shall furnish all labor, equipment, and means required and shall carry out effective measures wherever and as often as necessary to prevent its operation from producing dust in amounts damaging to property, cultivated vegetation, or domestic animals, or causing a nuisance 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 Contractor shall provide adequate watering or other dust control measures to control dust on the work site. Dust control shall prevent fugitive dust from leaving the work area. Dust control or ground cover on graded areas left exposed for more than 90 days shall be provided by the Contractor. If necessary, the Contractor shall wash or sweep the adjacent access roads on the construction site to keep adjoining public roads clean.

C. Equipment Control: All motorized construction vehicles operating onsite for more than 90 days shall have a low NOx emission engine tune-up. Documented proof of tune-ups shall be made available to RMWD when requested.

D. Management: The Contractor shall encourage ride sharing among Contractor personnel.

1.03 RUBBISH CONTROL

A. During the progress of the work, the Contractor shall keep the work site and other areas used by it in a neat and clean condition, and free from any accumulation of rubbish. The Contractor shall provide sufficient dumpsters and trash containers for collection of rubbish. The Contractor shall dispose of all rubbish and waste materials of any nature occurring at the work site, and shall establish regular intervals, at least weekly, for collection and disposal of such materials and waste. The Contractor shall also keep all roads free from dirt, rubbish, and unnecessary obstructions resulting from its operations. Disposal of all rubbish and surplus materials shall be off the work site in accordance with local codes and ordinances governing locations and methods of disposal, and in conformance with all applicable safety laws, and to the particular requirements of Part 1926 of the OSHA Safety and Health Standards for Construction. The Contractor shall not dispose of rubbish or debris into storm drains or stream channels.

1.04 SANITATION

A. Toilet Facilities: 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 Part 1926 of the OSHA Standards for Construction.

B. Sanitary and Other Organic Wastes: The Contractor shall establish a regular daily inspection and collect of all sanitary and organic wastes. 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 away from the site in a manner satisfactory to RMWD and in accordance with all laws and regulations pertaining thereto.

1.05 CHEMICALS

A. All chemicals used during Project construction or furnished for project operation, whether defoliant, soil sterilant, herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall be stored in accordance with the manufacturer's instructions. The Contractor shall maintain copies of Material Safety Data Sheets for all chemicals used or furnished by the Contractor. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer.

B. All chemicals used during the Project construction or furnished for project operation, whether defoliant, soil sterilant, herbicide, pesticide, fertilizer, disinfectants, polymers, reactants, fuel, oil, hydraulic fluid, detergent, paint, solvent, glue, or any other classification, shall be stored within a containment area that minimizes contact of the chemicals and the storage containers with precipitation and surface water flows due to precipitation or flows from adjacent areas. If precipitation or surface water flows contact the chemicals or the storage containers, the Contractor shall notify the RMWD to determine if the surface water has been contaminated or may be allowed to be discharged to the storm drains or stream channels. If the surface water flows have become contaminated due to contact with the chemicals or the storage containers, the Contractor shall provide for removal and/or treatment of the surface water flows at no additional costs to RMWD. If spills occur in the containment area, the Contractor shall immediately notify RMWD and shall contain and clean up the spill to prevent spilled material from entering storm drains, stream channels, or groundwater or from being absorbed by the underlying pavement or soil.

C. All chemicals shall be stored, handled, and used in compliance with the appropriate regulatory agency requirements.

1.06 HAZARDOUS MATERIALS

A. The Contractor shall collect waste oil, used oil filters, other waste petroleum materials, and any other Contractor generated hazardous materials. Remove and legally dispose of all waste petroleum products and any other Contractor generated hazardous materials at suitable disposal facilities off of the job site at the Contractor's expense.

B. On site temporary fuel storage facilities shall be constructed to comply with current

regulations. Such facilities shall be diked to contain any fuel spills. Fuel tanks shall be properly grounded.

C. The Contractor shall park construction vehicles in locations designated by RMWD. The Contractor shall provide oil drip pans to contain any oil leakage from construction vehicles.

1.07 EROSION AND SEDIMENT CONTROL

A. The Contractor shall provide and maintain all necessary erosion and sediment control measures throughout the construction period as required to minimize stormwater pollution from the Contractor's work area, and as required by the Storm Water Pollution Prevention Plan (SWPPP), Water Quality Control Plan (WQCP), or other plan required by the jurisdictional agency. Erosion and sediment control measures may include straw bale dikes, sandbag dikes, silt fences, drainage swales, pipe drains, sediment traps, protective sheets, jute matting, hydro-seeding, and appropriate surface contouring.

B. The Contractor shall secure erosion control devices at the end of each work shift during the period from October 1 to May 1, or when rain is forecast prior to the next work day.

C. Grading activities shall be prohibited during the period when rain is falling at a rate in excess of 0.1 inches per hour. The Contractor shall immediately secure the site for erosion control and storm water runoff.

D. The Contractor shall be responsible for inspecting and maintaining erosion and sediment control measures in the Contractor's work area before, during, and after storm events. The Contractor shall notify RMWD if erosion and sediment control measures do not operate properly and shall take all necessary corrective action.

1.08 CULTURAL RESOURCES

A. 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, archaeological, or cultural resources (hereinafter called "cultural resources").

B. The Contractor shall conform to the applicable requirements of the National Historic Preservation Act of 1966 as it relates to the preservation of cultural resources.

C. In the event potential cultural resources are discovered during subsurface excavations at the site of construction, the following procedures shall be instituted:

1. RMWD will issue a Stop Work Order directing the Contractor to cease all construction operations at the location of such potential cultural resources find.

2. Such Stop Work Order shall be effective until such time as a qualified archaeologist can be called to assess the value of these potential cultural resources.

1.09 TRAFFIC CONTROL

A. Work Hours: Normal work hours shall be from 6:30 a.m. to 4:30 p.m., unless otherwise restricted by the jurisdictional agency.

B. Truck Traffic: The Contractor shall schedule truck deliveries and hauling to and from the construction site prior to 2:30 p.m. on weekdays. Truck deliveries or hauling on weekends or holidays shall require prior approval by the RMWD.

1.10 PROGRESS CLEANING

A. The Contractor shall maintain areas free of waste materials, debris, and rubbish. The site shall be maintained in a clean and orderly condition. Broom all concrete or other finished work areas at least once per month, prior to each progress payment request. Where material or debris has washed or flowed into or has been placed in existing watercourses, ditches, shoreline areas or elsewhere, remove such material or debris and legally dispose of it during the progress of the work.

B. Remove debris and rubbish from channels, wet wells, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing and continue cleaning to eliminate dust.

1.11 SITE MAINTENANCE

A. The Contractor is responsible for site maintenance in the Contractor's staging and storage area, and in all areas impacted by the Contractor's work activities. Such site maintenance activities include but are not limited to dust control, rubbish control, fence repair, maintenance of construction access roads and parking lots, and maintenance of erosion and sediment control facilities.

B. RMWD may direct the Contractor to perform site maintenance activities in other areas of the Project site.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

-END OF SECTION-

SECTION 01600

PRODUCTS, MATERIALS, EQUIPMENT AND SUBSTITUTIONS

PART 1 - GENERAL

1.01 DEFINITIONS

A. The word “Products,” as used herein, is defined to include purchased items for incorporation into the Work, regardless of whether specifically purchased for the project or taken from Contractor's stock of previously purchased products. The word “Materials” is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form units of Work. The word “Equipment” is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items). Definitions in this paragraph are not intended to negate the meaning of other terms used in the Contract Documents, including “specialties,” “systems,” “structures,” “finishes,” “accessories,” “furnishings,” “special construction,” and similar terms, which are self-explanatory and have recognized meanings in the construction industry.

B. Neither “Products” nor “Materials” nor “Equipment” includes machinery and equipment used for preparation, fabrication, conveying and erection of the Work.

1.02 QUALITY ASSURANCE

A. Source Limitations: To the greatest extent possible for each unit of Work, the Contractor shall provide products, materials, and equipment of a singular generic kind from a single source.

B. Compatibility of Options: Where more than one choice is available as options for the Contractor's selection of a product, material, or equipment, the Contractor shall select an option which is compatible with other products, materials, or equipment. Compatibility is a basic general requirement of product, material and equipment selections. Where similar products (such as flexible couplings, etc.) are used on different pieces of equipment or in different areas within the Work, standardize the products by providing all products from the same supplier.

1.3 PRODUCTS

A. General: Only products meeting the indicated requirements shall be provided.

B. Manufacturers: Products shall be new, of current manufacture, and shall be the products of reputable manufacturers specializing in the manufacture of such products who have had previous experience in manufacturing similar products for not less than five (5) years.

C. Products: Materials shall be suitable for the intended purpose and free of defects and shall be recommended by the manufacturer for the application indicated. Where a specific manufacturer or manufacturer's model number is indicated, the equipment shall be modified, as necessary, to comply with the specified features, materials, performance and functions.

1.04 PRODUCT DELIVERY AND STORAGE

The Contractor shall deliver and store all products in accordance with manufacturer's written recommendations and by methods and means which will prevent damage, deterioration, and loss including theft. Delivery schedules shall be controlled to minimize long-term storage of products at site and overcrowding of construction spaces. In particular, the Contractor shall ensure coordination to ensure minimum holding or storage times for flammable, hazardous, easily damaged, or sensitive materials to deterioration, theft, and other sources of loss.

1.05 TRANSPORTATION AND HANDLING

A. Products shall be transported by methods to avoid damage and shall be delivered in undamaged condition in manufacturer's unopened containers and packaging.

B. The Contractor shall provide equipment and personnel to handle products, materials, and equipment including those provided by RMWD, by methods to prevent soiling and damage.

C. The Contractor shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

1.06 STORAGE AND PROTECTION

A. Products shall be stored in accordance with manufacturer's written instructions and with seals and labels intact and legible. Sensitive products shall be stored in weather-tight climate-controlled enclosures and temperature and humidity ranges shall be maintained within tolerances required by manufacturer's recommendations.

B. For exterior storage of fabricated products, products shall be placed on sloped supports above ground. Products subject to deterioration shall be covered with impervious sheet covering and ventilation shall be provided to avoid condensation.

C. Loose granular materials shall be stored on solid flat surfaces in a well-drained area and shall be prevented from mixing with foreign matter.

D. Storage shall be arranged to provide access for inspection. The Contractor shall periodically inspect to assure products are undamaged and are maintained under required conditions.

E. Storage shall be arranged in a manner to provide access for maintenance of stored items and for inspection.

1.07 PROPOSED SUBSTITUTES OR "OR EQUAL" ITEM

The Contractor shall conform to the requirements of this section and that of Section 00700, Article 9.4, of these Specifications. In the event of a conflict, the requirements of Section 00700 shall take precedence.

A. Whenever reference to a specific brand name is made in the Contract Documents, it is illustrative and to be construed as a term of specification which describes a component that has been tested or evaluated by the owner as best meeting the specific operational, design, performance, maintenance, quality, service and/or reliability standards and requirements of the owner, thereby incorporating these requirements by reference within the specifications, and shall be deemed to be followed by the word "or equal." A listing of materials is not intended to be comprehensive, or in order of preference. The Contractor may offer any material, process, or equipment considered to be equivalent to that indicated. Materials, equipment, or service of other suppliers may be accepted if sufficient information is submitted by the Contractor to allow RMWD to determine that the material or equipment proposed is equivalent or equal to that named, subject to the following requirements:

1. It shall be the sole responsibility of the bidder to provide at bidder's expense any product information, test data and other information the District may require to fully evaluate the acceptability of the offered substitute. Where appropriate, independent testing including destructive testing or evaluation at qualified test facilities at bidder's expense may be required as a condition of acceptance. Exceptions to the foregoing are permissible for procurement for replacement parts, or for testing and evaluation purposes or where compatibility with existing District equipment and/or facilities is mandated.

2. RMWD will be the sole judge as to the type, function, and quality of any such substitute and RMWD's decision shall be final.

3. RMWD may require the Contractor to furnish at the Contractor's expense additional data about the proposed substitute.

4. The Owner may require the Contractor to furnish at the Contractor's expense a special performance guarantee or other surety with respect to any substitute.

5. Acceptance by the RMWD of a substitute item proposed by the Contractor shall not relieve the Contractor of the responsibility for full compliance with the Contract Documents and for adequacy of the substitute.

6. The Contractor shall be responsible for resultant changes including design and construction changes and all additional costs resulting from the changes which the accepted substitution requires in the Contractor's Work, the Work of its subcontractors and of other Contractors, and shall effect such changes without cost to the Owner.

B. The procedure for review of substitution request will include the following:

1. If the Contractor wishes to provide a substitute item, the Contractor shall make written application to the RMWD on the “Substitution Request Form.” The substitution request form, along with all descriptive and technical information normally required for an item's approval, shall be submitted to the District Representative following the standard submittal process.

2. Unless otherwise provided by law or authorized in writing by RMWD, the “Substitution Request Form(s)” shall be submitted within the thirty-five (35) day period after issuance of the Notice to Proceed.

3. Wherever a proposed substitute item has not been submitted within said thirty-five (35) day period, or wherever the submission of a proposed substitute material or equipment has been judged to be unacceptable by RMWD the Contractor shall provide the material or equipment indicated in the Contract Documents.

4. The Contractor shall certify that the proposed substitute will adequately perform the functions and achieve the results called for by the general design and be similar and of equal substance to that indicated and be suited to the same use as that specified.

5. RMWD will evaluate each proposed substitute and respond as to the substitution's acceptability within thirty (30) days of receiving complete information from the Contractor.

6. As applicable, no substitute item shall be ordered, installed or utilized without the RMWD’s prior written acceptance of the Contractor's “Substitution Request Form.”

7. RMWD will record the time required in evaluating substitutions proposed by the Contractor and in making changes to the Contract Documents required by the substitution. Whether or not RMWD accepts a proposed substitute, the Contractor may be required to reimburse the RMWD for the charges of its staff for evaluating each proposed substitute at the discretion of the RMWD,

C. The Contractor's application using the “Substitution Request Forms” shall contain the following statements and information which shall be considered by the District Representative in evaluating the proposed substitution:

1. The evaluation and acceptance of the proposed substitute will not prejudice the Contractor's achievement of substantial completion on time.

2. Whether or not acceptance of the substitute for use in the Work will require a change in any of the Contract Documents to adopt the design to the proposed substitute.

3. Whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty.

4. All variations of the proposed substitute from the items originally specified will be identified.

5. Documentation which includes experience and qualifications with respect to the ability of the proposed substitute manufacturer or supplier to provide the specified equipment, material, or service.

6. Available maintenance, repair, and replacement service will be indicated. The manufacturer shall have a local service agency (within 50 miles of the site) which maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within twenty-four (24) hours.

7. Itemized estimate of all costs that will result directly or indirectly from acceptance of such substitute, including cost of redesign and claims of other Contractors affected by the resulting change.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

-END OF SECTION-

SECTION 01610

DELIVERY, STORAGE, AND HANDLING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the delivery, storage, and handling of materials. Additional provisions may be included in specific Specification sections for individual products or materials.

B. Materials, articles, and equipment shall be delivered, stored, and handled in accordance with these Specifications and the printed recommendations of the manufacturer; using means and methods that will prevent damage, deterioration, and loss, including theft.

1.02 SUBMITTALS

A. Submittals shall be made in accordance with Specifications Section 01300, Contractor Submittals, and the following special provisions provided herein.

B. Product Data: The Contractor shall submit (2) copies of the manufacturer's printed recommendations for storage, handling, and protection of materials, articles, and equipment to be incorporated in the Work shall be submitted a minimum of 20 work days prior to the receipt of the material, article, or equipment at the site.

C. Test Reports and Certifications: Items requiring certification or mill test reports shall not be delivered or unloaded until (3) copies of the certification or mill test report have been submitted and approved by RMWD.

1.03 DELIVERY

A. Delivery shall be scheduled to minimize long-term storage at the sites and to prevent overcrowding of construction spaces. Special emphasis shall be placed on ensuring minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, or other losses.

B. Items shall be delivered to the sites in the manufacturer's original sealed container or packaging system, complete with legible and intact labels and instructions for handling, protecting, storing, and unpacking. The label shall include the manufacturer’s name, product name, manufacturing batch number (if appropriate), expiration date, ANSI hazard classification and ANSI handling precautions, if applicable.

C. The Contractor shall take delivery of each pump station (and one emergency generator) at each site, including all required equipment, materials, and labor to off-load the pump stations and generators from the delivery truck and to place and/or store the pump stations and generator until placement.

D. Contractor to be aware that each of the three pump station delivery will be two but not more than four loads per station per site and will not occur on the same day. See Project Coordination Spec Section 1.06.

1.04 STORAGE

A. Items subject to damage by the elements shall be stored in a warehouse or within a weatherproof enclosure or wrap that has adequate ventilation to prevent condensation.

B. Flammable materials shall be stored in a separate area. Temperature and humidity shall be maintained within the range required by the manufacturer's printed recommendations.

C. Materials and equipment that are to be included in the Contractor's estimate for partial payment shall be stored in a manner that will facilitate inspection and inventory. Items requiring periodic maintenance or inspection shall be stored in a manner that will facilitate these operations.

D. If RMWD determines that satisfactory storage of an item is not being provided by the Contractor, RMWD may direct the Contractor to provide additional protection. If the Contractor fails to provide the additional protection, protection may be provided by the RMWD. The cost for providing the additional protection may be charged to the Contractor or deducted from payment due the Contractor.

E. Installed items shall have protection provided equivalent to that specified above, with additional regard for possible damage or loss due to continuing construction operations.

1.05 HANDLING

The Contractor shall supply appropriate equipment and personnel to handle materials, articles, and equipment in a safe manner and in a manner that will not cause damage to the product, to the environment, to Work in progress, or to completed Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

-END OF SECTION-

SECTION 01700

PROJECT CLOSEOUT

PART 1 - GENERAL

1.01 DESCRIPTION

A. Contract Closeout is the process that commences as the Work nears Substantial Completion. It continues through Substantial Completion, and Final Acceptance of the Work.

B. This specification section defines the overall changeover process from construction (by the Contractor) to operations (RMWD). This section defines the terms in this process and outlines the responsibilities of the Contractor and RMWD.

1.02 CONTRACT CLOSEOUT SEQUENCE OF EVENTS

A. The sequence of events and their description listed below represent the suggested order of activities as the Contract proceeds from construction, through checkout, testing, Substantial Completion, and the Notice of Completion. Not all work will proceed in this exact order. Adjustments may be made, after approval by RMWD for the mutual benefit of the Contractor, if the situation so warrants. Any adjustment made in the sequence of events, to accommodate the Contractor, shall be at no additional cost to the RMWD

B. Closeout Sequence of Events and Description:

1. Work Nears Completion - Signifies the start of testing. The Contractor shall indicate when work is ready for testing on a facility and/or system basis.

2. Contract Closeout Deliverables - The Contractor shall provide the following;

    a. Final as built Redline Drawings.
    b. Written guarantees, where required.
    c. Maintenance stock items; spare parts; special tools.
    d. Certificates of inspection and acceptance by local governing agencies having jurisdiction.

3. Pre-Final Inspection and Discrepancy List - RMWD will conduct a pre- final inspection of the Work prior to substantial completion. RMWD will prepare a discrepancy list (punchlist). The discrepancy list includes items of work which do not conform to the Contract Documents, plus any additional items found to be missing, incomplete, damaged, incorrect, or constructed in an unworkmanlike manner. The Contractor shall correct all items on the discrepancy list.

4. Substantial Completion - Following correction of items on the discrepancy list and successful completion of the operational demonstration, the Contractor shall notify RMWD that the Work is substantially complete.

5. Final Inspection - Following written notice from the Contractor that the entire Work is complete RMWD and the Contractor will conduct a final inspection to verify that the Work is complete. RMWD will prepare a final punchlist of all outstanding items.

6. Final Payment - After the Contractor has completed all final punchlist items, and completed all other requirements, the Contractor shall submit a final application for payment to RMWD. The final payment application will include all necessary documentation, in addition to waivers or releases of all liens filed in connection with the Work. The Contractor shall specifically release the Owner from any claims not specifically renewed on the final application for payment. After acceptance by RMWD, RMWD will make final payment to the Contractor after deducting all amounts to be retained under the provisions of the Contract Documents.

7. Notice of Completion - The Owner will file a Notice of Completion with the County Recorder to begin the thirty-day (30-day) stop notice-filing period.

8. Release of Retention - Not more than sixty (60) days after filing the Notice of Completion, RMWD will release to the Contractor all retained funds, less any deductions to cover pending third party claims against RMWD.

1.03 SUBSTANTIAL COMPLETION:

A. Substantial Completion includes compliance with the following requirements:

1. The Contractor has, substantially completed the construction and erection of the Work in conformance with the Contract Documents.

2. The Contractor has installed, adjusted, and successfully tested Products, equipment, and systems. The facilities are constructed as indicated by the erection, installation, and operations and maintenance instructions of the Suppliers.

3. The Contractor has provided and completed the following items as approved by RMWD:

a. Contract Closeout Deliverables.
b. Special Supplier's Warranties.

1.04 PRE-FINAL AND FINAL INSPECTIONS

A. Pre-final and final inspections are surveys of the Contractor's work RMWD to create a list of incomplete or unsatisfactory items of Work.

B. Prior to the pre-final and final inspections, the Contractor must complete the following:

1. Clean site; sweep paved areas, rake clean unpaved surfaces.

2. Remove waste and surplus materials, rubbish, fencing, equipment, temporary utilities, and construction facilities from the site.

C. The discrepancy list(s) and punchlist will include all items of work found to be unsatisfactory, missing, incomplete, damaged, incorrect, or improperly installed or constructed. Prior to Final Acceptance, the Contractor shall correct the punchlist items by re-work, modification, or replacement, at the option of RMWD and at no additional cost to RMWD. RMWD will re-inspect punchlist items upon notice by the Contractor that they are complete.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 FINAL CLEANUP

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 Owner will be withheld until the Contractor has satisfactorily complied with the foregoing requirements for final cleanup of the project site.

3.02 MAINTENANCE AND GUARANTEE

A. The Contractor shall comply with the maintenance and guarantee requirements contained in the General Conditions.

B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work unless the Contractor shall have obtained a statement in writing from the affected private owner or public agency releasing the Owner from further responsibility in connection with such repair or resurfacing.

C. The Contractor shall make all repairs and replacements promptly upon receipt of written order from the Owner. If the Contractor fails to make such repairs or replacements promptly, the Owner reserves the right to do the Work and the Contractor and their surety shall be liable to the Owner for the cost thereof.

3.03 BOND

The Contractor shall provide a bond to guarantee performance of the provisions contained in the General Conditions.

-END OF SECTION-

SECTION 01720

RECORD DRAWINGS

PART 1 - GENERAL

1.01 SUMMARY

This Section includes requirements for the Contractor to provide record drawings at the completion of Work.

1.02 SUBMITTALS

Submittals shall be made in accordance with Specifications Section 01300, Contractor Submittals, and the following special provisions provided herein.

1.03 REQUIREMENTS

A. The Contractor shall provide RMWD with neat and legibly marked Drawings showing the final location of all components of the Work. Marking of the Drawings shall be kept current and shall be done concurrent with the progress of Work.

B. Record drawings shall be available to RMWD at all times. Final payment by RMWD shall not be made until the marked-up record drawings are delivered to and approved by RMWD.

1.04 MAINTENANCE OF DOCUMENTS

A. A set of Drawings will be furnished to the Contractor by the RMWD electronically for the sole purpose of the Contractor generating record drawings. The record drawings shall be updated by the Contractor with as-constructed record information. RMWD will review the accuracy and verify the on-going documentation at a minimum on a monthly basis and in conjunction with the Contractor's partial payment application. The progress and completeness of record drawings shall be a pre-condition of the partial payment application approval.

B. The following shall be maintained in the Contractor's office in clean, dry, legible condition and shall be consider part of the Record Drawings:

1. Contract Documents
2. Drawings
3. Specifications
4. Addenda
5. Approved shop drawings and submittals
6. Samples

7. Photographs

8. Change orders

9. Other modifications of to the contract

10. Test records

11. Survey data

12. Field orders

13. All other documents pertinent to Contractor's Work

C. Documents shall be available at all times for inspection by RMWD.

D. Record documents shall not be used for any other purpose and shall not be removed from the Contractor's office.

E. The Contractor shall not conceal any Work until the required record drawing information has been recorded by the Contractor. RMWD may direct the Contractor to expose concealed Work if Work was not recorded on the record drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

-END OF SECTION-

SECTION 01740

GUARANTEE AND WARRANTY

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes provisions for Contractor's guarantee and warranty for Work performed.

B. Additional provisions may be included in specific specification sections for individual products or materials.

1.02 GUARANTEE AND WARRANTY REQUIREMENTS

A. The Contractor shall warrant and guarantee that the entire Work constructed under the Contract fully meets all requirements of the Contract, and material furnished by Contractor shall be new and of specified quality, shall be free from defects, shall conform to the Contract Documents, Specifications, and Drawings and will be free from any security interest, lien or other encumbrances.

B. The Contractor shall further warrant and guarantee that all Work, including materials, articles, and equipment furnished by the Contractor under the Contract, shall be free of deficiencies and defects for the guarantee period of 12 months, unless otherwise specified in specific Specifications sections, after the date of the recording of the Notice of Completion, unless otherwise specified in the Contract. Any defective Work corrected during the warranty period shall be similarly warranted for 12 months following its corrections, or for such other period as specified in the Contract.

C. The Contractor shall further warrant and guarantee to make or have made at Contractor's expense repairs, adjustments, replacements, or other corrective work necessary to restore or bring into full compliance with the requirements of the Specifications or Drawings any part of the Work which during the guarantee period is found to be deficient with respect to any provision of the Specifications or Drawings.

1. If a defect or deficiency is of a kind which in the opinion of RMWD requires immediate correction to avoid injury to RMWD or adversely impacts RMWD's operations, RMWD may make or have made such repairs, adjustments, replacements, or other corrective work and the Contractor agrees to promptly pay RMWD invoice for the corrective work.

2. If a defect or deficiency is of a kind which in the opinion of RMWD does not require immediate correction but the Contractor has failed to undertake corrective work within 10 work days of receipt of written notice from RMWD, RMWD may make or have made such repairs, adjustments, replacements, or other corrective work without waiving any other rights or remedies it may have, at law or otherwise and the Contractor agrees to promptly pay RMWD invoice for the corrective work.

3. RMWD will have the right to use deficient material and equipment after installation until it can be taken out of service without expense to RMWD.

D. The guarantees and agreements set forth herein shall be secured by the “Faithful Performance Bond” furnished by the Contractor to RMWD at the time of execution of the Contract, which bond shall be deemed to continue in effect during the period of guarantee.

E. The express warranty set forth in the Specifications is exclusive and no other warranties of any kind, whether statutory, oral, written, express or implied, including any implied warranty of merchantability or fitness for a particular purpose, shall apply.

F. When guarantee and warranty provisions are started in other sections of the Specifications, the more stringent provisions shall govern.

G. This guarantee is not the exclusive remedy for RMWD in the event of any breach of this Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

-END OF SECTION-

SECTION 02050

DEMOLITION

PART 1 – GENERAL

1.01 DESCRIPTION

The Contractor shall furnish all materials, equipment and labor necessary to perform and complete demolition of paving, piping, valves, fencing and all other items as shown.

1.02 REFERENCES

A. The Work of this Section shall comply with the current edition of the California Building Code as adopted by the Rainbow Municipal Water District (RMWD).

B. Except as otherwise indicated in this Section, the Contractor shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC).

1.03 CONTRACTOR SUBMITTALS

A. The Contractor shall submit a demolition schedule in compliance with Section 01300 – Contractor Submittals. The demolition schedule shall provide a complete coordination schedule for demolition work including shut-off and continuation of utility services before the start of the demolition. The schedule shall indicate proposed methods and operations of facility demolition and provide a detailed sequence of demolition and removal work to ensure uninterrupted operation of occupied areas.

B. Before completion of the Work, the Contractor shall submit an Affidavit of Legal Disposal attesting to the lawful disposal of all demolished materials.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 GENERAL

Structures shall be demolished and removed in compliance with SSPWC subsection 306- 5 and the requirements indicated herein.

3.02 POLLUTION CONTROL

A. Water sprinkling, temporary enclosures, chutes, and other suitable methods shall be used for dust suppression in compliance with SSPWC Section 7.

B. Water shall not be used when it creates hazardous or objectionable conditions such as flooding, erosion, sedimentation, or pollution.

3.03 PROTECTION

A. Safe passage of persons around the area of demolition shall be provided. Operations shall be conducted to prevent injury to people and damage to adjacent buildings, structures, and other facilities in compliance with SSPWC Section 7.

B. Interior and exterior shoring, bracing, or supports shall be provided to prevent movement, settlement or collapse of structures to be demolished.

C. Existing landscaping materials, structures, and appurtenances which are not to be demolished shall be protected and maintained as necessary and in accordance with SSPWC Section 7.

D. Unless otherwise indicated, the Contractor shall protect and maintain all utilities in the proximity of the facilities to be demolished.

E. The Contractor shall protect nearby existing equipment from dust caused by demolition activities by covering, drop-curtains and other similar methods.

3.04 REMOVAL AND/OR ABANDONMENT OF EXISTING WATER FACILITIES

A. Any existing gate valve to be removed shall be removed entirely, together with the valve box and cover. Any gate valve to be abandoned shall be abandoned in place by removing the box cover, filling the valve box with sand, and patching the pavement. Any existing fire hydrant which is served by a main to be abandoned shall also be abandoned, together with its services, unless otherwise shown on the Drawings. Fire hydrant services to be abandoned shall be cut and plugged at least 12 inches below finished grade or below the top of curb, whichever is lower.

B. In general, existing water mains shall be removed if the alignment of the existing main is within the trench excavation of the new water main or is not more than one foot outside of the trench for the new main. Where portions of the old water main and/or services are abandoned and left in place, the exposed ends of the abandoned main and services shall be tightly plugged with concrete.

C. All salvaged material from abandoned water mains and appurtenances, except fire hydrant bodies, shall become the property of the Contractor upon removal from the trench unless otherwise shown on the Drawings. Such material shall not be allowed to accumulate along the line of the Work but shall be removed from the area at the earliest practical time.

D. Payment for removing and/or abandonment of existing water facilities shall be included in the Bid amount and no separate payment will be allowed.

3.05 BELOW-GRADE DEMOLITION

A. Structures designated on the plans to be removed shall be removed to the full depth of the structure, including its foundation.

B. Below-grade areas and voids resulting from demolition of structures shall be completely filled to a minimum compaction of 95%.

C. All fill and compaction shall be in accordance with Section 02200 - Earthwork.

D. After fill and compaction, surfaces shall be graded to meet adjacent contours and to provide flow to surface drainage structures, or as indicated.

3.06 DISPOSAL OF DEMOLISHED MATERIALS

A. Demolition and removal of debris shall be conducted to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities which shall not be closed or obstructed without permission from RMWD. Alternate routes shall be provided around closed or obstructed traffic ways.

B. Site debris, rubbish, and other materials resulting from demolition operations shall be removed and disposed of in compliance with all laws and regulations. Burning of removed materials from demolished structures will not be permitted.

3.07 PATCHING AND REPAIRING

A. The Contractor shall provide patching, replacing, repairing, and refinishing of damaged areas involved in demolition as necessary to match the existing adjacent surfaces.

B. The Contractor shall repair all damages caused to adjacent facilities by demolition at no additional cost to RMWD.

C. After patching and repairing has been completed, the Contractor shall carefully remove splatterings of mortar from adjoining work and repair any damage caused by such cleaning operations.

3.08 CLEANING

A. During and upon completion of Work, the Contractor shall promptly remove unused tools and equipment, surplus materials, rubbish, debris, and dust and shall leave areas affected by the Work in a clean condition in accordance with Section 01700 - Project Closeout.

B. The Contractor shall clean adjacent structures and facilities of dust, dirt, and debris caused by demolition and return adjacent areas to condition existing prior to start of Work.

C. The Contractor shall clean and sweep the affected portions of roads, streets, sidewalks and passageways daily.

-END OF SECTION-

SECTION 02200

EARTHWORK

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The Contractor shall perform all earthwork required for construction of the Work. The Work includes the loosening, removing, loading, transporting, depositing, and compacting in their final locations of all materials, wet and dry.

B. The Contractor shall comply with applicable requirements of the SSPWC Section 300, Section 02222, Section 02228, Section 02350, Section 02555 and to the requirements specified herein.

1.02 DEFINITIONS

A. Fill material is defined as material used to raise the level of a portion of the site to the line and grade indicated.

B. Backfill material is defined as material used to refill an excavation.

1.03 SUBMITTALS

A. The Contractor shall submit the following in compliance with Section 01300

Contractor Submittals:

1. The Contractor's detailed plan showing the design and calculations for all shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of trenches or structure excavation. The Contractor’s detailed plan shall include a description of the methods, schedule and equipment, including trench shields, to be used for earthwork operations. The Contractor’s plan shall identify the locations of temporary soil stockpiles. The Contractor’s detailed plan shall be submitted before starting any trench or structure excavation 5-feet deep or over. The Contractor shall be in possession of the RMWD's written acceptance of the detailed plan before starting any trench or structure excavation 5-feet deep or over. If the Contractor’s detailed plan varies from the shoring system established in the Construction Safety Orders of the State of California, the Contractor’s detailed plan shall be prepared and signed by a civil or structural engineer licensed in the State of California.

2. A copy of the excavation permit issued by the California Department of Industrial Safety.

3. Report from testing laboratory verifying that imported material is asbestos free and conforms to the specified gradations or characteristics. Samples of imported material in accordance with SSPWC Subsection 306-1.3.5.

4. Such other samples of materials as RMWD may be required.

PART 2 – PRODUCTS

2.01 FILL AND BACKFILL MATERIALS

A. General: Fill and backfill material shall consist of select material obtained from the excavation, imported material, bedding material, unclassified material, structure backfill or slurry backfill. The Contractor shall import at its expense materials in excess of the approved material obtained from excavation as required to complete the fill, backfill, and grading Work as indicated.

B. Select Material: Select material shall consist of primarily granular material obtained from the excavation which is free of vegetation, organic matter, rubbish, debris, rocks larger than 4 inches in diameter and other unsuitable material, has an expansion index less than 30 (less than 20 for footings and floor slabs) as determined by ASTM D 4829 - Standard Test Method for Expansion Index of Soils, has a plasticity index of 10 or less, has a liquid limit of 30 or less, and is approved as select material by RMWD

C. Imported Material: Imported material shall conform to the same specifications as select material defined above. In addition, the imported materials shall comply with SSPWC subsection 306- 1.3.7. Imported material placed in areas to be planted shall be able to support normal plant growth. The Contractor shall obtain approval by RMWD before transporting imported material.

D. Bedding Material: Bedding material shall conform to Section 02223.

E. Unclassified Material: Unclassified material shall conform to SSPWC Subsection 300-4.

F. Structure Backfill: Structure backfill shall conform to Section 02223.

G. Slurry Backfill: Slurry backfill shall conform to Section 02222.

2.02 ROCK PRODUCTS

Rock products, consisting of crushed rock, rock dust, gravel, sand, and stone for riprap shall be clean, hard, sound, durable, uniform in quality and free of disintegrated material, organic matter, oil, alkali, or other deleterious substance, and shall unless otherwise specified conform to the requirements of SSPWC Subsection 200-1.

2.03 UNTREATED BASE MATERIALS

A. Untreated base materials shall conform to the requirements of SSPWC Subsection 200-2.2.

B. Materials for use as untreated base or subbase shall be:

1. Crushed Aggregate Base

2.04 PIPELINE MARKING TAPE

Plastic tape shall be provided and installed along the entire length of buried pipelines. Tape shall be minimum 4-mil thick polyethylene which is impervious to alkalis, acids, chemicals, and solvents which are likely in the soil. Tape shall be 12 inches wide and lettering shall be 1-inch tall permanent black on a blue background.

PART 3 – EXECUTION

3.01 GENERAL

A. The Contractor shall perform earthwork as necessary to complete the Work as shown on the Drawings and specified herein. The Contractor shall take the necessary precautionary measures to prevent dust or other nuisances which might be created by reason of their activities. The necessary precautionary measures shall conform to the requirements of SSPWC Subsection 7-8. The requirements specified in Subsection 7-8 shall be extended to include paved surfaces.

B. Pursuant to California Code of Regulations, Title 8, Section 1541, at least two working days before the start of excavation, the Contractor shall notify the Regional Notification Center and known owners of underground facilities in the area who are not members of the Regional Notification Center of the proposed excavation.

3.02 SITE PREPARATION

Areas to be excavated, filled, graded, and to be occupied by permanent construction or embankments shall be prepared by clearing, grubbing and stripping. Clearing, grubbing and stripping shall conform to the applicable requirements of SSPWC Subsection 300-1.

3.03 EXCAVATION

A. General: Except when specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution and completion of the Work. Unless otherwise directed, the removal of said materials shall conform to the lines and grades shown. Unless otherwise provided, prior to performing any excavation or placing any fill the area shall be stripped of all vegetation and debris, and such material shall be removed from the site. The Contractor shall furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations. Based on the available geotechnical information water is not anticipated during excavation however if water is encountered during excavation the Contractor may request Specification Section 02223 – Dewatering for all pumping, ditching, or other measures for the removal or exclusion of water. Excavations shall be sloped or otherwise supported in a safe manner in accordance with the rules, orders, and regulations of the Division of Industrial Safety of the State of California.

B. Unclassified Excavation: Unclassified excavation shall consist of all excavation, including roadways, unless separately designated.

1. Unsuitable material shall be excavated and disposed of in accordance with the requirements of SSPWC Subsection 300-2.2.

2. Wet material, if unsatisfactory for the specified use on the project solely because of high moisture content, may be processed to reduce the moisture content, or may be required to be removed and replaced with suitable material in accordance with the requirements of SSPWC Subsection 300-2.2.2.

3. The removal and disposal of slide and slipout material shall be in accordance with SSPWC Subsection 300-2.4.

4. Excavation slopes shall be finished in conformance with the lines and grades shown, and in accordance with SSPWC Subsection 300-2.5.

5. Surplus material shall be disposed of off-site, and in accordance with SSPWC Subsection 300-2.6.

C. Structure Excavation: Structure excavation shall consist of the removal of material for the construction of foundations for vaults, retaining walls, headwalls, or other structures, and shall be in accordance with SSPWC Subsection 300-3.

1. The treatment of foundation material shall be in accordance with SSPWC Subsection 300-3.3.

D. Underground Conduit Excavation: Underground conduit excavation shall consist of the trench excavation for the construction of waterlines, drainlines, or other conduits and shall be in accordance with Section 02223.

E. Over-Excavation Ordered by District Representative: Trenches shall be over-excavated beyond the depth shown when required by the District Representative. Such over-excavation shall be to the depth ordered by the District Representative. The over-excavation shall then be backfilled using 3/4-inch crushed rock underlain by an approved woven geotextile. The Contractor shall then place bedding material over the crushed aggregate. All work specified in this Section shall be performed by the Contractor at no additional cost to the RMWD when the over-excavation ordered by the District Representative is within 6 inches of the limit shown on the Drawings. When the over-excavation ordered by the District Representative is 6 inches more than the limit shown on the Drawings, additional payment will be made to the Contractor for the portion that exceeds the said 6-inch distance.

F. Over-Excavation not Ordered or Indicated: Any over-excavation carried below the grade ordered or indicated shall be backfilled to the required grade with material specified by the District Representative and the material shall be compacted. Such work shall be performed by the Contractor at no additional cost to the RMWD.

G. Excavation in Vicinity of Trees: Except where trees are shown to be removed, trees shall be protected from injury during construction operations. No tree roots over 2 inches in diameter shall be cut without written permission of RMWD. Trees shall be supported during excavation by means previously reviewed by the RMWD.

H. Rock Excavation:

1. Rock excavation shall include removal and disposal of the following: (1) all boulders measuring 1/3 of a cubic yard or more in volume; (2) all rock material in ledges, bedding deposits, and unstratified masses which cannot be removed without systematic drilling; (3) concrete or masonry structures which have been abandoned; and (4) conglomerate deposits which are so firmly cemented that they possess the characteristics of solid rock and which cannot be removed without systematic drilling and blasting.

2. Rock excavation shall be performed by the Contractor; however, should the quantity of rock excavation be affected by any change in the scope of the Work, an appropriate adjustment of the contract price will be made.

3.04 FILL AND BACKFILL

A. General:

1. Fill and backfill shall be placed in accordance with the applicable provisions of SSPWC Section 300 and the requirements stated herein.

2. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any concrete structure until the concrete has cured in accordance with the requirements of Section 03300 - Cast-in-Place Concrete and has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed.

B. Placing and Spreading of Materials:

1. Materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment the layers shall be evenly spread so that when compacted, each layer shall not exceed 8 inches in thickness.

2. During spreading, each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Bedding materials shall be brought up evenly around the pipe so that when compacted, the material will provide uniform bearing and side support.

3. Where the material moisture content is below the optimum moisture content water shall be added before or during spreading until the proper moisture content is achieved.

4. Where the material moisture content is too high to permit the specified degree of compaction the material shall be dried until the moisture content is satisfactory.

C. Compaction Requirements

1. The Contractor shall perform density and compaction tests in accordance with SSPWC Subsection 211-2. The District Representative may perform additional tests.

2. The relative compaction of fill, backfill, and base material shall be in accordance with SSPWC Section 300, with the following exceptions:

a. Subgrade where trench has been over-excavated 95%.

b. Fill beneath structures, including water-containing structures 95%.

3. In case the tests of the fill or backfill show non-compliance with the required compaction or density, the Contractor shall accomplish such remedy as may be required to ensure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the RMWD and shall be at the Contractor's expense.

D. Unclassified Fill: All fill shall be of unclassified material unless separately designated. Construction of unclassified fill, including preparing the area on which fill is to be placed, and the depositing, conditioning, and compacting of fill material shall be in accordance with SSPWC Subsection 300-4.

E. Structure Backfill: Backfill at structures shall be material placed in accordance with SSPWC Subsections 300-3.5 and 300-4.5.

F. Underground Conduit Bedding and Backfill: Bedding and backfill for underground conduit shall be material placed in accordance with Section 02223.

3.05 PREPARATION OF SUBGRADE

The preparation of subgrade for pavement, curbs and gutters, driveways, sidewalks and other improvements shall be in accordance with SSPWC Subsection 301-1.

3.06 UNTREATED BASE

Aggregate base material shall be spread and compacted in accordance with SSPWC Subsection 301-2.

3.07 TEMPORARY STOCKPILES

A. Locations of temporary stockpiles shall be approved by RMWD.

B. Temporary stockpiles shall not surcharge buried pipe, conduits, or other structures.

-END OF SECTION-

SECTION 02222

SLURRY BACKFILL

PART 1 – GENERAL

1.01 WORK INCLUDED

The Contractor shall furnish and place slurry backfill in all voids beneath the prefabricated pump stations and generator and where otherwise shown on the Drawings.

1.02 SUBMITTALS

A. The Contractor shall furnish submittals in accordance with Section 01300 – Submittals.

B. Slurry Backfill shall be submitted for review and approval. No changes shall be made in the amounts or sources of the approved mix ingredients without the approval of the District Representative. Product inspection and field testing of the approved mix shall be made on-behalf of the RMWD.

PART 2 – PRODUCTS

2.01 MATERIALS

A. General: The slurry backfill shall consist of a mixture of sand, coarse aggregate, cement and water. Fly ash and approved admixtures may be used to obtain the required properties of the mix. The mix shall have good workability and flowability with self-compacting and self-leveling characteristics.

B. The slurry backfill shall have a minimum cement content of 40 pounds per cubic yard. The water-cementitious materials ratio of the mix shall not exceed 3.5:1

C. Cement: All cement used shall be Type II Portland cement that shall conform to the requirements of ASTM C 150.

D. Fly Ash: Fly ash may be either Class C or Class F. The fly ash shall conform to ASTM C 618.

E. Aggregates:

1. Fine Aggregate: All fine aggregate shall conform to the grading and quality requirements of ASTM C 33.

2. Coarse Aggregate: Coarse aggregate shall conform to the grading and quality requirements of ASTM C 33 for size No. 476, No. 57 or No. 67.

F. Water: The batch mixing water and mixer washout water shall conform to the requirements of ASTM C 94.

G. Admixtures: Chemical admixtures that do not contain calcium chloride and conform to ASTM C 494 for concrete may be used in the slurry backfill mix. All chemical admixtures shall be compatible with the cement and all other admixtures in the batch.

H. Slurry Backfill Proportions:

1. Strength: Slurry backfill shall have a minimum 28-day compressive strength of 60 psi and maximum 28-day compressive strength of 100 psi when molded and cured as in conformance with ASTM D 4832.

2. Air-Entrainment: All slurry backfill shall be air entrained to a total air content of approximately 5%.

3. Slump: The minimum slump shall be six inches and the maximum slump shall be eight inches as when tested in accordance with ASTM PS 28.

4. Aggregate: Fine aggregate shall be between 50% and 60% by volume of the total aggregates in the slurry backfill mix.

5. Consistency: The consistency of the slurry backfill shall be such that the material flows easily into all openings between the pipe and the lower portion of the trench. When trenches are on a steep slope, a stiffer mix of slurry may be required to prevent slurry backfill from flowing down the trench. When a stiffer mix is used, vibration shall be performed to ensure that the slurry backfill completely fills all spaces between the pipe and the lower portion of the trench.

PART 3 – EXECUTION

3.01 PLACEMENT

A. Slurry backfill shall be used as backfill, in all voids beneath the prefabricated pump stations and generator and where otherwise shown on the Drawings, but may not be used as a substitute for bedding material.

1. Rodding, mechanical vibration and compaction of slurry backfill shall be performed to assist in consolidating the slurry backfill.

2. Slurry backfill shall be placed as closely behind pipe laying operations as possible where used for pipes.

3. When required to prevent uplift, the slurry backfill shall be placed in two stages as required, allowing sufficient time for the initial set of the first stage before the remainder is placed. Slurry backfill shall be deposited as nearly as practical in its final position and in no way disturb the pipe trench or cause foreign material to become mixed with the slurry backfill.

4. Soil backfill shall not be placed until the slurry backfill has reached the initial set. If backfill is not to be placed over the slurry backfill within 8 hours, a 6-inch cover of moist earth shall be placed over the slurry backfill surface.

5. If the air temperature is 50° F or less, the moist earth cover should be at least 18-inches thick. Slurry backfill shall not be placed when the air temperature is below 40° F unless the air temperature is 35° F or more and the temperature is rising.

6. Slurry backfill shall not be placed, if, in the judgment of the District Representative, weather conditions are unsuitable.

-END OF SECTION-

SECTION 02223

TRENCHING, BACKFILLING, AND COMPACTING

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, installation, and testing of trench excavation, backfilling, and compacting.

1.02 REFERENCE STANDARDS

The publications listed below form part of this specification to the extent referenced and are referred in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for.

ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D3017	Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN-m/m^3))
ASTM D4253	Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D4254	Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D75	Standard Practice for Sampling Aggregates
ASTM C90	Standard Specification for Load bearing Concrete Masonry Units
ASTM A82	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement

1.03 RELATED WORK SPECIFIED ELSEWHERE

RMWD Standards Manual

1.04 EARTHWORK AND REPAIRS IN CITY, COUNTY, AND STATE RIGHTS OF WAY

Conform to the requirements and provisions of the permits issued by those agencies in addition to the requirements of these Standard Specifications. If a permit is not required, earthwork and repairs shall conform to the standards of the agency in whose right of way the work is done in addition to the requirements of these Standard Specifications.

1.05 SAFETY PRECAUTIONS

Observe safety precautions in all phases of the work. Included shall be trench shoring, bracing, lighting, and barricades as dictated by reason and by the Safety Orders of the Division of Industrial Safety, State of California (CAL OSHA). Acquire an exemption letter or trenching permit from the California Division

of Industrial Safety (CAL OSHA) and comply with Labor Code Section 6705, Excavation Plans For Worker Protection. Submit a copy of the exemption letter or trenching permit with excavation drawings to the District prior to excavation work.

1.06 ROCK EXCAVATION

Classified rock excavation is defined as removal of solid rock, within the specified or indicated trench limits only, in ledges, bedded deposits, or unstratified masses which by actual demonstration cannot be reasonably excavated with a Caterpillar 345C L Hydraulic Excavator with general duty rippers and rock points, in good condition or similar approved equipment. The term “rock excavation” shall be understood to indicate a method of removal and not a geological formation. The method of removal may include, but not be limited to, the use of a hydraulic breaker or blasting. The demonstration may be waived if, in the Engineer’s opinion, the material is obviously unrippable.

1.07 OBSTRUCTIONS

The Contractor's attention is directed to the possible existence of pipe and other underground improvements which may or may not be shown on the Drawings. Preserve and protect any such improvements whether shown on the Drawings or not. Expose such improvements in advance of the pipeline construction to allow for changes in the alignment as necessary. Where it is necessary to remove and replace or to relocate such improvements in order to prosecute the work, they shall be removed, maintained, and, permanently replaced by the Contractor at their expense. Relocation of said improvements shall not be performed without written permission of the owner of the utility. Existing underground utilities shall be protected in place.

1.08 SUBMITTALS

A. Submit shop drawings in accordance with Section 1- General Conditions.

B. Submit a report from a testing laboratory verifying that imported material is asbestos-free and conforms to the specified gradations or characteristics.

C. Cal OSHA trenching permit or exemption letter.

1.09 TESTING FOR COMPACTION

A. RMWD who has jurisdiction over the area of the work will require the Contractor to provide a licensed soils engineer to test for compaction as described below.

B. Determine the density of soil in place by the sand cone method, ASTM D1556 or by nuclear methods, ASTM D2922 and D3017.

C. Determine laboratory moisture-density relations of soils by ASTM D1557.

D. Determine the relative density of cohesion-less soils by ASTM D4253 and D4254.

E. Sample backfill materials by ASTM D75.

F. "Relative compaction" is the ratio, expressed as a percentage, of the in place dry density to the laboratory maximum dry density.

G. Make excavation for compaction tests at the locations and to the depths designated by the soils engineer. Backfill and re-compact the excavations at completion of testing. When tests indicate that the compaction is less than the specified relative compaction, rework and retest those areas until the specified relative compaction has been obtained.

1.10 PIPE BEDDING

The pipe bedding shall be defined as a layer of material immediately below the bottom of the pipe and extending over the full trench width in which the pipe is bedded. Thickness of pipe bedding shall be a minimum of 6-inches compacted to 90% relative compaction.

1.11 PIPE ZONE

The pipe zone shall include the full width of trench from the bottom of the pipe to a horizontal level 12-inches above the top of the pipe. Where multiple pipes are placed in the same trench, the pipe zone shall extend from the bottom of the lowest pipe to a horizontal level above the top of the highest or topmost pipe. Thickness of pipe zone above the highest top of pipe shall be a minimum of 12-inches. No jetting within pipe zone.

1.12 TRENCH ZONE

The trench zone includes the portion of the trench from the top of the pipe zone to the bottom of the pavement zone or to the existing surface in unpaved areas. No jetting within trench zone.

1.13 UPPER ZONE

The upper zone includes the asphalt concrete and aggregate base pavement section placed over the trench backfill.

1.14 WATER FOR CONSTRUCTION

Water supplied by RMWD for whatever needs and uses, shall be paid for in accordance with the rates and rules of RMWD by the Contractor. The only exception is by written agreement with the RMWD.

PART 2 - MATERIALS

2.01 NATIVE EARTH BACKFILL - TRENCH ZONE

Native earth backfill used above the pipe zone shall be excavated fine grained materials or loose soil free of asbestos, organic matter, roots, debris, rocks larger than 4-inches in diameter, clods, clay balls, broken pavement, and other deleterious materials. Backfill material shall be so graded that at least 40% of the material passes a No. 4 sieve. The coarser materials shall be well distributed throughout the finer material. Backfill materials that are obtained from trench excavated materials to the extent such material is available, shall be screened at the discretion of the District Representative during the trenching operation.

If screened during trenching, the material shall be maintained free of unscreened material during the handling and backfilling process. Hand selecting of rocks from earth as it is placed into the trench will not be permitted in lieu of the specified screening. Under no circumstances will native earth backfill be allowed or used in the pipe base area, pipe zone area, or directly under paved roads.

2.02 IMPORTED MATERIAL FOR BACKFILL - TRENCH ZONE

Imported material shall conform to that specified for native earth backfill or imported sand.

2.03 IMPORTED SAND - PIPE BEDDING AND PIPE ZONE

Imported sand used in the pipe base and pipe zone shall consist of natural or manufactured granular material, or a combination thereof, free of deleterious amounts of organic material, mica, loam, clay, and other substances. Under no circumstances will decomposed granite or native earth backfill be allowed or used in the pipe base or pipe zone areas. The material must have been tested to a minimum Sand Equivalent of 30 within two (2) weeks of its use. Imported sand shall have the following gradation or similar:

Sieve Size	Percent Passing By Weight
3/8-inch	100
No.4	75 -100
No.30	12 - 50
No.100	5 - 20
No.200	0 - 15

2.04 ROCK REFILL FOR FOUNDATION STABILIZATION

Rock refill shall be crushed or natural rock having the following gradation:

Sieve Size	Percent Passing By Weight
3 inches	100
1-1/2 inches	70 -100
3/4-inch	60 -100
No.4	25 - 55
No.30	10 - 30
No.200	0 - 15

2.05 GRANULAR MATERIAL FOR STRUCTURAL BACKFILL

A. Granular material for structural backfill shall be free of asbestos, organic materials, clay balls, and shall have the following gradation:

Sieve Size	Percent Passing By Weight
3/4-inch	100
1/2-inch	95 -100
3/8-inch	50 -100
No.4	20 - 65
No.8	10 - 40
No.40	0 - 20
No.200	0 - 5

B. Whenever the phrase "structural backfill material" is used in these Standard Specifications, it shall mean granular material for structural backfill as described above.

C. Excavated material may be used for structural backfill provided it conforms to the Standard Specifications for structural backfill material.

2.06 CONCRETE FOR BELOW GROUND INSTALLATIONS

A. Concrete for anchors, collars, encasements, supports, and thrust blocks shall be Class A for reinforced items and Class C for un-reinforced items per Specification Section 03300, except use rapid set concrete mix where indicated.

B. Provide anchor blocks at valves in pipe having rubber gasket bell and spigot or unrestrained mechanical joints.

C. Provide support blocks at all valves.

D. Provide thrust or anchor blocks at all vertical or horizontal bends unless other restraint means are approved by the District Representative.

2.07 TRENCH CUT-OFF WALLS

A. Provide ASTM C 90, Grade N-I, hollow load-bearing concrete masonry units, medium weight, moisture controlled, average compressive strength over gross area of 1,000 psi. Nominal face dimensions: 8-inches by 8-inches by 16-inches.

B. Provide ladder steel conforming to ASTM A82.

C. Mortar and grout shall be a mixture of cement, sand, and water. Mortar shall consist of not more than one part cement to two and one-half parts sand by damp loose volume. The quantity of mixing water shall be no more than necessary for handling and placing.

2.08 WATER FOR COMPACTION

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 or coatings. Salt water will not be allowed.

PART 3 - EXECUTION

3.01 COMPACTION REQUIREMENTS

Unless otherwise shown on the Drawings, otherwise described in the Specifications, or required by the agency having jurisdiction over the area of the work, relative compaction in pipe trenches shall be a minimum as follows:

Pipe Bedding	90% relative compaction
Pipe Zone	90% relative compaction
Trench Zone	90% relative compaction
Upper Zone	95% relative compaction

3.02 SHEETING, SHORING, AND BRACING OF TRENCHES

Trenches shall have sheeting, shoring, and bracing conforming California Occupational and Health Administration (Cal-OSHA) - California Code of Regulations (CCR) Title 8, and the District's requirements.

3.03 SIDEWALK, PAVEMENT, AND CURB REMOVAL

Cut and remove bituminous and concrete pavements regardless of the thickness, and curbs and sidewalks, prior to excavation of trenches with a pavement saw, hydrohammer, or pneumatic pavement cutter. Width of the pavement cut shall be at least equal to the required width of the trench at ground surface. Haul pavement and concrete materials from the site. Do not use for trench backfill.

3.04 BLASTING

Blasting operations will not be allowed unless approved by RMWD and as otherwise required by Specification Section 02228 - Blasting.

3.05 DEWATERING

A. 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 pipelaying, during the laying of the pipe, until cement mortar of exterior joints has set hard, when concrete is being deposited and during the hydration process, and until the backfill at the pipe zone and trench zone has been completed. These provisions shall apply during non-working hours (i.e. the noon hour as well as overnight) for open trenches. Dispose of the water in a manner to prevent damage to adjacent property and in accordance with regulatory agency requirements. Do not drain trench water through the pipeline under construction.

B. The contractor is responsible for meeting all Federal, State, County, and local laws, rules and regulations regarding the treatment and disposal of water from dewatering operations at the construction site.

3.06 MATERIAL REPLACEMENT

Remove and replace any trenching and backfilling material which does not meet the Specifications, at the Contractor's expense.

3.07 TRENCH WIDTHS

Pipe trench widths in the pipe zone will be limited as follows:

Pipe Diameter	Minimum Trench Width	Maximum Trench Width
4" through 12"	O.D. + 12"	O.D. + 16"
14" through 48"	O.D. + 16"	O.D. + 24"

Trench width at the top of the trench will not be limited except where width of excavation would undercut adjacent structures and footings. In such case, width of trench shall be such that there is at least 2 feet between the top edge of the trench and the structure or footing. Where shoring or encasement is required, trench widths shall be increased accordingly.

3.08 TRENCH EXCAVATION

A. Perform all excavation regardless of the type, nature, or condition of the material encountered to accomplish the construction. Do not operate excavation equipment within 5 feet of existing structures or newly completed construction. Excavate with hand tools in these areas.

B. Excavate the trench to the lines and grades shown on the Drawings with allowance for pipe thickness, sheeting and shoring if used, and for pipe base. If the trench is excavated below the required subgrade, refill any part of the trench excavated below the subgrade at no additional cost to the District with imported sand. 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.

C. Trench depth shall accommodate the pipe and the pipe base at the elevations shown in the profile on the Drawings. No pipe shall be installed without a designed profile unless approved by the District Representative.

D. Construct trenches in rock by removing rock to a minimum of 6-inches below bottom of pipe and backfilling with imported sand.

3.09 LOCATION OF EXCAVATED MATERIAL

During trench excavation, place the excavated material only within the working area or within the areas shown on the Drawings. Do not obstruct any roadways or streets. Conform to federal, state, and local codes governing the safe loading of trenches with excavated material.

3.10 LENGTH OF OPEN TRENCH

A. The total length of open trench shall not exceed 600 feet including excavation, pipeline installation and backfill in any one location.

B. Where pipelines are located beneath or adjacent to existing paved roads, backfill all trenches at the end of each workday and place temporary or first layer of paving. Clean all new and adjacent existing paved surfaces of residual excavated and backfill materials. Perform dust control operations in these areas with a vacuum type mobile street sweeper. No open trenches will be allowed in these areas.

C. Provide ingress and egress to buildings and property at all times. Provide steel covering for vehicular access in accordance with the County of San Diego Public Works requirements.

3.11 FOUNDATION STABILIZATION

After the required excavation has been completed, RMWD will inspect the exposed 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 such as soft, spongy or deleterious materials exist at the exposed grade. Over excavation shall include the removal of all such unacceptable material that exists directly beneath the pipeline to a minimum width equal to the maximum trench width and to a depth determined by RMWD. Backfill the trench to the established subgrade of the pipe base with rock refill material for foundation stabilization. Place the foundation

stabilization material over the full width of the trench and compact in layers not exceeding 6-inches deep to the required grade. Place imported sand on the compacted foundation stabilization and apply water to wash the sand into the voids of the rock refill material. Continue this procedure until the voids of the rock refill have been filled with imported sand. Do not apply water in such quantities that it will damage the integrity of the pipeline or other improvements.

3.12 CONCRETE FOR BELOW GROUND INSTALLATIONS

Encase pipe with concrete to the line and dimensions indicated or place concrete between the undisturbed ground and the pipe or fittings to be restrained or supported. Quantity or bearing area of the concrete against undisturbed ground shall be as shown on the Standard Drawings, Drawings, or as directed by the District Representative. Provide temporary support on the pipe, fittings, or valves until the concrete has obtained a 3-day cure. Place concrete such that the pipe joints, fittings, or valves are accessible for repairs. Spade or rod the concrete during placement to eliminate honeycombing. Backfilling of the trench adjacent to the concrete will not be allowed until the concrete has cured for at least 3 days. Allow concrete to cure for at least 7 days prior to subjecting the concrete to pipeline pressure. Where rapid set concrete mix has been used, the 3-day and 7-day cure time is not required. Backfill the rapid set concrete mix as soon as the concrete is hard (approximately one to two hours) and place pipeline into service.

3.13 TRENCH CUT -OFF WALLS

Install trench cut-off walls at the locations shown on the Drawings, and at 20 feet on center on slopes 30% and steeper and with the District's consultation slopes steeper than 50%. Hand cut trench walls to form a neat slot into which the concrete blocks can be laid as tight as possible to the downhill side. Place concrete blocks in horizontal layers and reinforce with ladder steel as the wall is laid. Lay blocks full-bedded in mortar to prevent leakage of grout. All head joints shall be solidly filled with mortar. Cut blocks to fit around the pipe and mortar in place. Provide weep holes in the wall to relieve hydrostatic pressure. Provide one 1/2-inch diameter weep hole for each 1.5 square foot of wall in the trench pipe zone. Grout solid all cells of the wall. Place backfill in layers being evenly brought up on each side of the cut-off wall. Compact by hand tamping. Give special attention to placing backfill in slot in trench walls.

3.14 TRENCH BACKFILLING

A. Place the specified thickness of pipe bedding material over the full width of trench and compact to the specified relative compaction. Grade the top of the pipe base ahead of the pipe laying to provide firm, continuous, uniform support along the full length of the trench for the pipe, fittings, and valves.

B. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Fill and compact the area excavated for the joints with the pipe base material.

C. After the pipeline has been bedded and the cement mortar used in the exterior joints has set hard, place pipe zone material simultaneously on both sides of the pipe, fittings, and valves, keeping the level of backfill 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 un-compacted 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. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe.

D. Compact material in the pipe zone by hand tamping only. Care shall be exercised in backfilling to avoid damage to pipe coatings and polyethylene encasement.

E. Push the native earth backfill or imported material for backfill carefully onto the imported sand previously placed in the pipe zone. Do not permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe. Compact backfill material in the trench zone to the specified relative compaction by mechanical compaction or hand tamping.

F. Place and compact pipe zone material in layers not exceeding 12-inches of compacted thickness. Place and compact native earth or imported material for backfill in the middle zone in layers not exceeding 6-inches of compacted thickness.

3.15 MECHANICAL COMPACTION OR HAND TAMPING

Place imported sand and backfill materials, per Part 2, in uniform layers of the indicated thickness. Compact each layer to the required minimum relative compaction at the optimum moisture content. Do not use heavy duty compaction equipment with an overall weight in excess of 125 pounds until backfill has been completed to a depth of 2 feet over the top of pipe. Do not use high impact hammer type equipment except where the pipe manufacturer warrants in writing that such use will not damage the pipe.

3.16 DISPOSAL OF EXCESS EXCAVATED MATERIAL

Dispose of excess excavated material off-site. Contractor shall make their own arrangements for the disposal of the excess material and bear all costs incidental to such disposal.

3.17 TRENCHING RESURFACING

A. Thickness of asphalt concrete resurfacing shall be 1-inch greater than the depth of the existing asphalt or a minimum of 3-inches whichever is greater, unless jurisdictional agency requirements are more restrictive.

B. Base material shall be replaced to the depth of the existing base or a minimum of 6-inches whichever is greater, unless jurisdictional agency requirements are more restrictive.

C. Trench resurfacing shall be done in accordance with RMWD Standard Drawings W-21 and S-15 or per jurisdictional agency requirements.

3.18 FINAL CLEAN-UP

A. After backfilling, grade the right-of-way to the contours of the original ground and match the adjacent undisturbed ground. Make surfaces free of all cleared vegetation, rubbish and other construction wastes. Dispose of all excavated or surface rocks and lumps which cannot be readily covered by spreading. On slopes 15% and steeper or where rainfall would create an erosion problem as determined by the District Representative, provide cut off walls per RMWD Standard Drawing.

B. Replace street improvements in kind, such as curbs and gutters, monuments, barricades, traffic islands, signalization, fences, signs, mailboxes, etcetera that are cut, removed, damaged, or otherwise disturbed by the construction.

3.19 SLOPE PROTECTION

A. Install slope protection as required by the agency of jurisdiction. Slope protection should be installed as soon as possible after grading to minimize the potential for erosion. Prepare and seed all open ground within the easement or working area disturbed by the construction, not otherwise protected from erosion, or as determined by RMWD. After final clean-up, cultivate areas to be seeded to break up any compaction resulting from grading operations.

B. Unless otherwise noted on the drawings, cover areas to be seeded with a mulch of rice, wheat, oats, or barley straw spread uniformly at the rate of 2 tons per acre for new straw. If stable bedding straw is used, spread uniformly at the rate of 3 tons per acre. Roll straw with stud roller to produce a uniform ground surface, incorporating the straw into the soil so as not to support combustion or to be blown from the area by winds. Seed the mulched areas with a mixture of 32 pounds of barley and 32 pounds of western rye grass seed per acre. Seed shall be 95% pure and have a minimum of 85% germination.

C. Unimproved areas disturbed during construction of the pipeline or appurtenances may be hydro seeded at RMWD's discretion. An example of a seed mixture list for coastal sage scrub re-vegetation is as follows:

BOTANICAL NAME	COMMON NAME	lbs/acre
Eriogonum Fasiculatum	Flat-Top Buckwheat	2.0
Artemisia Californica	California Sagebrush	8.0
Lotus Scoparius	Deerweed	5.0
Salvia Apiana	White Sage	1.0
Eriophyllum Confertiflorum	Golden Yarrow	2.0
Yucca Whipplei	Our Lord's Candle	0.5
Vulpia Muralis 'Zorro'	Zorro Fescue	8.0
Plantago (Insolaris) Ovata	Plantain	3.0
Eschscholzia Californica	California Poppy	3.0
Lupinus Hirsutissimus	Stinging Lupine	3.0
Phacelia Parryi	Bluebells	1.0

D. The hydro seed mix shall be a bonded matrix consisting of wood fiber, fertilize and high quality live seed in the following proportions:

SEED	SEE ABOVE
Fiber Mulch	2,000 lbs/acre
Slow Release Fertilizer	150 lbs/acre
Soil Binder(Mix soil Binder at the rate of 1-lb per 25 gals)	100 lbs/acre

-END OF SECTION-

SECTION 02228

BLASTING

PART 1 – GENERAL

1.01 DESCRIPTION

A. This section includes procedures for blasting for excavation. The use of explosives during construction shall be as specified herein. However, no blasting will be permitted which, in the blasting supervisor's judgment or the judgment of the District's Representative, may be detrimental to existing facilities or pipelines.

B. The Contractor shall be liable for all injuries to, or death of, persons, or damage to property caused by a blast or explosive, and he agrees by submission of a bid to indemnify and hold the District, its officers, agents, employees, volunteers and project consultants harmless from any and all liability claims, costs, expenses including expenses of investigation and defending against the same in regard thereto).

C. Blasting may be proposed by the Contractor as a means of excavating rock, but may not be allowed by the District. At least 28 calendar days in advance of any proposed blasting, Contractor shall submit to the District a request for permission to blast that includes a general description of the proposed blasting activities, and the approximate location(s) and volume(s) of rock to be removed by blasting. The request shall be submitted in accordance with Standard Specification Section 01300 for approval by the District. If the request for blasting is not approved by the District, then rock must be removed by means other than blasting. If the request for blasting is approved by the District, then the procedures for blasting shall conform to the requirements described herein

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Contractor Submittals, Specification 01300

B. Earthwork, Specification 02200

C. Trenching, Backfilling, and Compaction, Specification 02223

1.03 REFERENCES

Comply with the applicable rules, regulations and standards established by the Regulatory agencies, codes and professional societies listed herein, including rules and regulations for storage, transportation, and use of explosives.

A. Whenever blasting operations are in progress, explosives shall be stored, handled and used as provided in: the Federal Occupational Safety and Health Act of 1970 and the Construction Safety Act of 1969, as amended; Safe Explosives Act, Title XI, Subtitle C of Public Law 107-296, Interim Final Rule; and Organized Crime Control Act of 1970, Title XI, Public Law 91-452, Approved October 15, 1970, as amended; and California Occupational Safety and Health Administration (Cal OSHA) – Division of Mining and Tunneling rules.

B. Ensure that all explosive deliveries to work sites are done in compliance with recent rules and regulations issued by the Department of Transportation (DOT) and the Transportation Security Administration (TSA) on commercial transportation of explosives pursuant to the mandates of the USA PATRIOT ACT of 2001. Under TSA rules, commercial drivers with hazardous materials endorsement shall undergo a personal background records check, training and testing.

C. Comply with all the applicable provisions of OSHA of 1970, 29 U.S.C., Section 651 et seq., including safety and health regulations for construction.

D. U.S. Code of Federal Regulations (CFR)

1. CFR 27, U.S. Department of Justice, Alcohol, Tobacco, Firearms and Explosives Division (ATF). 27 CFR Part 555, Implementation of the Safe Explosives Act, Title XI, Subtitle C of Public Law 107-296; Interim Final Rule.

2. Organized Crime Control Act of 1970, Title XI, Public Law 91-452, Approved October 15, 1970, as amended.

3. CFR 49, Parts 100-177 (DOT RSPA); 301-399 (DOT FHA).

4. Federal Occupational Safety and Health Act of 1970, as amended.

5. Construction Safety Act of 1969, as amended.

E. State Agencies:

1. California Code of Regulations (CCR)

a. Title 8, Chapter 4, Subchapter 20, Tunnel Safety Orders.

b. Title 8, General Industry Safety Orders, Subchapter 7, Group 18. Explosives and Pyrotechnics.

F. Non-regulating Industry Support Organizations:

1. Vibration Subcommittee of the International Society of Explosive Engineers (ISEE), blast monitoring equipment operation standards (1999).

2. IME (Institute of Makers of Explosives) Safety Library Publications (SLPs).

1.04 DEFINITIONS

A. Peak Particle Velocity (PPV): The maximum of the three ground vibration velocities measured in the vertical, longitudinal and transverse directions. Velocity units are expressed in inches per second (ips).

B. Air-Overpressure: Temporary changes in ambient air pressure caused by blasting. Air-overpressure is expressed in units of psi or dB or dBL (linear decibel scale). Measurements for blasting are made with microphones having a flat frequency response for over-pressure in the 2 to 200 Hz range. A- weight or C-weight microphones shall not be used for these measurements.

C. Occupied Building: Structure on or off construction limits that is occupied by humans or livestock.

D. Residential Building: Includes single and multiple family dwellings, hotels, motels and any other structure containing sleeping quarters.

E. Scaled Distance: A factor describing relative vibration energy based on distance and charge-per-delay. For ground vibration control and prediction purposes, Scaled Distance (Ds) is obtained by dividing the distance of concern (D) by the square root of the charge-per-delay (W), Ds = D/(W)0.5. Minimum scaled distance limits are used to establish charge weights and the units of scaled distance (Ds) are ft-lb-0.5.

F. Charge-per-Delay: For vibration control, any charges firing within any 8-millisecond time period are considered to have a cumulative effect on vibration and air-overpressure effects. Therefore, the maximum charge-per-delay (W) is the sum of the weight of all charges firing within any 8-millisecond time period. For example, if two 10-lb. Charges fire at 100 ms and one 15-lb charge fires at 105 ms, the maximum charge per delay would be 35 lbs.

G. Production Holes: Blast holes in the main body of the rock mass being removed by drilling and blasting.

H. Stemming: Crushed stone, tamped clay or other inert earth material placed in the unloaded collar area of blastholes for the purpose of confining explosive charges and limiting rock movement and air-overpressure (airblast).

I. Primary Initiation: The method whereby the blaster initiates the blast(s) from a remote and safe location. Primary initiation systems use pneumatic tubing or shock-tubes to convey firing energy from blasters to blast locations.

J. Sub-drilling: The portion of the blasthole that is drilled below or beyond the desired excavation depth or limit. Subdrilling is generally required to prevent the occurrence of high or tight areas of unfractured rock between blastholes.

K. Prohibited Persons: Persons prohibited from handling or possessing explosive materials as defined by the seven categories described in Section 555.11 of 27 CFR (ATF Rules).

L. Delay: A distinct pause of pre-determined time between detonations of single charges or groups of charges.

M. Blaster-in-Charge or Blasting Supervisor: The single designated and licensed person with complete responsibility and total authority over all decisions involving safe handling, use and site storage of explosives.

1.05 SUBMITTALS

A. Submit submittal packages in accordance with Standard Specification Section 01300.

B. Submit Safety Plan for the Use of Explosives that meets all requirements of paragraph 1.06, E.

C. Submit Blasting Control Plan meeting requirements of paragraph 1.06, J.

D. Submit after blast reports meeting all requirements of paragraph 1.06, R.

E. E. Submit copies of all required blasting permits.

1.06 PERMITS, SAFETY ORDERS AND RECORDS

A. No drilling or blasting work shall be performed until the Contractor's Safety Plan and Blasting Control Plan for such operations has been submitted and approved by the District's Representative.

B. Prior to any blasting by the Contractor for the work, obtain the blasting permits required by San Diego County, the State of California, and any applicable agency having jurisdiction. Notify the fire district, local fire department, and utilities in the general blast area. The San Diego Sheriff's Department requires prior notification of any blasting work. The assigned USA Dig Alert construction project notification number, date and blast area location are required on the permit application from the Sheriff's Department. A copy of all permits required shall be submitted to the District's Representative prior to drilling for blasting.

C. The transporting, handling, storage, and use of explosives shall conform to the requirements specified in the General Industry Safety Orders of the California Division of Industrial Safety; provided, that if the amount of explosives to be transported exceeds 1,000 pounds, a permit to transport shall be secured from the California Highway Patrol; and further provided, that the locations, access, and construction of all explosive storage magazines shall be in accordance with the American Table of Distances for Storage of Explosives and approved by the District's Representative.

D. Comply with the requirements specified in the General Industry Safety Orders of the California Division of Industrial Safety.

E. At a minimum of 14 days prior to the commencement of any work involving explosives, including drilling, submit a complete Safety Plan For The Use Of Explosives. A Blasting Safety Plan simply stating: “all regulations will be followed” will not be acceptable. Blasting Safety Plan shall include:

1. A complete list of all authorities having jurisdiction over operations involving the transportation, storage, handling and use of explosives.

2. A printed copy of all applicable federal, state and local regulations governing the use and storage of explosives for this work shall be attached to the Blasting Safety Plan.

3. Copies of all required blasting permits regarding explosive use and storage.

4. Copies of California Blasting Licenses, including proper initiation system and

construction blasting endorsements, for all blasters overseeing blasting operations.

5. A list of at least three previous projects of similar character, successfully completed. List shall include contact names and phone numbers of the owner's responsible project manager or engineer.

6. A complete description of the clearing and guarding procedures that will be employed to ensure personnel, staff, visitors, and all other persons are at safe locations during blasting. This information shall include details regarding visible warning signs or flags, audible warning signals, method of determining blast areas (all areas affected by any potentially harmful blast effects), access blocking methods, guard placement and guard release procedures, primary initiation method, and the system by which the blaster-in-charge will communicate with site security guards.

7. A detailed description of how explosives will be: 1) kept in day-storage-boxes when on site, and 2) transported and used at the various project work areas. Plans shall explain how day-storage magazines and explosive transport vehicles will satisfy all applicable ATF, OSHA, federal, CalOSHA, and San Diego County regulations. This plan shall also indicate how explosives will be inventoried, secured and guarded to prevent theft or unauthorized use.

8. Include Material Safety Data Sheets (MSDS) and specific details about hazard communication programs for employees.

9. Equipment that will be used to monitor the approach of lightning storms and in the event of such, evacuation and site security plans.

10. Detailed contingency plans for handling of misfires caused by cutoffs or other causes.

F. A minimum of 14 days prior to commencement of any blasting operations, the Contractor shall be responsible for all notification required by his permits but shall at a minimum notify all residences within 600 feet of any blast at least 24 hours prior to the blast. Contractor shall be responsible for inspection of structures as required by his permits prior to the blast.

G. A blasting supervisor licensed by the State of California, Division of Industrial Safety, and acceptable to the District's Representative shall be on the site, and in immediate charge of the blasting operations. The license of the supervising blaster(s) shall contain endorsements for construction blasting and use of non-electric initiation systems. Such supervisor shall have no less than three years of continuous experience in controlled blasting on projects of similar character. A written description of the education and experience of this supervisor shall be submitted to the District's Representative. The description shall be specific and include references who are able to verify the details.

H. The Contractor shall retain the services of an outside Consultant regarding the prediction and control of ground vibration and air-overpressure. Such Consultant shall not be in the employ of the Contractor and shall be subject to the approval of the District's Representative. Consultant's qualifications shall be submitted to the District's Representative in writing as part of the Blasting Control Plan.

I. Proper criteria and blast effects limitations for any given location and any given structures, residences, utilities, and any other facilities shall be evaluated and determined by the Contractor and by the approved Blasting Consultant.

J. Submit a Blasting Control Plan to the District's Representative. No blasting operation, including drilling, shall start until the District has reviewed and approved the Blasting Control Plan. Allow not less than two weeks for District review of the Plan. In the event that additional or revised Blasting Control Plans are required, provide at least two weeks for the review of each additional plan. Approval of the Contractor's Blasting Control Plan or blasting procedures shall not relieve the Contractor of any of his responsibility for assuring the complete safety of his operations or for the successful completion of the work in conformity with the requirements of the Drawings and Standard Specifications. The Blasting Control Plan shall include:

1. Details of controlled blasting techniques. Include plan and vertical section drawings showing hole locations, spacing, diameter and loading details for typical blastholes charges.

2. All blast plan drawings shall indicate explosive types, amounts, priming method, initiator types, delay periods, and locations, charge firing times, stemming type and quantities, and typical charge weights.

3. Plans for preventing overbreak or ground shifting that could threaten adjacent buried utilities. Plan shall include calculations showing predicted levels of vibration not exceeding 5.0 in/s at the nearest buried pipe.

4. Methods of drilling, including equipment descriptions, and hole placement and alignment techniques.

5. Hole Charging Methods: Primer make-up, placement of charges and inert stemming and method of securing detonators until tie-in.

6. Initiation system hook-up methods and method of primary initiation.

7. Methods for preventing spills or losses of explosives, drilling fluids, oil, or any other pollutants to ground during all handling and hole charging operations. Include details of all containment and contingency plans for quickly and effectively cleaning up any spilled materials.

8. Method of safe and approved disposal of all explosive packaging materials.

9. Copies of: 1) blasting permits, 2) blasters' licenses, and 3) explosive transporters' commercial driver’s licenses with Hazmat endorsements.

10. The Blasting Control Plan shall indicate the type and method of instrumentation proposed to determine the ground motion particle velocity and air blast overpressure. The description shall include the manufacturer and model of the instrumentation, the source of the instrumentation (rented or owned and by whom). Include copies of calibration certificates issued by the equipment maker that confirm the instruments and transducers have been calibrated within the last 12 months.

K. A minimum of two portable seismographs shall be available for use on the project

at all times. The seismographs shall be capable of producing a permanent record and shall meet the following technical standards.

1. Equipment for on-site and off-site particle velocity and air overpressure monitoring shall be 4-channel (1 overpressure and 3 seismic channels) units capable of digitally storing collected data. Equipment shall be capable of printing ground motion time histories and summaries of peak motion intensities and frequencies. Printed report records shall also include date, time of recording, operator name, instrument-number and date of last calibration.

2. Instruments shall have a flat frequency response between 2 and 250 Hz for particle velocity and from 2 to 200 Hz for air overpressure.

3. The digitizing sampling rate for peak particle velocity and air overpressure measurements shall be least 1,024 samples per second.

4. Seismographs used for off-site compliance monitoring shall be capable of recording overpressure from 88 to 148 dBL, and particle velocity from 0.05 to 5.0 in/sec.

5. Systems shall be capable of providing printed event reports that include all peak measurements, frequencies and complete waveform plots.

6. Seismographs shall have adequate memory to digitally record events of the blast-induced motion lasting up to five seconds.

7. All seismograph software systems shall be capable of saving back-up copies of all event files on floppy or Zip disks in file formats supported by software that can open and interpret stored data. Upon request of the District's Representative the Contractor shall provide a licensed copy of the appropriate software, and all monitoring data files, to the District.

8. Seismographs shall be provided by:

   a. White Industrial Seismology Inc. (303) 324-4116,

   b. Nomis Seismographs. (205) 592-2466,

   c. GeoSonics/Vibr-Tech. (724) 934-2900, or

   d. Instantel. (425) 888-5425.

L. All vibration and air-overpressure measuring equipment shall be used in accordance with the standards established by the Vibration Section of The International Society of Explosives Engineers (ISEE). The following standards shall be applied when measuring blast-induced vibration and air-overpressure.

1. General Guidelines for Vibration and Air-Overpressure Measuring Equipment:

   a. Only personnel who have successfully completed a proper training course shall operate monitoring equipment.

   b. The recording units and sensor instruments shall be calibrated. Documenting certificates shall be kept on file and copies shall be provided

to District's Representative upon request.

c. When employing instruments to operate in auto-trigger-mode, trigger levels shall be set low enough to record blast effects. If expected levels of blast noise or vibration do not exceed minimum trigger levels, the instrument shall be attended by an operator and turned on manually.

d. The horizontal distance from the seismograph to the blast shall be known to at least two significant digits. For example, a blast within 1000 feet would be nearest tens of feet and a blast within 10,000 feet would be measured to the nearest hundreds of feet. Where the vertical-to-horizontal ground slope ratio exceeds 2.5 to1, slant distances or true distance shall be used and recorded in the monitoring records.

e. When instruments are used in auto-trigger and continuous-recording mode to record the effects of multiple blasts, the time between successive blasts shall be at least one (1) minute and seismographs shall be set to NOT automatically print out event records. These procedures shall ensure that instruments have adequate time to save event data for each blast and reset to monitoring mode before subsequent blasts occur.

f. The memory or record capacity of the seismograph shall be sufficient to store the event data from the blast(s) planned during that operating day.

g. Instruments shall be set to save full waveform data for all monitored blast and digitally saved event files shall contain this data for use in further analyses if needed.

h. In order to prevent false triggering, suspended or freely moving cables shall be secured from movement by the wind or other extraneous sources.

2. Ground Vibration Monitoring:

a. Sensor Placement

(1) Place the sensor on or in the ground on the side of the structure towards the blast. A structure can be a house, pipeline, telephone pole, etc. Measurements on driveways, walkways, and slabs are to be avoided where possible.

(2) Place the sensor within 10 feet of the structure or less than 10% of the distance from the blast, whichever is less.

(3) Avoid placing velocity transducers in loose or low-density soils. The density of the ground shall be greater than or equal to the sensor density.

(4) Place transducers so they are level or nearly level.

(5) Orient sensor blocks so the arrow indicating the longitudinal direction is aimed at the blast location.

(6) Where access to a structure is not available, place the transducers at the accessible location closest to the structure of concern and in line

with the blast.

b. Sensor Coupling

(1) Based on expected acceleration as determined from ISEE Standards (see Table 1 below), use the following methods to couple vibration transducers to the ground or structure to avoid decoupling errors:

(a) Less than 0.2 g: No burial or attachment is necessary.

(b) Between 0.2 and 1.0 g: Transducer shall be attached to the ground with a spike or covered with a sand bag.

(c) Greater than 1.0 g: Transducer shall be buried, bonded to the ground or structure with stiff clay or putty, or some other method that shall achieve firm attachment.

Table 1: Acceleration Intensity (g's) gased on Estimated Particle Velocities and Frequencies

	Maximum Frequency (Hz or cycles per second)										
	4	10	15	20	25	30	40	50	100	150	200
PPV (in/s) at Acc. (g) >= 0.2	3.08	1.23	0.82	0.62	0.49	0.41	0.31	0.25	0.12	0.08	0.06
PPV (in/s) at Acc. (g) >= 1.0	15.38	6.15	4.10	3.08	2.46	2.05	1.54	1.23	0.62	0.41	0.31

(2) Employ the following methods for sensor burial:

(a) Excavate a hole that is no less than three times the height of the sensor (ANSI S2.47-1990, R1997).

(b) If possible, spike the sensor to the bottom of the hole.

(c) Firmly compact soil around and over the sensor.

(3) Employ the following methods for attaching sensors to bedrock or hard structural surfaces:

(a) Bolt, clamp or use epoxy or putty to firmly couple the sensor to the hard surface.

(b) The sensor may be attached to the foundation of the structure if it is located within +/- 1-foot of ground level (USBM RI 8969). This method shall only be used if burial, spiking or and bagging is not practical.

(4) If disturbance of the ground is not possible, cover transducers with sand bags loosely filled with about 10 pounds of sand. When placed over the

sensor, the sandbag profile shall be as low and wide as possible with a maximum amount of firm contact with the ground. If possible also spike the sensor to the ground.

c. Programming Considerations for Ground Vibration Monitoring:

(1) The PPV ground motion trigger-level shall be programmed low enough to trigger the unit from blast vibrations and high enough to minimize the occurrence of false events. The level shall be slightly above the expected background vibrations for the area.

(2) If PPV is expected to exceed 10 in/s or frequency is expected to exceed 250 Hz, special sensors shall be used to measure blast effects. A digital sampling rate shall be used that provides accurate recordings. The approach shall be described in the Blasting Plan.

(3) Set the record time for 2 seconds longer than the blast duration plus 1 second for each 1100 feet from the blast.

3. Air-Overpressure Monitoring:

a. Microphone Placement:

(1) Place the microphone along the side of the structure nearest the blast.

(2) Cover the microphone with a windscreen and mount it near the velocity transducers.

(3) The preferred microphone height is 3 feet above the ground or within 1.2 inches of the ground. If other heights are to be used, describe them in the Blasting Plan. (ANSI S12.18-1994, ANSI S12.9-1992/Part2) (USBM RI 8508)

(4) If possible, the microphone shall not be shielded from the blast by nearby buildings, vehicles or other large barriers. If such shielding cannot be avoided, the horizontal distance between the microphone and shielding object shall be greater than the height of the shielding object above the microphone.

(5) If microphones are placed too close to a structure, the airblast may reflect from the house surface and record higher amplitudes. Structure response noise may also be recorded. Place the microphone near a corner of the structure in order to minimize reflection of over-pressure energy. (USBM RI 8508).

b. Programming Considerations for Air-Overpressure Monitoring:

(1) When only an airblast measurement is desired, set the trigger level low enough to trigger the unit from the airblast and high enough to minimize the occurrence of false events. The level shall be slightly above the expected background noise for the area.

(2) When only recording airblast, set the recording time for at least 2 seconds more than the blast duration. When ground vibrations and air-

overpressure measurements are desired on the same record, set the record time for 2 seconds longer than the blast duration plus 1 second for each 1100 feet from the blast.

M. Design of drilling and blasting patterns, explosive types, and quantities shall be at the Contractor's choice; provided, that non-electric initiation devices shall be used and the ground motion limitations as specified herein are met with respect to explosive detonated per delay period; and provided further, that non-nitroglycerin explosive types are used in wet ground conditions, unless the dynamite is phlegmatized (i.e. PowerDitch 1000).

N. Approval of the Contractor's Blasting Control Plan shall not relieve the Contractor of any of his responsibility under the Contract for assuring the complete safety of his operation with respect to adjacent improvements so as to not aggravate the existing structural conditions or cause damage, or for the successful completion of the work in conformity with the requirements of the Drawings and Standard Specifications. Such approval shall not operate to waive any of the requirements of the Standard Specifications nor relieve the Contractor of any regulation or permit obligation thereunder.

O. As production blasting operations progress, the drilling and blasting procedures shall be determined only by satisfactory results achieved. If a drilling and blasting program results in unacceptable results, devise and employ methods which will improve results. The revision may include special methods such as, but not limited to, zone blasting, shorter holes, different delay patterns, reduction in size of individual blasts, smaller diameter blast holes, closer spacing of blast holes, or reduction of explosives as necessary to improve results.

P. Regardless of the ground motion and air-overpressure limits set forth herein, controlled blasting shall be conducted in a manner which will produce relatively smooth and sound rock faces at the final excavation lines. The type, distribution and quantity of explosive detonated per delay period shall be such that existing rock fractures will neither be opened nor new fractures created outside of the minimum excavation limits. Whenever, in the opinion of the District's Representative or independent Inspector, further blasting is liable to reduce rock stability or damage pipelines or other structures, the Contractor shall cease blasting and continue to excavate the rock by approved mechanical means. Excessive blasting or "overshooting" will not be permitted, and any material outside the authorized cross-section which may be shattered or loosened by blasting shall be removed and replaced with acceptable materials at the Contractor's expense.

Q. Blasting shall be done only by properly trained workers under the direct supervision of a State-licensed Blasting Supervisor. Blasting shall be done only when proper precautions are taken for the protection of persons, the work, and existing structures. Any damage done to persons, private property, the work, or existing structures shall be the responsibility of the Contractor.

R. Keep accurate records of each blast. Blasting records shall be available to the District's Representative at all times and shall contain the following data as a minimum:

1. Blast identification by numerical and chronological sequence.

2. Location (referenced to pipeline stationing), date and time of blast.
3. Type of material blasted.
4. Number of holes, burden and spacing.
5. Diameter and depth of holes.
6. Height or length of stemming.
7. Types of explosives used.
8. Types of caps and delay periods used.
9. Total amount of explosives used.
10. Maximum amount of explosives per delay period of 9 milliseconds or greater.
11. Powder factor (pounds of explosive per cubic yard of material blasted).
12. Method of firing and type of circuit.
13. Weather conditions (including wind direction).
14. Direction and distance to nearest structure or position of concern.
15. Type and method of instrumentation.
16. Location and placement of instruments by plotting numbered locations on scaled maps to within +/- 1 foot where the equipment was placed.
17. Instrumentation records and calculations for determination of ground motion particle velocity or for charge size based on scaled distance.
18. An ongoing log-log plot of both vibration and air blast data. The Contractor or his consultant shall maintain an ongoing log-log plot of both ground vibration and air blast overpressures, and shall submit an updated plot to the District's Representative after each blast, highlighting the newest data.
19. Measures taken to limit air overpressure and fly rock.
20. Any unusual circumstances or occurrences during blast.
21. Name of Contractor.
22. Name, license number and signature of responsible Blasting Supervisor.
23. Summary report of all complaints including complaints regarding blasting-related damage.
24. Method to notify other contractors, personnel on-site of a scheduled blast.
25. Provide a summary report of all complaints, including complaints regarding blast-related damage.

26. Within 24 hours after each blast, Contractor shall submit to the District's Representative a summary report addressing items 1 through 25 above for compilation in a three-ring binder and have the Contractor's current blast reports so compiled and available for immediate review by authorities having jurisdiction, including the District and the District's Representative.

PART 2 – PRODUCTS

Furnish materials and equipment required for blasting operations and monitoring. Material usage, including transportation and storage, shall conform to all applicable regulatory agency and permit requirements.

PART 3 – EXECUTION

3.01 BLASTING HOURS

Blast only between the hours of 7 a.m. and 5 p.m. during any workday, Monday through Friday, unless special circumstances warrant another time or day and special approval is granted in writing by the District and the agency having jurisdiction. For any blasting within 1,200 feet of a residence or commercial structure, blast only between the hours of 9:00 a.m. and 5:00 p.m.

3.02 BLASTING PROCEDURES

A. Control fly rock and debris to prevent damage to persons, structures, existing improvements, or vegetation. Clean the blasting site of debris associated with the blasting operation at the end of each working day. Use blasting mats in developed areas. Equipment used for drilling of holes shall have a positive means of dust control.

B. Do not perform blasting closer than 8 feet to existing water, gas, sewer, or other buried utilities.

C. Use controlled blasting techniques to keep the air blast overpressure, vibrations, and noise within the limits herein specified. Use controlled blasting techniques to minimize overbreak or fracturing of rock beyond the designated excavation boundaries. Excessive blasting will not be permitted. Material outside the authorized cross-section, which may be shattered or loosened because of blasting, shall be removed at the Contractor's expense and the area repaired to the satisfaction of the District's Representative. Discontinue any method of blasting which leads to overshooting, is hazardous in any way to persons, or destructive to property or habitat.

D. Notify the District’s Representative at least seven workdays before all blasting and if blasting will occur within 1200 feet of a residence or commercial structure or utility.

E. Fifteen minutes prior to each blast, sound an audible siren or horn capable of being heard within one-half mile of the blasting site.

F. Blasting operations may be suspended by the District’s Representative for any one or more of the following:

1. Safety precautions are inadequate.

2. Ground motion vibration levels exceed specified limits of particle velocity or

frequency.

3. Existing structural conditions are aggravated or adjacent improvements are damaged as a result of blasting.

4. Blasting methods adversely impact the stability of intact rock outside the prescribed limits of excavation.

5. Skilled operators and/or licensed foreman are not present.

Blasting operations shall not resume until modifications have been made to correct the conditions that resulted in the suspension.

G. Repair or replace any damage caused by blasting. Repair or replace any damage resulting from possession or use of explosives for the Work.

3.03 MAXIMUM PARTICLE VELOCITIES

Monitor vibrations by measuring the peak particle velocity in the vicinity of work. Peak particle velocity is defined as a maximum of the three velocity components, measured in three mutually perpendicular directions at any point by an instrument. The peak particle velocity of any individual components as measured on or at the locations as specified in the submitted vibration and frequency's monitoring plan, for all blasting, or other vibration-inducing operations, shall not exceed the following levels:

Point of Concern	Maximum Allowable Peak Particle Velocity, PPV (in/sec)	Frequency Range (Hz)
Surface Structures	0.5	2-250
Buried Pipes or Utility Cables	5.0	2-250

3.04 AIR-OVERPRESSURE

Blast induced air-overpressure at the property or right of way lines or structures within 300 feet of the blast area shall not exceed 0.03 psi (140 dBL). Air-overpressure at residential or other occupied structures shall not exceed 0.012 psi (133 dBL).

3.05 CONSEQUENCES OF BLASTING SPECIFICATION VIOLATIONS

Any violations of Section 3.03 Maximum Particle Velocities or Section 3.04 Air-Overpressure shall obligate the Contractor to pay for all costs to the District caused by the violation, including by not limited to: District staff and consultant's time and expenses that are required, as solely determined by the District's Representative, to investigate such violations. This includes, but is not limited to, reviews of resubmittals by the Contractor, analyses of subsequent Blasting Control Plans submitted by the Contractor, meetings with the Contractor and his Blasting Consultant, and investigations into the condition of existing pipeline, wells, structures, etc. These costs shall be

actual cost to the District without additional mark-up, and the District's decision to charge the contractor shall be final.

-END OF SECTION-

SECTION 02350

SHEETING, SHORING, BRACING, AND SAFETY

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The Work of this Section includes support of temporary open excavations by means of sheet pilings, soldier piles and lagging, structural steel walls and struts, liner plates, and timber. The Contractor shall be responsible for the design and selection of methods in conformance with the design criteria as specified herein.

B. The Work of this Section applies to temporary excavation support systems for demolition, construction of underground cast-in-place concrete structures, and installation of buried pipelines, and boring and receiving shaft or pits.

1.02 STANDARD SPECIFICATIONS

Except as otherwise indicated in this Section, the Contractor shall comply with the Standard Specifications for Public Works Construction, including the Regional Supplement Amendments and City of San Diego Supplement Amendments (SSPWC).

1.03 CONTRACTOR SUBMITTALS

A. The following shall be submitted in compliance with Section 01300:

1. The proposed excavation support system for each construction component where excavation support systems will be used.

2. Arrangement and details for each excavation support system, supporting design calculations, and construction methods to be used for the installation of each system.

3. Soldier pile installation methods, connection details, bracing preloading, and jacking procedures.

4. Depths below the main excavation bottom elevation to which the support system will be installed.

5. Elevations of ground surface, struts, and shores, as applicable.

6. Permissible depth to which excavation may be carried before supports must be installed and preloaded.

7. Full excavation depth load to be carried by various support system members.

8. Bracing loads for various stages of excavation, bracing removal, and concrete placement.

9. Preloads as required.

10. Proposed sequence of strut and shore removal as applicable and as related to concrete placement and backfilling operations.

B. The above Shop Drawings shall be coordinated with other shop drawing submittals for work specified elsewhere in which support of excavation is required.

C. The proposed method of installing sheet piling including sequence of installation, template, and equipment description.

D. Contingency plan for alternative procedures to be implemented if the excavation support system is found to perform unfavorably.

1.04 QUALITY ASSURANCE

Support of excavation shall be designed, and shop drawings and calculations signed, by a Professional Engineer, licensed to practice in the State of California and experienced in the design of excavation support systems. All design drawings and calculations shall be checked and initialed by a checker.

1.05 DESIGN CRITERIA

A. Shop drawings with supporting calculations for the various excavation support systems shall be prepared in accordance with the following criteria:

1. Design the excavation support system and all components to support the earth pressures, unrelieved hydrostatic pressures, utility loads, equipment, traffic, and construction loads including impact, and other surcharge loads in such manner as will allow the safe and expeditious construction of the permanent structures, to minimize ground movement or settlement, and to prevent damage to or movement of adjacent buildings, structures, roadways and utilities.

2. Design support members to resist the maximum loads expected to occur during the excavation and support removal stages.

3. Design for staged removal shall conform to construction concrete placement, and backfill sequence shown. Design shall consider provisions for future construction, and limits on bracing level elevations as shown on the plans.

4. Maximum vertical center-to-center spacing of supports shall be 16 feet between top 2 support levels and 12 feet below second support level unless otherwise approved. If decking beams are not required, install the uppermost bracing tier at a vertical distance of not more than 6 feet below the top of excavation.

5. Where water flows from the face of excavation, the maximum height of unsupported excavation shall not exceed 15 inches.

6. In running sand and silt, provide positive means for securing timber lagging to the soldier piles to avoid shifting or falling off of the lagging, and positive means for containing such material behind lagging.

7. Review of the Contractor's shop drawings and methods of construction by RMWD does not relieve the Contractor of responsibility for the adequacy of the excavation support systems.

8. No portion of the excavation support system's vertical face will be permitted to penetrate the design lines as indicated on the Drawings for the permanent concrete structure to be constructed within the excavation.

9. Vertical support capacity shall be provided for wall systems and internal bracing elements, for loads due to vertical force components of tieback anchors, the weight of the structural systems themselves, and live load on any portion of the system.

B. Timber Support Systems and Members:

1. Bases for determination of minimum allowable working stress: California Building Code.

2. The minimum thickness of timber lagging between soldier piles spaced 5 to 7 feet center-to-center shall be 3 inches for excavations up to 25 feet in depth, and 4 inches for excavations deeper than 25 feet.

3. For other conditions and types of lagging, design calculations shall be submitted.

1.06 SAFETY

A. Except as otherwise indicated, the following codes apply to the Work of this Section:

1. Title 8, California Administrative Code, Chapter 4, Subchapter 4, Construction Safety Orders, Article 6, Excavations, Trenches, Earthwork, Section 1542, Shafts.

1.07 PROJECT CONDITIONS

A. Utility agencies shall be notified, and caution exercised while exposing utility facilities by hand or other methods approved by utility owner.

B. If existing utility facilities interfere with the proposed method of support, the method shall be modified in a manner that will protect the facility and accommodate the proposed Work. Shop drawings shall be revised and resubmitted along with design calculations required to account for the modified support method and to show the actual location of the existing utilities.

C. Provisions shall be made for contingencies as follows:

1. Monitor performance of support system components, for both vertical and horizontal movement, at regular intervals not to exceed 3 days.

2. Provide contingency plan for alternative procedures to be implemented if unfavorable performance is evidenced.

3. Keep on hand materials and equipment necessary to implement contingency plan.

D. Elements of the support system shall not be spliced unless approved by the District Representative.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Steel sheet piling shall be continuous interlocking type ASTM A 328 of appropriate shape and provided with at least one 2-1/2-inch-diameter handling hole on the centerline of the web located at least 6 inches from each end of the sheet pile.

B. Fabricated connections and accessories, steel H-piles, WF shapes, and other structural steel shall conform to the requirements of ASTM A 36, unless otherwise approved.

C. Concrete shall be as specified in Section 03300.

1. For encasement of steel soldier piles below the final level of excavation, 2,500 psi shall be used.

2. For encasement of soldier piles above the final level of excavation, lean concrete shall be used, the strength of which shall be adequate to protect the excavated faces of the augured hole.

D. Wood lagging shall be dimension lumber with minimum allowable stress of 1100 psi.

1. The stress grade of the lagging shall be in conformance with the allowable stresses of the California Building Code.

2. Lumber shall be grade marked by WWPA or WCLIB with species and grade conforming to those shown on approved shop drawings.

PART 3 – EXECUTION

3.01 GENERAL

A. The support system shall extend the main excavation bottom elevation to a depth adequate to prevent lateral movement and to adequately support applied vertical loads. In areas where additional excavation is required below the main excavation subgrade provisions shall be made to prevent movement of main excavation

supports. Damage to existing utilities during installation of excavation support system shall be avoided.

B. Water control measures shall be provided in accordance with the requirements specified in Section 02050 and 02200.

3.02 SOLDIER PILES

A. Soldier piles shall be installed by pre-boring or other approved pre-excavation methods to tip elevation shown on approved shop drawings. Prevent pre-bored or other pre-excavated holes from collapsing.

B. Pre-bored hole shall be filled with lean concrete from bottom of hole to subgrade dependent upon analysis of vertical support requirements.

C. Remaining pile length shall be filled with lean concrete, completely encasing the pile.

D. Concrete shall be placed from the bottom of the hole upwards by means of a flexible pipe connected to a hopper.

3.03 SHEETING AND LAGGING

A. Sheeting and lagging shall be installed with no gap between the boards unless specifically approved. As installation progresses, the voids between the excavation face and the lagging or sheeting shall be backfilled with sand or soil rammed into place. Materials such as hay or burlap shall be used where necessary to allow drainage of groundwater without loss of soil or packing material. If gaps in the lagging are allowed, the gap width between lagging boards shall be limited to 1/2 inch maximum.

B. If unstable material is encountered, suitable measures shall be taken to retain it in place or to otherwise prevent soil displacement.

C. Extend lagging down to final subgrade.

D. A sufficient quantity of material shall be on hand for sheeting, shoring, bracing, and other operations for protection of work and for use in case of accident or emergency.

3.04 STEEL SHEET PILING

A. Steel sheet piling may be used only where existing subsurface conditions are suitable for installation of sheet piling to the full depth of penetration required, and to proper alignment and plumbness, specified herein, without damage to the sheet piling or rupture of its interlocks. The use of steel sheet piling will not be permitted where sheeting would be required to penetrate boulders, rock or other materials which may prevent the proper installation of sheet piling.

B. Steel sheet piling shall be installed in plumb position with each pile interlocked with adjoining piles for its entire length so as to form a continuous diaphragm throughout the length of each run of wall, bearing tightly against original ground.

Install sheeting to depth required for design. Exercise care during installation so that interlocking members can be extracted, if required, without injury to adjacent ground. The installation equipment shall be suitable to the type and nature of the subsurface materials anticipated to be encountered. The equipment and methods of installation, cutting, and splicing shall conform to the approved shop drawings.

3.05 INTERNAL BRACING SUPPORT SYSTEM

A. All bracing support members shall be installed and maintained in tight contact with each other and with the surface being supported.

B. Bracing members shall be preloaded by jacking the struts and shores in accordance with loads, methods, procedures, and sequence as described on the approved shop drawings. Coordinate excavation work with bracing installation and preloading. Use steel shims and steel wedges welded or bolted in place to maintain the preloading force in the bracing after release of the jacking equipment pressure. Use procedures so as to produce uniform bracing member loading without appreciable eccentricities, overstressing, or support member distortion.

C. Struts shall be provided with intermediate bracing as needed to enable them to carry their maximum design load without distortion or buckling. Provide diagonal bracing as necessary to maintain the stability of the system. Web stiffeners, plates, or angles shall be provided as needed to prevent rotation, crippling, or buckling of connectors at points of bearing between structural steel members. Allow for eccentricities resulting from field fabrication and assembly.

D. Excavations shall be to a depth no more than 2 feet below the elevation of the support member about to be placed. The support member shall be installed and preloaded immediately after installation and prior to continuing excavation.

3.06 REMOVAL OF SUPPORT SYSTEMS

A. Where removal is required wholly or in part, such removal shall be performed in a manner that will not disturb or damage adjacent new or existing construction or utilities. Fill all voids immediately with lean concrete, or other approved means.

B. All elements of support systems shall be removed to a minimum depth of 6 feet below final ground surface. However, when a structure poured against the sheeting system extends above the 6-foot limit, removal of the sheeting system shall be to the top of the structure.

C. All damage to property resulting from removal shall be promptly repaired at no cost to the RMWD. RMWD shall be the sole judge as to the extent and determination of the materials and methods for repair.

-END OF SECTION-

SECTION 02555

ASPHALT CONCRETE PAVEMENT

PART 1 – GENERAL

1.01 WORK INCLUDED

The Contractor shall provide asphalt concrete pavement, cement-treated base, and associated materials in accordance with the Contract Documents.

1.02 REFERENCES

Except as otherwise indicated in this Section, the Contractor shall comply with the latest adopted edition of the Standard Specifications for Public Works Construction (SSPWC) together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.

1.03 CONTRACTOR SUBMITTALS

A. The Contractor shall submit, in writing, materials testing reports, job-mix formulas, and other pertinent information satisfactory to the District Representative, demonstrating that materials and methods Contractor proposes to use will comply with the provisions of this Section. Submittals shall be in accordance with the requirements of Section 01300 - Submittals.

B. Suitability Tests of Proposed Materials: Tests for conformance with the Specifications shall be performed by the Contractor before start of the Work. The samples shall be identified to show the name of the material, aggregate source, name of the supplier, contract number, and the segment of the Work where the material represented by the sample is to be used. Results of all tests shall be submitted to the District Representative for approval. Materials to be tested shall include aggregate base, coarse and fine aggregate for paving mixtures, mineral filler, and asphalt binder.

C. Trial Batch: Before placing the paving material, the Contractor will prepare a trial batch of asphalt concrete for each job-mix formula to be used for the Work. The trial batch will be prepared using samples of aggregates and asphalt binder. The compacted trial batch will provide a basis for computing the voids ratio, provide an indication of the optimum asphalt content, and establish a basis for controlling compaction during construction. The cost of laboratory trial batch tests will be borne by the Contractor.

D. The Contractor shall submit certification and test records of all proposed materials showing that they meet the applicable requirements.

1.04 QUALITY ASSURANCE

The Contractor shall provide all testing for compliance. RMWD may perform additional testing if determined necessary by the District Representative.

PART 2 – PRODUCTS

2.01 AGGREGATE BASE

Materials for aggregate base shall be crushed rock and rock dust complying with SSPWC Subsection 200-2.

2.02 PRIME COAT

The prime coat shall be liquid asphalt complying with SSPWC Subsection 302-5.3.

2.03 TACK COAT

The tack coat material shall comply with SSPWC Subsection 302-5.4

2.04 ASPHALT CONCRETE

Except as noted below, asphalt concrete shall comply with SSPWC Subsection 400-4. Where construction of the pavement is to be accomplished in a single course, Class III C2 PG 64-10 grading shall be used. Where construction consists of two or more courses, the surface course shall be Class III C2 PG 64-10 grading and the lower courses shall be Class III B3 PG 64-10 grading. Unless otherwise specified, paving asphalt of viscosity grade PG 64-10 shall be used for Type III asphalt concrete, and PG 70-10 shall be used for asphalt concrete dikes.

2.05 NOT USED

2.06 PAVEMENT MARKING PAINT

Pavement marking paint shall comply with SSPWC Subsection 210-1.6.

2.07 EMULSIFIED ASPHALT SLURRY COAT

The slurry coat shall meet the requirements of SSPWC Subsection 203-5 and shall have the composition and grading indicated for Type II material.

2.08 SOIL STERILANT

Soil sterilant or chemical weed control agent shall be a commercial product manufactured specifically to sterilize the subgrade soil to prevent the growth of weeds, plants or any type of vegetation

PART 3 – EXECUTION

3.01 SUBGRADE PREPARATION

A. The subgrade shall be prepared as specified in Section 02200 - Earthwork as applicable to roadways and embankments. Redwood headers measuring 2-inch by 4-inch shall be firmly staked in the proper positions along all edges other than

those where the pavement is to be placed against existing concrete or paved surfaces or has an asphalt concrete dike.

3.02 NOT USED

3.03 TACK COAT

A tack coat shall be applied in accordance with the requirements of SSPWC Subsection 302-5.4.

3.04 ASPHALT CONCRETE

A. Asphalt concrete paving shall be constructed in accordance with SSPWC Subsection 302-5.

B. Existing asphalt pavement that has been gouged, marred, or scarred during construction shall be repaired by the Contractor in accordance with SSPWC Subsection 302-5.10. The repair shall consist of asphalt patching and/or seal and sand. Repairs. Repairs of asphalt pavement shall be as determined at the sole discretion of RMWD.

C. Unless provisions are made in the Bid, payment for trench resurfacing, repairs and replacement of all surface improvements damaged, displaced or removed as a result of the Contractor's operation shall be included in the Bid and no separate payment will be made.

3.05 TRENCH RESURFACING

Trench resurfacing for asphalt concrete surfaced streets shall conform to Rainbow Municipal Water District Standard Drawing W-21 or the jurisdictional agency requirements, whichever is more stringent.

-END OF SECTION-

SECTION 03100

CONCRETE FORMWORK

PART 1 - GENERAL

1.01 WORK INCLUDED

This Section includes concrete formwork and accessory components as shown on the Drawings and specified in this Section.

1.02 REFERENCES

A. General

1. The publications and standards referenced herein form a part of the Specifications.

2. Where a date is given for reference standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition shall be used.

1.03 SUBMITTALS

A. Submittals shall be made in accordance with Specifications Section 01300, Submittals, and the following special provisions provided herein.

B. Product Data: The Contractor shall submit information on the following:

1. Epoxy putty for use in sealing joints between panels

2. Form release

3. Bond preventer

C. Formwork Designs: The Contractor shall submit formwork designs (drawings and calculations) prepared, stamped, and signed by a registered engineer in California. Concrete formwork designs shall indicate the specified design loadings in combination with the allowable stresses for the materials used, the proposed construction methods, placement rates, equipment, and sequences. Formwork designs are the responsibility of the Contractor. Formwork designs submitted are for record purposes only and will not be reviewed by the District Representative for suitability or technical accuracy.

D. Method of support for pipe, fabricated fittings, and conduits where encasement in concrete required.

E. Form Release Agent: NSF 61 certification.

PART 2 - PRODUCTS

2.01 CLASSIFICATION

A. The Specifications classify concrete formwork according to the intended final appearance or use of the finished concrete. Each classification of form has special construction requirements.

1. Class 1: For permanently exposed interior and exterior concrete surfaces where architectural finishes are required.

2. Class 2: For sumps, water passages, ceilings and interior walls, interior stairwells, underground vaults, interiors of electrical structures, tunnel linings, and other formed surfaces not otherwise specified.

3. Class 3: For miscellaneous formed surfaces not exposed to view, such as footings, backfilled walls, and minor structures below ground surface.

2.02 DESIGN

A. The components for Class 1 forms shall be new.

B. Class 2 forms shall conform to the requirements for Class 1 forms except that the plywood may be reused.

C. Class 3 forms may be of steel or of smooth planed boards in good condition, free from large or loose knots, with tongue and groove or shiplap joints. Lagging shall be laid horizontally with all joints tight and smooth.

D. The Contractor may use steel forms instead of the Class 2 wooden forms specified in this Section provided they are approved by the District Representative as being equal to the specified wooden forms for the purpose. Surfaces of steel forms shall be smooth and free of dings, gouges, and other imperfections.

E. Forms shall be true in every respect to the required shape and size and shall conform to the established alignment and grades. Their strength and rigidity shall be sufficient to maintain position and shape under the loads and operations of placing and vibrating the concrete.

F. The deflection of a span of an individual component of the form shall be limited to 1/360th of the length of span between supports, or 1/8-inch, whichever is less.

G. The camber required in the finished structure shall be as shown on the Drawings. The camber required to resist deflection of the formwork imposed by construction loads or the weight of fresh concrete shall be the responsibility of the Contractor and shall be incorporated into the design of the forms.

H. Where grooves are shown on the drawings, they shall be formed by molding strips or other suitable means.

2.03 MATERIALS

A. Plywood

1. New, waterproof, synthetic resin-bonded, exterior-type Douglas fir plywood, manufactured especially for concrete formwork and in accordance with NIST PS-1, Class I. Panels shall be edge-sealed but not mill-oiled.

B. Dimension Lumber

1. Lumber shall be new, surfaced four sides, Douglas Fir No. 2 or better, conforming to WWPA grading rules, except as otherwise permitted in this Section.

2. Lumber from previous projects, but otherwise in accordance with the requirements of this Section, may be used for Class 3 forms.

C. Structural Composite Lumber: Lumber shall be new or used, conforming to the size requirements of new surfaced dry-dimension lumber, and manufactured for use in concrete forming applications.

D. Beams, Wales, Strongbacks, Stringers, and Similar Members: Steel or aluminum members may be new or used. Steel shall be in accordance with ASTM A36.

2.04 ACCESSORIES

A. Form Release Agent

1. Form release agent shall be a ready-to-use, water-based material.

2. Form release agent shall not bond to, stain, or adversely affect concrete surfaces and shall not impair subsequent treatments of concrete surfaces. The form release agent shall be non-staining and shall not leave residual matter on the surface of the concrete nor adversely affect proper bonding of other surface coatings. Coating containing mineral oils or other nondrying ingredients is not permitted.

3. Form release agent shall be NSF 61 approved for contact with potable water.

B. Form Ties

1. Ties shall be provided with welded steel waterstops, which shall remain embedded unless the ties are completely removable. The ties shall be constructed and removed so that no material other than steel will be left in the concrete, and no steel will be left within 1½ inches of concrete surface.

2. The maximum diameter of removable cones for rod ties or other removable form tie fasteners shall not exceed 1 inch, and fasteners shall leave holes of regular shape for reaming.

3. Twisted wire ties shall not be used for holding forms. Form ties or form-tying methods that cause spalling of the concrete when the forms are stripped or the ties removed will not be permitted.

C. Temporary Anchorages

1. Steel coil inserts or drop-in anchors shall be installed to leave no steel within 1 ½ inches of the surface and leaving holes suitable for reaming and patching.

2. Powder actuated fasteners, bolts and nails driven in drilled holes, lead anchors, and expansion bolt anchors are not permitted.

PART 3 - EXECUTION

3.01 SEQUENCING AND SCHEDULING

A sufficient number of forms of each kind shall be provided to permit the required concrete placement rate to be maintained. Whenever additional forms are necessary to maintain the required progress, the additional forms shall be provided by the Contractor at the Contractor's expense.

3.02 ERECTION OF FORMWORK

A. All vertical surfaces of concrete members shall be formed unless placement of the concrete against the ground is called for on the Drawings or is approved by the District Representative.

1. The dimensions of concrete members shown on the Drawings apply to formed surfaces except where otherwise indicated. Where concrete is placed directly against earth, the excavation shall be made to the dimensions shown on the Drawings, plus an additional 1-inch on all surfaces where forms are omitted. Permission will be granted to place concrete without forms only for members where the ground can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

2. Sloped surfaces steeper than 4 horizontal to 1 vertical shall be provided with a top form to hold the shape of the concrete during placement.

B. Suitable and effective means shall be provided for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. The forms shall be sufficiently tight to prevent the loss of water, cement, and fines during placing and vibrating of the concrete.

C. Forms greater than 5-feet, measured along the surface of the form in either direction, shall be provided with openings of sufficient size and spacing to permit satisfactory introduction, working, and inspection of the concrete at intervals not greater than 5-feet, unless this requirement is specifically waived by the District Representative. Adequate clean-out holes shall be provided at the bottom of each lift of forms.

D. Reentrant corners and exterior corners shall be formed with ¾-inch fillets and ¾-inch chamfers unless otherwise ordered by the District Representative.

E. Plywood to be used as forms shall be given a preliminary oil treatment by the manufacturer or shall be oiled by the Contractor at least 2-weeks in advance of its use.

F. Forms shall be coated with an approved form release agent before placing of concrete. The coating shall be applied in accordance with the manufacturer's printed instructions.

1. Excess coating shall be satisfactorily removed from forms before placing concrete. Care shall be taken to keep form release agent off adjacent surfaces.

2. Form release agent shall be removed from adjacent concrete, reinforcing steel, and other items to be embedded before concrete placement.

G. Pipe, fabricated fittings, and conduits, to be encased in concrete, shall be supported on concrete piers or pedestals or by other approved means. Concrete supports, if used, shall be carried to firm foundations so that no settlement of the pipe, fabricated fittings, or reinforcement cage assemblies will occur during construction. The tops of permanent supports shall be kept at least 6-inches from pipe, fabricated fittings, and reinforcement cage assemblies for manhole structures and conduits. Steel ties or supports may be used provided they meet the requirements of this Section. Whatever the type of supports or ties used, the pipe, fabricated fittings, or conduits shall be properly secured in position to prevent floating or other movement during the placing of concrete.

3.03 INSTALLATION OF CLASS 1 FORMS

A. Class 1 forms shall be constructed with particular care to secure a quality architectural finish of uniform texture, free from visible irregularities, patch marks, and discolorations.

B. Installation of Class 1 forms shall conform to the following:

1. The edges of facing panels shall be butted tightly, and the joints shall be pointed with epoxy putty.

2. Plywood form panels shall be placed with the grain of the outer ply parallel to the direction of the span wherever possible.

3. Plywood facing shall be machine-sanded and then lightly sanded on the job as required to obtain a uniform texture over the whole area.

4. Facing panels shall be full-sized sheets of plywood except where smaller pieces will cover an entire area. Panels shall be of uniform size with joints in line vertically and horizontally. The panels shall be installed with the grain and long dimension of the plywood in the horizontal position.

5. Class 1 forms may be reused only with the approval of the District Representative.

3.04 REMOVAL OF FORMS

A. Forms shall be removed without injury to the surface of the finished concrete.

B. Forms for concrete encasement of pipe or fabricated fittings shall not be removed until the strength of the concrete is such that form removal will not result in spalling, peeling, perceptible cracking, breaking of edges or of surfaces, or other damage to the concrete; but not sooner than 24 hours after completion of concrete placement.

C. Forms for sloping surfaces shall be removed as soon as the concrete has attained sufficient stiffness to prevent sagging of the concrete.

D. Forms and falsework supporting slabs or other members that are subject to direct bending stress shall not be removed sooner than 28 days after the concrete has been placed unless concrete test cylinders show a compressive strength of at least 4,000 psi when cured under conditions similar to those effecting the structure.

E. Side forms for walls or other members not subject to dead load bending may be removed after a minimum period of 24 hours provided that satisfactory arrangements are made to cure and protect the exposed concrete.

F. Prior to removal of forms, exposed concrete shall be cured in accordance with Section 03300, Cast-in-Place Concrete, and forms shall be protected from increase in temperature due to ambient conditions.

G. Immediately upon removal of the forms, the concrete surfaces shall be thoroughly wetted and shall be kept wet until specific curing procedures are made effective in accordance with Specifications Section 03300, Cast-in-Place Concrete.

H. The periods of time specified in this Section for form removal are permissive only and the Contractor shall be responsible for all risks that may be involved in such removal.

I. Loads and soil backfill shall not be placed upon or against recently completed concrete until the concrete has attained its full 28-day design compressive strength (f'c).

3.05 TOLERANCES

A. Tolerance limitations for all formwork and completed concrete structures shall conform to the following values except that for any element of the structure the tolerances permitted in the several categories shall not be combined to allow a total combined tolerance greater than that allowable under a single category.

1. Variation from plumb, specified batter, or specified position of structures, including the lines and surfaces of walls, piers, or vertical joint grooves: In forms, prior to placement of concrete, maximum ¼-inch; change in position between any two points on the form shall not exceed a rate of ¼-inch in 10 feet. In completed concrete work, maximum ½-inch; variation from indicated shall not exceed ¾-inch in 40 feet.

2. Variation from the level or from the grades indicated on the Drawings in slabs, horizontal joints, and tops of walls, columns or other structures: In forms, prior to placement, maximum ¼-inch; in completed concrete work, maximum 3/8- inch; variation from indicated grades shall not exceed ¼-inch in 10 feet.

3. Variation from the level or from the grades indicated on the Drawings at weir-walls and spillway crests: In forms, prior to placement, maximum 1/8-inch; in completed concrete work, maximum ¼-inch; variation from indicated grades shall not exceed 1/8-inch in 10 feet unless otherwise shown on the Drawings.

B. Abrupt Offsets in Formed Surfaces of Completed Concrete Work: At abutting edges of individual plywood panels, steel panels, or smooth-planed boards, 1/16-inch; at abutting edges of prefabricated form panels in a gang or continuous wall form, 1/8-inch; at construction joints that are accentuated by a groove or reveal, ¼- inch; at construction joints that are shown to be flush across the joint, 1/8-inch.

C. Irregularities resulting from warping and variations from planeness or true curvature of lines and surfaces of walls, piers, or similar structures shall not exceed L/360 or ¼-inch when tested with a 5-foot template.

D. In totally buried structures, the preceding tolerances may be doubled.

E. Departure from cross-sectional dimensions of columns, formed beams, piers, and similar members: In forms prior to placement, ±¼-inch; in completed concrete work, - ¼-inch, + ½-inch.

F. Departure from specified thickness of slabs, walls, and similar members: In forms prior to placement, ± 1/8-inch; in completed concrete work, ± ¼-inch.

G. Where tolerances closer than those given above are necessary to accommodate the installation of any items of equipment, they shall be limited to values compatible with the equipment installation requirements.

H. For determination of compliance with specified tolerances, measurements may be made at any point on the surface of the completed concrete. For formwork tolerances, measurements may be made at any point on the surface of the form to be in contact with concrete or supporting structural members with proper allowance for the actual dimensions of such members.

3.06 FIELD QUALITY CONTROL

A. The Contractor shall notify the District Representative 24 hours prior to concrete placement so that the completed formwork may be inspected. Inspection of incomplete or partially completed Work will not be made.

B. Inspection will be made only after all formwork, reinforcing steel, embeds, cleanouts, screeds, ties, and final adjustments have been completed by the Contractor.

C. Forms are subject to check for line, grade, plumb, and position by the Contractor, District Representative, or both prior to placement of concrete.

D. Concrete shall not be placed in forms that do not meet the tolerances specified in this Section.

E. The Contractor shall correct the defective work found in the inspection at least 2 hours prior to delivery of concrete.

F. Neither the review of the Contractor's formwork drawings nor the inspection of forms by the District Representative shall relieve the Contractor of responsibility for the adequacy of the forms nor from the necessity for remedying defects which may develop or become apparent with use.

1. The District Representative may at any time condemn a section or multiple sections of forms found deficient in any respect, and the Contractor shall promptly remove the condemned forms from the work and replace them with forms meeting the requirements of the Specifications.

2. Form surfaces that have been damaged and are no longer in smooth condition or that have scrapes, gouges, peeling veneer, blistered surfaces, swelling at panel edges, or similar defects shall not be used unless the District Representative approves their use in writing for surfaces to be backfilled.

G. Should any form, forming system, process, installation, or method of construction, even though previously approved for use, produce completed concrete not conforming to the requirements of these Specifications, its use shall be discontinued until sufficient corrections have been made to again bring the completed Work into conformance.

-END OF SECTION-

SECTION 03200

REINFORCING STEEL

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This Section includes furnished and installed reinforcing steel and accessory components as shown on the Drawings and specified in this Section.

1.02 REFERENCES

A. The publications and standards referenced herein form a part of the Specifications.

B. Where a date is given for referenced standards, that edition shall be used. Where no date is given for referenced standards, the latest edition shall be used.

1.03 SUBMITTALS

A. Submittals shall be made in accordance with Specifications Section 01300, Submittals, and the following special provisions provided herein.

B. The Contractor shall submit shop drawings for the following:

1. Bending Diagrams.

2. Materials Lists.

3. Placement Drawings: Placement drawings that show all reinforcing steel in their correct positions. Placement drawings shall include all information necessary for complete fabrication and placing of reinforcing steel, bar supports, splices, dowels, ties, inserts, and temporary support steel.

C. Mill Certificates and Test Reports: For each heat of reinforcing steel delivered to the site, the Contractor shall submit a certified copy of the mill test showing physical and chemical analysis.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Identification of Reinforcing Steel

1. Bundles of reinforcing steel shall be tagged showing quantity, grade, size, and suitable identification to allow checking, sorting, and placing.

2. Tagging and identification requirements shall be the same for both shop-fabricated and field-fabricated reinforcing steel.

3. Unidentified reinforcing steel will be rejected.

B. Storage and Protection: Reinforcing steel shall be stored off the ground and protected from oil or other deleterious materials.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Deformed reinforcing steel shall be in accordance with ASTM A615. Deformed reinforcing steel to be welded shall be in accordance with ASTM A706.

B. All reinforcing steel shall be Grade 60, unless otherwise noted.

C. Deliver reinforcing steel to the site bundled and with identifying tags.

2.02 ACCESSORIES

A. Tie wire shall be 16 gauge or heavier, black, soft annealed, except as otherwise noted below.

B. Reinforcement Supports:

1. Reinforcement supports shall be cement mortar cubes (dobes) wherever the finished concrete surface is to be in contact with water. Cubes shall be of the same strength and density as the concrete in the section being placed.

2. Metal supports, where used, shall have stainless steel tips, in accordance with the CRSI Manual of Standard Practice Class 2, Type B so that no non-stainless steel wire of the bar support is closer than 3/4-inch to the form surface.

3. Plastic supports and plastic-tipped supports shall not be used.

2.03 FABRICATION

A. The Contractor shall fabricate and place reinforcing steel in accordance with the reviewed complete bending diagrams, material lists, and placing drawings.

B. All reinforcing steel shall be fabricated in accordance with ACI 315 and ACI 318, except as noted on the Drawings or within the Specifications.

C. Minimum inside bend radius and hook extensions for primary reinforcement, stirrups, and ties shall be as shown on the Drawings.

D. The Contractor shall cut and bend reinforcing steel in accordance with the reviewed fabrication submittals.

E. Reinforcing steel shall be bent cold.

F. Should the Contractor elect to fabricate reinforcing steel on the job, the Contractor

shall do so in a manner and with equipment suited to the purpose and approved by the District Engineer. All field fabricated reinforcing steel shall conform to the same tolerances and requirements as though the reinforcing steel was shop fabricated.

PART 3 – EXECUTION

3.01 PREPARATION

A. Reinforcing steel shall be thoroughly cleaned of dirt, loose mill scale, excessive rust, and other substances that may reduce the bond between reinforcing steel and concrete.

B. Reinforcing steel shall be protected from moisture until concrete is placed around it. Ends of bars that are to be left projecting from the concrete for a considerable time shall be painted with a heavy coat of neat cement grout. Special care shall be taken to prevent disturbance of reinforcement in concrete that has already been placed.

3.02 INSTALLATION

A. The Contractor shall furnish and install the wires, metal supports, clips, and other appurtenances necessary to fulfill the requirements of the Specifications.

B. Reinforcing steel in addition to those shown on the Drawings, which may be found necessary or desirable by the Contractor for securing reinforcement steel in position, shall be furnished and installed by the Contractor, at no additional cost to RMWD.

C. Except for welded splices specified in this Section, welding as an aid to fabrication or installation will not be permitted except as specifically shown on the Drawings or permitted by the District Engineer.

D. Reinforcing steel bars shall be placed accurately in the position with the spacing shown on the Drawings and shall be securely fastened in position to prevent displacement during the placing of concrete.

1. Templates shall be furnished for dowels.

2. Concrete cover over reinforcing steel, unless otherwise shown on the Drawings, shall be not less than:

    a. inches for formed concrete surfaces expose to water, earth, or weather.

    b. 3 inches for concrete surfaces cast against and permanently exposed to earth.

3. Reinforcing steel shall be placed not closer than 3 inches to embedded pipes or sleeves passing through concrete, unless otherwise shown on Drawings.

4. Bundling of reinforcing steel may be used only where shown on the Drawings. Bundled bars shall be wired together securely to prevent separation during concrete placement.

5. When necessary to move reinforcing steel to avoid interference with other reinforcement, conduits, or embedded items exceeding the specified placing tolerances, the resulting arrangement of reinforcing steel shall be approved by the District Engineer 6. No tie wire shall remain within 1½ inches of the concrete surface.

E. Reinforcing steel partially embedded in concrete shall not be field bent, except at locations specifically stated on the Drawings or when permitted by the District Engineer.

F. Splices

1. Reinforcing steel shall be spliced only at points shown on the approved bending lists and placing Drawings or where approved by the District Engineer.

2. Wherever reinforcing steel is spliced, the lapped distance shall be as shown on the Drawings. For bars of different sizes, the lap length shall be that given for the larger size bar, unless otherwise shown on the Drawings.

3. Reinforcing steel in lapped splices shall be in contact and shall be tied in a manner that maintains reinforcing steel spacing shown on the Drawings.

G. Welded Splices

1. Reinforcing steel welded splices shall be only at those locations specifically shown on the Drawings. All other reinforcing steel welded splice locations shall be approved by the District Engineer.

2. Welding of reinforcement shall be in accordance with AWS D1.4.

3. Welded connections shall be provided in reinforcement assemblies where called for on the Drawings or elsewhere in the Specifications and at splices where the required length of lap cannot be provided and is approved by the District Engineer.

4. Where reinforcing steel is spliced by welding, the bars shall be spliced with full-penetration butt welds provided that the welding shall be done by an approved arc-welding process, performed by certified welders, and shall develop 125% of the specified yield strength of the reinforcing steel.

5. All welded splices shall be subject to continuous special inspection. The Contractor shall be responsible for coordinating all special inspection requirements and the cost of all continuous special inspections. The special inspector shall be certified for inspection of reinforcing steel welding. At the completion of reinforcing steel welding, the special inspector shall furnish a

final signed inspection report to the District Engineer.

3.03 FIELD QUALITY CONTROL

A. Reinforcing steel placement tolerances shall be in accordance with the IBC and ACI 117.

B. Reinforcing steel placement shall be approved by the District Engineer prior to the placement of concrete.

C. The Contractor shall notify the District Engineer 24 hours prior to concrete placement for inspection of reinforcing steel placement. Inspection of incomplete or partially completed Work will not be made.

-END OF SECTION-

SECTION 03250

CONCRETE ANCHORS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the requirements for the use and installation of concrete anchors.

1.02 REFERENCES

A. The publications and standards referenced herein form a part of this Specification.

B. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition shall be used.

1.03 SUBMITTALS

A. Submittals shall be made in accordance with Specifications Section 01300, Submittals, and the following special provisions provided herein.

B. Product Data: The Contractor shall submit manufacturer's standard catalog data sheets.

C. Material Safety Data Sheets: The Contractor shall submit Material Safety Data Sheets (MSDS) for each proposed product.

D. Test Reports and Certifications: The Contractor shall submit a manufacturer's certification verifying conformance to these Specifications and that all products in contact with potable water are NSF approved.

E. Manufacturer's Instructions: Manufacturer's printed instructions for shipping, storing, mixing and application and the applicable ICC report shall be submitted prior to delivery of the product.

F. Installation Instructions: Manufacturer's printed instructions for all phases of installation including hole size, preparation, placement, and procedures. Specific instruction for safe handling and installation of all concrete anchors to personnel handling and installing concrete anchors.

1.04 QUALITY ASSURANCE

A. Manufacturer’s Service for Adhesive Anchors:

1. Jobsite training of Contractor’s personnel shall be conducted for safe and proper installation, handling, and storage of adhesive system.

2. Training shall be scheduled with Contractor, and the District Representative shall be notified of time and place for sessions.

1.05 DELIVERY, STORAGE AND HANDLING

A. Materials shall be delivered in sealed containers with labels legible and intact. Each container shall be clearly marked with the following information:

1. Name of manufacturer
2. Manufacturer's product identification
3. Manufacturer's instructions for mixing, installation, and application
4. Warning for handling and toxicity
5. Manufacturer's batch numbers

B. Materials shall be stored at temperatures between 40°F and 100°F unless specifically stipulated otherwise by the manufacturer.

C. Materials shall be handled safely and in a manner that will avoid breaking container seals.

D. The Contractor shall store adhesive components as recommended by the manufacturer and approved by District Representative and shall store and handle adhesive components in accordance with the requirements of the International Fire Code (IFC), local fire marshal, and all health, safety, and environmental regulations.

PART 2 - PRODUCTS

2.01 GENERAL

A. 316 Stainless steel anchors shall be used in all applications shown on the Drawings and in all cases where concrete anchors will be intermittently or continuously in contact with water or in a moist environment whether or not shown on the Drawings.

B. Stainless steel studs, bolts, nuts, and washers shall be stamped indicating the type of stainless steel.

C. Concrete anchors shall be 316 stainless steel, unless noted otherwise on the Drawings. Galvanized concrete anchors shall be used where stainless steel anchors are not specified on the Drawings or required based on exposure requirements noted above.

2.02 CONCRETE ADHESIVE ANCHORS

A. Concrete adhesive anchors shall be Type 316 stainless steel studs, bolts, nuts, and washers. After anchor stud installation and prior to assembly, all threaded portions of stainless steel bolts, studs, and cap screws shall be coated with an NSF-certified thread lubricant. Lubricant shall be as specified in Section 05500, Miscellaneous Metalwork.

B. Adhesive for anchorage and doweling in hardened concrete shall be 2-component,

insensitive to moisture, and be designed for installation in adverse environments.

C. Adhesive anchors shall be preproportioned adhesive system or an adhesive capsule system.

D. Stainless steel fasteners shall conform to the requirements of ASTM A193, Grade B8MA or B8MNA Type 316 or 316N.

E. Studs shall be Type 316 stainless steel threaded rod free of grease, oil, or other deleterious material with 45° chisel point.

F. The cure temperature, pot life, and workability of adhesive shall be compatible for intended use and anticipated environmental conditions.

G. Acceptable Products:

1. Hilti, Inc., HIT HY-150 Adhesive Anchor System (ICC ER-5193),

2. ITW Ramset/Redhead Epcon System, Ceramic 6 Epoxy Anchors (ICC ER-4285),

3. Or approved equal.

2.03 CONCRETE EXPANSION ANCHORS

A. Concrete expansion anchors shall be used where specifically stated on the Drawings.

B. Expansion anchors are used for the installation of comparatively light metal accessories that are not required to be installed before the concrete is placed. Expansion anchors will not be permitted in applications that will be subjected to vibrations or impact loads.

C. Expansion anchor body, nut, washer, and expansion sleeve shall be Type 316 stainless steel. All threaded portions of stainless steel anchors shall be coated with an NSF-certified thread lubricant. Lubricant shall be as specified in Section 05500, Miscellaneous Metalwork.

D. Acceptable Products:

1. Hilti, Inc., Kwik Bolt TZ Anchors in Concrete (ICC ESR-1917),

2. Hilti, Inc., Kwik Bolt 3 Concrete Anchor

3. ITW Red Head, Trubolt Wedge Anchors in Concrete (ICC ESR-2251),

4. ITW Ramset/Redhead, Dynabolt Sleeve Anchor

5. Simpson Strong-Tie Company, Inc., Strong-Bolt Wedge Anchor (ICC ESR1771)

6. Simpson Strong-Tie company Inc., Anchor Systems, Sleeve-All Sleeve Anchors

7. Or approved equal.

2.04 CONCRETE SCREW ANCHORS

A. Concrete screw anchors shall be used where specified on the Drawings.

B. Screw anchor shall be Type 410 stainless steel.

C. Acceptable Products:

1. Hilti, Inc., Kwik Con II Concrete Screw Anchor (ICBO ER-5259),

2. Or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Dispensing, Metering, or Mixing Adhesive Components: The Contractor shall use portable, automatic metering and mixing device or machine capable of maintaining prescribed mix ratio within deviation of 5% or less, by volume. Dispensing equipment shall be as recommended by the manufacturer and approved by District Representative.

B. The Contractor shall install anchors in accordance with the manufacturer's printed recommendations and the applicable ICC report.

C. The Contractor shall dispense components through a specially designed static mixing nozzle that thoroughly mixes components and places mixed components at base of predrilled hole.

D. Mixing nozzles shall have non-removable internal static mixer required to ensure proper blending of components.

3.02 PREPARATION OF CONCRETE SURFACES

A. Concrete surfaces shall be prepared in accordance with the requirements of the applicable ICC report and the manufacturer’s written recommendations.

B. Holes for all studs shall be accurately located and drilled by using templates and drilling jigs.

C. Drilling Equipment:

1. Drilling hammers for holes shall be electric or pneumatic rotary type with medium or light impact.

2. The Contractor shall use drill bit diameter meeting ICC report requirements.

3. Hollow drills shall be provided with flushing air systems.

4. Where edge distances are less than 2 inches, the Contractor shall use lighter impact equipment to prevent micro cracking and concrete spalling during drilling process.

5. Obstructions in Drill Path:

   a. When existing reinforcing steel is encountered during drilling and when approved by the District Representative, the Contractor shall enlarge the hole by 1/8-inch, core through the existing reinforcing steel at the larger diameter, and resume drilling at original hole diameter.

   b. Misdrilled holes shall be filled with adhesive, as specified in this Section, so as not to entrap or create air pockets.

6. Holes shall be made free of dust and loose materials by the use of moisture free and clean compressed air or other acceptable and approved means.

7. Anchor embedment depth and spacing shall be as shown on the Drawings.

3.03 INSTALLATION

A. Concrete anchors shall be installed in accordance with the manufacturer's printed recommendations and the requirements of the applicable ICC Report. Manufacturer's recommended drills and equipment shall be used. Hole diameter is critical to installation; only drills recommended by the anchor manufacturer shall be used.

B. Concrete anchors shall not be installed until concrete has attained the minimum design compression strength.

C. Anchor shall be dry and grease-free.

D. Turn and agitate anchor immediately following placement to ensure the absence of voids and to ensure that adhesive makes contact with all surfaces.

E. An anchor shall not be installed closer than 6 times its diameter to either an edge of concrete or 12 times its diameter to another anchor, unless specifically shown on the Drawings.

F. Adhesive anchoring system shall not be used when temperature of concrete is outside the ranges recommended by the manufacturer.

G. Specific manufacturer safe handling practices shall be followed when handling and/or installing all concrete anchors.

H. Concrete shall be dry at the time of adhesive anchor placement.

I. Concrete adhesive anchors installation torque shall be in accordance with the provisions stated on the Drawings. In no case shall the torque exceed the manufacturer’s installation recommendations.

J. Concrete expansion anchors installation torque shall be in accordance with the manufacturer's installation recommendations.

K. Concrete screw anchors shall be installed in accordance with the manufacturer's installation recommendations.

3.04 CURING

A. Adhesive materials shall be protected from temperature extremes during curing. The temperature of the base materials shall not exceed the range permitted.

3.05 FIELD QUALITY CONTROL

A. The District Representative will inspect concrete surfaces prior to application.

B. The Contractor shall engage the services of a testing agency to provide special inspection services where required by applicable ICC product evaluation reports. Special inspection personnel shall be certified for the specific application.

C. Moisture content for concrete shall be evaluated by determining if moisture will collect at bond lines between old concrete and adhesive before adhesive has cured. This shall be accomplished by taping a 4-foot by 4-foot polyethylene sheet to concrete surface in accordance with the requirements of ASTM D4263. If moisture collects on underside of polyethylene sheet before adhesive curing time has elapsed, then concrete shall be allowed to dry and the test shall be repeated until results show no moisture.

D. Concrete adhesive materials will be sampled in the field and tested for conformance with the Specifications. At least one sample will be taken from each shipment or production lot.

3.06 CLEANUP

A. Concrete surfaces beyond the limits of the adhesive shall be protected against spillage.

B. Adhesive applied or spilled beyond desired areas shall be immediately removed. Cleanup shall be performed with material designated by the adhesive manufacturer.

-END OF SECTION-

SECTION 03251

EXPANSION, CONSTRUCTION, AND CONTROL JOINTS

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This Section covers the Work necessary to furnish and install complete concrete expansion, construction, and control joints including all waterstops, dowels, premolded, pourable, and gun grade fillers or sealants.

B. The joints required are of various types and sizes. The joints shall be constructed as shown on the Drawings.

1.02 REFERENCES

A. The publications and standards referenced herein form a part of the Specifications.

B. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition shall be used.

1.03 SUBMITTALS

A. Submittals shall be made in accordance with Specifications Section 01300, Submittals, and the following special provisions provided herein.

B. Product Data:

1. Joint fillers for horizontal, vertical, and sloped joints.

2. Preformed control joints.

3. Waterstops.

4. Joint sealant.

5. Mastic strip waterstop.

C. Shop Drawings:

1. Details of waterstops support used in both concrete pours to demonstrate that the waterstops will remain secure until complete encasement.

2. Details of construction joints indicating type of waterstop to be used.

D. Samples: Splice, joint, and fabricated cross of each size, shape, and fitting of waterstops.

E. Quality Control Submittals:

1. Joint Filler and Sealant for Potable Water Structures: National Sanitation Foundation (NSF) certification by the Federal Environmental Protection Agency (EPA) and State health agency as acceptable for use in potable water structures.

2. Waterstop manufacturer's printed recommendations for product shipment, storage, handling, installation, and repair.

3. Three certified copies of test reports of waterstop material from a recognized testing laboratory showing that the material complies with the Specifications.

4. Joint Filler and Primer: Manufacturer's printed recommendations for product shipment, storage, handling, application, and repair.

5. Joint Sealant and Primer: Manufacturer's printed recommendations for product shipment, storage, handling, application, and repair.

6. Preformed Control Joint: Manufacturer's printed recommendations for product shipment, storage, handling, application, and repair.

7. Mastic strip waterstop: Manufacturer's printed recommendations for product shipment, storage, handling, application, and repair.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Delivery, storage, and handling shall be in accordance with the requirements of Division 1, Special Provisions, or as required by the manufacturer, whichever is more stringent.

B. Plastic waterstop material, except for factory-made fittings, shall be furnished in rolls.

C. Plastic waterstop materials shall be stored in covered warehouses in the manner specified by the manufacturer.

D. Factory-made fittings shall be stored in their original crates in a similar manner.

E. Coils or rolls of waterstop shall be unrolled a minimum of 3 days prior to installation.

PART 2 - PRODUCTS

2.01 BOND BREAKER TAPE FOR EXPANSION JOINTS

A. Where shown, bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape which will satisfactorily adhere to the premolded joint material or concrete surface as required. The tape shall be the same width as the joint.

2.02 PREMOLDED JOINT FILLER

A. Expansion joint filler material shall conform to the joint dimensions and material type designated on the Drawings.

B. Sponge Rubber: Sponge rubber filler shall be of the preformed, non-extruding, resilient, non-bituminous type in accordance with the requirements of ASTM D1752, Type I.

C. Bituminous expansion joint filler shall consist of strips of preformed, non-extruding, resilient, bituminous-fiber-type material in accordance with ASTM D1751.

2.03 JOINT SEALANTS

A. Joint sealant shall conform to the requirements of ASTM C920, Type M, Grade P, Class 25, Use T.

B. Joint sealant shall have a Shore “A ” hardness range of 25 to 35 in accordance with ASTM D2240.

C. Acceptable Products:

1. Pacific Polymer Elasto-Thane 227,
2. Select Products U227,
3. Sika, Sika Flex 2C NS/SL,
4. Or equal.

2.04 PLASTIC PVC WATERSTOPS

A. Plastic PVC waterstops shall be uniform in cross-section and formed to the size and shape designated on the Drawings.

B. Plastic PVC waterstops shall be extruded from an elastomeric plastic material of which the basic material shall be virgin polyvinyl chloride resin. PVC compound shall not contain any scrapped or reclaimed material or pigment. Additional resin, non-migrating type plasticizers, stabilizers, or other materials may be added to provide the specified properties. All material in waterstops shall be virgin material and shall be resistant to weather, alkalis, acids, and saltwater.

C. The plastic material shall be in accordance with the following physical properties:

Physical Property	Test Method	Result
Water absorption	ASTM D570	0.15% (max)
Tear resistance	ASTM D624	200 lbs./in. (min.)
Ultimate elongation	ASTM D638	350% (min.)
Tensile strength	ASTM D638	2000 psi (min.)
Low temperature brittleness	ASTM D746	No failure @ -35°F
Stiffness in flexure	ASTM D747	600 psi (min.)
Specific gravity	ASTM D792	1.45 (max.)
Hardness, Shore A	ASTM 2240	79 ± 3
Tensile strength after accelerated extraction	CRD-C572	1850 psi (min.)
Elongation after accelerated extraction	CRD-C572	300% (min.)

Physical Property	Test Method	Result
Effect of Alkalies after 7days: Weight change Hardness change	CRD-C572	 Between -0.10% / +0.25% ± -5 points

D. Products/Manufactures:

1. 4-inch centerbulb PVC waterstop, style number. 702 manufactured by Greenstreak or approved equal.

2. 6- inch center bulb PVC waterstop, style number 732 manufactured by Greenstreak or approved equal.

3. 9-inch centerbulb PVC waterstop, style number 731 manufactured by Greenstreak or approved equal.

E. Accessories:

1. Provide factory made fabrications for all changes of direction, intersections, and transitions. Only straight butt joint splices permitted in field.

2. Teflon coated thermostatically controlled waterstop splicing irons for field butt splices.

3. Hog rings or grommets spaced at 12 inches on center along length of waterstop.

2.05 NAILS

A. Nails for securing joint materials shall be common copper wire.

2.06 STEEL EXPANSION JOINT DOWELS

A. Dowel bars shall be round smooth steel in accordance with ASTM A36 and Specifications Section 05500, Miscellaneous Metals.

B. Dowel bars shall be coated in accordance with Specifications Section 09900, Painting and Coating Systems.

2.07 MASTIC STRIP WATERSTOP

A. Mastic strip applied waterstop shall be comprised of a single component, self-sealing mastic.

B. Mastic strip waterstop shall have the following properties:

Property	Test Method	Required Limits	Typical Values
Specific Gravity	ASTM D 71	1.2 min. 1.35 max.	1.27
Ductility	ASTM D 113	5 cm min.	5.25

Property	Test Method	Required Limits	Typical Values
Softening Point	ASTM D 36	320^{0}F min.	350^{0}F+
Flash Point	ASTM D 92	600^{0}F min.	610^{0}F
Fire Point	ASTM D 92	625^{0}F min.	630^{0}F
Penetration	ASTM D 217	50 to 120	60
Sag	SS-S-210, 4.5.3	None	None
Bitumen Content	ASTM D 4	50 - 70%	62.4%
Ash Inert Materials	ASTM D 482	30 - 50%	34.3%
Volatile Material	ASTM D 6	2.0% max.	0.5%
Chemical Resistance	SS-S-210, 3.6		
- KOH 5%		None	None
- HCL 5%		None	None
- H_2SO_4 5%		None	None
- NaOH 5%		None	None
- H_2S Saturated Solution		None	None

C. Products / manufacturer

1. Lockstop, Greenstreak
2. Or approved equal

D. Primer adhesive, as recommended by the manufacturer, shall be used to secure mastic strip waterstop.

PART 3 – EXECUTION

3.01 JOINT PREPARATION

A. General

1. The joints shall be accurately located and constructed to produce straight joints; and shall be vertical or horizontal, except where walls intersect sloping floors.

2. The concrete placement shall not commence until after the joint preparation has been inspected and approved by the District Representative.

3. Joint preparation shall be in accordance with the requirements of Section 03300, Cast-in-Place Concrete.

B. Construction Joints

1. Prior to placing the abutting concrete for all construction joints, the contact surface shall be cleaned by sandblasting or other approved means to remove all laitance, expose the aggregate, and roughen surface to a minimum ¼-inch amplitude. The exposed portion of the reinforcing steel shall be cleaned of all concrete. The cleaning method shall be conducted so as not to damage the waterstop.

2. The Contractor shall roughen the surface of the hardened concrete by one of the following methods:

a. Sandblasting the concrete surfaces and reinforcing dowels after the concrete has fully cured to remove all laitance and spillage, and to expose sound aggregate.

b. Water blasting the concrete surfaces and reinforcing dowels after the concrete has partially cured to remove all laitance and spillage, and to expose sound aggregate.

c. Green cutting fresh concrete with high pressure water and hand tools to remove all laitance and spillage from the concrete surfaces and reinforcing dowels, and to expose sound aggregate.

3.02 INSTALLATION OF CONSTRUCTION JOINTS

A. Construction joints shall be constructed a maximum of 30 feet on center in each direction, unless otherwise shown on the Drawings, except that the Contractor will be permitted to make a construction joint 30 feet beyond the nearest expansion joint. The Contractor may install additional construction joints, provided the Contractor obtains the District Representative's approval and all such joints are in accordance with the requirements specified herein.

B. Waterstops shall be installed in accordance with the requirements specified herein.

3.03 INSTALLATION OF EXPANSION JOINTS

A. The filler shall be cut to the size and shape of the joint surface to be covered and

securely held in place.

B. The joints between portions of the joint filler shall be sufficiently tight to prevent mortar from seeping through.

C. The edges of joint filler shall be placed flush with the finished surface of the concrete or to the bottom edge of the chamfers, except where polyurethane sealant is required to be placed, in which case the edge of the joint material shall be trimmed in accordance with details shown on the Drawings.

D. Where the joint filler material abuts a waterstop, it shall be placed snugly against the waterstop to prevent grout from entering the space.

3.04 JOINT SEALANTS

A. All expansion joints shall be filled with joint sealant and shall be provided with tapered grooves as shown on the Drawings.

B. Construction joints shall be filled with joint sealant, where indicated on the Drawings, and shall be provided with tapered grooves as shown on the Drawings.

C. The material used for forming the tapered grooves shall be left in place in the groove until after all forms have been removed and the floors or other adjacent areas have been cleaned and swept. After the forms have been removed from the grooves, all laitance and fins shall be removed and the grooves shall be sandblasted.

D. Surfaces to accept sealant shall be cleaned and primed in accordance with the sealant manufacturer's printed recommendations.

E. The sealant shall be placed in accordance with the printed recommendations of the manufacturer; special care shall be taken to properly mix the sealant before its application.

3.05 INSTALLATION OF PLASTIC WATERSTOPS

A. Continuous waterstops shall be installed at locations shown on the Drawings.

B. A continuous seal at each joint is required. When construction and expansion joints are not in the same plane, the waterstop shall extend 6 inches into adjoining walls or slabs. Clearance between waterstops and surrounding reinforcing steel shall be greater than twice the concrete maximum aggregate size.

C. The waterstop shall be installed by extending it through a slot in the keyway of the joint or by holding it in place by split bulkheads. Forms for bulkheads containing waterstops shall be constructed to hold the waterstop in position during concrete placement without displacement of the waterstop or loss of fines from the concrete.

1. Waterstops in construction joints shall be held in position at right angles to the plane of the construction joints with hog rings and tie wires. Tie wires shall be fastened to the reinforcement steel on each side of the waterstop at 18-inch spacing, maximum. Hog rings shall be secured between the last rib and the end of the waterstop.

2. Nails shall not be used to secure waterstops.

3. Inserting of waterstop in fresh concrete will not be permitted.

4. Center bulb shall be centered in the joint within ±1/3 of the outside diameter of the center bulb.

D. Splices and Intersections

1. Ells, crosses, tees, and any other intersection configuration, both edge and flat, shall be factory-made with stub ends of sufficient length to allow for field splicing.

2. Joints shall be accurately aligned without offsets. Any joint showing excessive offset, which in the opinion of the District Representative, is a result of either poor workmanship or unevenness of material, will be rejected.

3. Waterstop splices shall be heat-welded in accordance with the printed instructions of the manufacturer. The splicing iron shall be approved by the manufacturer. Welds shall exhibit a continuous bead of excess melted material and shall be free of pinholes and charred or burnt material.

E. Waterstops shall be clean and free from oil, dirt, mortar, and any other foreign matter prior to installation and during the concrete placement. The concrete placed around the waterstop shall be thoroughly and systematically vibrated to avoid air entrapment and to provide positive contact between the waterstop and concrete.

3.06 INSTALLATION OF MASTIC STRIP WATERSTOP

A. Mastic strip waterstop shall be installed in accordance with the manufacturer’s written recommendations.

B. Mastic strip waterstop shall be installed at locations shown on the Drawings.

C. Inspect mastic strip waterstop for discontinuity and debris contamination prior to concrete pour. Replace unacceptable mastic strip waterstop material.

D. Mastic strip waterstop shall be adhered to base material with primer adhesive. Primer adhesive shall be allowed to dry for two (2) hours prior to application of mastic strip waterstop.

E. Apply mastic strip waterstop the same day as primer adhesive.

F. Protect mastic strip waterstop from moisture, dirt, oil, and sunlight during the progress of the work.

G. Mastic strip waterstop shall be spliced by overlapping ends and pressing ends together in a molding action ensuring no separation or air pockets.

H. Remove the separation paper from the mastic strip waterstop just prior to placement of concrete.

3.07 QUALITY CONTROL

A. Waterstop shop and field joints will be subject to inspection.

B. All joints will be inspected for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects. joints having defects greater than the following will be rejected:

1. Offsets at joints greater than 1/16-inch
2. Exterior cracks in joint, deeper than 1/32-inch, due to incomplete bond
3. Misalignment of a joint that results in misalignment of the waterstop in excess of ½-inch in 10 feet
4. Porosity in the weld joint
5. Bubbles or inadequate bonding

C. No waterstop shall be buried in concrete without prior approval by the District Representative. The Contractor shall notify the District Representative 24 hours in advance of required inspection.

D. Field and shop splices shall develop at least 50% of the specified minimum tensile strength of the material when tested. Samples of shop or field splices may be selected at random by the District Representative for testing.

E. Repair of damaged waterstops will be subject to the approval of the District Representative.

F. Training in splicing waterstop material shall be given by a representative of the company supplying the waterstop material.

-END OF SECTION-

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes materials and methods for formwork, reinforcement, mixing, placement, curing and repairs of concrete, and the use of cementitious materials and other related products. This section includes concrete, mortar, grout, reinforcement, thrust and anchor blocks, slabs, foundations, valve support blocks, pads at fire hydrants and air/vacs, and manhole bases.

1.02 REFERENCE STANDARDS

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.

ASTM A185	Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A615 / A615M	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C150	Specification for Portland Cement
ASTM C494	Specification for Chemical Admixtures for Concrete
ASTM C881	Specification for Epoxy-Resin-Base Bonding Systems for Concrete
CRSI	Recommended Practice for Placing Reinforcing Bars
SSPWC	Standard Specifications for Public Works Construction "Greenbook" (Current Version)

1.03 RELATED WORK SPECIFIED ELSEWHERE

RMWD	Standards Manual
Section 02223	Trenching, Backfilling and Compacting

1.04 APPLICATIONS

The following materials, referenced in other sections, shall be provided and installed in accordance with this specification for the applications noted below:

A. Concrete for thrust and anchor blocks for horizontal and vertical bends, ductile-iron or steel fittings, fire hydrant bury ells, and support blocks for valves 4-inch and larger, all in accordance with the Standard Drawings.

B. Concrete for collars, cradles, curbs, encasements, gutters, manhole bases, protection posts, sidewalks, splash pads, and other miscellaneous cast-in-place items.

C. Mortar for filling and finishing the joints between manhole and vault sections and setting manhole grade rings and cover frames. Mortar may also be used for repairs of minor surface defects of no more than 1/4-inch in depth or 1/2-inch in width on non-structural, cast-in-place items such as splash pads or concrete rings around manholes. (Note that large voids, structural concrete and pipe penetrations into vaults shall be repaired with non-shrink grout; repairs to precast manholes and vaults and cast-in-place manhole bases shall be repaired with an epoxy bonding agent and repair mortar, as outlined below.)

D. Epoxy bonding agent for bonding repair mortar to concrete on repairs to damaged surfaces of precast or cast-in-place concrete manholes and vaults.

E. Repair mortar for repair to damaged surfaces of precast or cast-in-place concrete manholes and vaults. An epoxy bonding agent shall be used in conjunction with repair mortar.

F. Non-shrink grout for general purpose repair of large construction voids, pipe penetrations into vaults and grouting of base plates for equipment or structural members.

G. Epoxy adhesives for grouting of anchor bolts.

H. Protective epoxy coating for application to reinforcing steel within existing concrete structures exposed during construction.

I. Damp-proofing for application to the exterior surfaces of concrete manholes and vaults located at or below the water table or where showing evidence of moisture or seepage, and as directed by RMWD.

J. New construction and repairs use Con Shield MS-10,000 with Con mic Shield.

K. Concrete slabs and footings – See Structural Drawings. Drawings shall take precedent.

1.05 DELIVERY, STORAGE AND HANDLING

Deliver reinforcing steel to the site bundled and tagged with identification. Store on skids to keep bars clean and free of mud and debris. If contaminated, all bars shall be cleaned by wire brushing, sand blasting, or other means prior to being set in forms.

PART 2 - MATERIALS

2.01 CONCRETE

A. All Portland cement concrete shall conform to the provisions of Sections 201, 202 and 303 of the Standard Specifications for Public Work Construction (Greenbook).

B. Unless otherwise noted on the drawings or directed by RMWD, class 560-C-3250 concrete, as described in the Greenbook, Section 201, shall be used for all applications. The maximum water/cement ratio shall be 0.53 by weight, and the maximum slump shall be 4-inch.

C. In certain circumstances, rapid-setting concrete may be required. Accelerating admixtures shall conform to ASTM C494 and may be used in the concrete mix as permitted by RMWD. Calcium chloride shall not be used in concrete.

D. Where concrete is needed to resist microbial induced corrosion of sewer structures an antimicrobial agent, Con^{MIC} Shield®, or approved equal, shall be used to render the concrete uninhabitable for bacterial growth. The liquid antibacterial additive shall be an EPA registered material and the registration number shall be submitted for approval prior to use in the project. The amount to be used shall be as recommended by the manufacturer of the antibacterial additive. This amount shall be included in the total water content of the concrete mix design. The additive shall be added into the concrete mix water to insure even distribution of the additive throughout the concrete mixture. A letter of certification must be submitted stating that the correct amount and correct mixing procedure was followed of all antimicrobial concrete.

2.02 REINFORCING STEEL

A. Reinforcing steel shall conform to ASTM A615, Grade 60.

B. Fabricate reinforcing steel in accordance with the current edition of the Manual of Standard Practice, published by the Concrete Reinforcing Steel Institute.

2.03 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A185.

2.04 TIE WIRE

Tie wire shall be 16-gage minimum, black, soft annealed.

2.05 BAR SUPPORTS

Bar supports in beams and slabs exposed to view after removal of forms shall be galvanized or plastic coated. Use concrete supports for reinforcing in concrete placed on grade.

2.06 FORMS

A. Forms shall be accurately constructed of clean lumber. The surface of forms against which concrete is placed shall be smooth and free from irregularities, dents, sags or holes.

B. Metal form systems may be used upon approval from the District Representative. Include manufacturer's data for materials and installation with the request to use a metal form system.

2.07 MORTAR

Cement mortar shall consist of a mixture of Portland cement, sand and water. One (1) part cement and two (2) parts sand shall first be combined, and then thoroughly mixed with the required amount of water.

2.08 EPOXY BONDING AGENT

The epoxy bonding agent shall be an epoxy-resin-based product intended for bonding new mortar to hardened concrete and shall conform to ASTM C881. The bonding agent shall be selected from the Approved Materials List.

2.09 REPAIR MORTAR

Repair mortar shall be a two-component, cement-based product specifically designed for structurally repairing damaged concrete surfaces. The repair mortar shall exhibit the properties of high compressive and bond strengths and low shrinkage. A medium-slump repair mortar shall be used on horizontal surfaces, and a non-sag, low-slump repair mortar shall be used on vertical or overhead surfaces. Repair mortar shall be selected from the Approved Materials List.

2.10 NON-SHRINK GROUT

Non-shrink grout shall be a non-metallic cement-based product intended for filling general construction voids or grouting of base plates for equipment or structural members. The non-shrink grout shall exhibit the properties of high compressive and bond strengths and zero shrinkage, and shall be capable of mixing to a variable viscosity ranging from a dry pack to a fluid consistency as required for the application. The non-shrink grout shall be selected from the Approved Materials List.

2.11 EPOXY ADHESIVE

Epoxy adhesive shall be a high-modulus epoxy-resin-based product intended for structural grouting of anchor bolts and dowels to concrete. The epoxy adhesives shall conform to ASTM C881. A pourable, medium-viscosity epoxy shall be used on horizontal surfaces, and a heavy-bodied, non-sag epoxy gel shall be used on vertical surfaces. The epoxy adhesives shall be selected from the Approved Materials List.

2.12 PROTECTIVE EPOXY COATING

The protective epoxy coating shall be an epoxy-resin-based product exhibiting high bond strength to steel and concrete surfaces, and shall conform to ASTM C881. The protective epoxy coating shall be selected from the Approved Materials List.

2.13 DAMP-PROOFING FOR CONCRETE STRUCTURES

Damp-proofing material shall consist of two (2) coats of a single-component self-priming, heavy-duty cold-applied coal tar selected from the Approved Materials List.

PART 3 - EXECUTION

3.01 FORMWORK

A. The Contractor shall notify RMWD a minimum of one (1) working day in advance of intended placement of concrete to enable the RMWD to check the form lines, grades, and other required items before placement of concrete.

B. The form surfaces shall be cleaned and coated with VOL compliant form release oil prior to installation. The form surfaces shall leave uniform form marks conforming to the general lines of the structure.

C. The forms shall be braced to provide sufficient strength and rigidity to hold the concrete and to withstand the necessary fluid pressure and consolidation pressures without deflection from the prescribed lines.

D. Unless otherwise indicated on the plans, all exposed sharp concrete edges shall be 1/4-inch chamfered.

3.02 REINFORCEMENT

A. Place reinforcing steel in accordance with the current edition of Recommended Practice for Placing Reinforcing Bars, published by the Concrete Reinforcing Steel Institute.

B. All reinforcing steel shall be of the required sizes and shapes and placed where shown on the drawings or as directed by RMWD.

C. Do not straighten or re-bend reinforcing steel in a manner that will damage the material. Do not use bars with bends not shown on the drawings. All steel shall be cold bent – do not use heat.

D. All bars shall be free from rust, scale, oil, or any other coating that would reduce or destroy the bond between concrete and steel.

E. Position reinforcing steel in accordance with the Approved Plans and secure by using annealed wire ties or clips at intersections and support by concrete or metal supports, spacers, or metal hangers. Do not place metal clips or supports in contact with the forms. Bend tie wires away from the forms in order to provide the concrete coverage equal to that required of the bars. If required by RMWD, the Contractor shall install bars additional to those shown on the drawings for the purpose of securing reinforcement in position.

F. Place reinforcement a minimum of 2-inch clear of any metal pipe, fittings, or exposed surfaces.

G. The reinforcement shall be so secured in position that it will not be displaced during the placement of concrete.

H. All reinforcing steel, wire mesh, and tie wire shall be completely encased in concrete.

I. Reinforcing steel shall not be welded unless specifically required by the Approved Plans or otherwise directed by the District Representative.

J. Secure reinforcing dowels in place prior to placing concrete. Do not press dowels into the concrete after the concrete has been placed.

K. Minimum lap for all reinforcement shall be 40 bar diameters unless otherwise specified on the Approved Plans.

L. Place additional reinforcement around pipe penetrations or openings 6-inch diameter or larger. Replace cut bars with a minimum of 1/2 of the number of cut bars at each side of the opening, each face, each way, same size. Lap with the uncut bars a minimum of 40 bar diameters past the opening dimension. Place one (1) same size diagonal bar at the four (4) diagonals of the opening at 45° to the cut bars, each face. Extend each diagonal bar a minimum of 40 bar diameters past the opening dimension.

M. Wire mesh reinforcement is to be rolled flat before being placed in the form. Support and tie wire mesh to prevent movement during concrete placement.

N. Extend welded wire fabric to within 2-inch of the edges of slabs. Lap splices at least 1-1/2 courses of the fabric and a minimum of 6-inch. Tie laps and splices securely at ends and at least every 24-inch with 16-gage black annealed steel wire. Pull the fabric into position as the concrete is placed by means of hooks, and work concrete under the steel to ensure that it is at the proper distance above the bottom of the slab.

3.03 EMBEDDED ITEMS

All embedded items, including bolts, dowels and anchors, shall be held correctly in place in the forms before concrete is placed.

3.04 MORTAR MIXING

The quantity of water to be used in the preparation of mortar shall be only that required to produce a mixture sufficiently workable for the purpose intended. Mortar shall be used as soon as possible after mixing and shall show no visible sign of setting prior to use. Re-mixing of mortar by the addition of water after signs of setting are evident shall not be permitted.

3.05 MIXING AND PLACING CONCRETE

A. All concrete shall be placed in forms before taking its initial set.

B. No concrete shall be placed in water except with permission of the District Representative.

C. As the concrete is placed in forms, or in rough excavations (i.e., thrust or anchor blocks), it shall be thoroughly settled and compacted throughout the entire layer by internal vibration and tamping bars.

D. All existing concrete surfaces upon which or against which new concrete is to be placed shall be roughened, thoroughly cleaned, wetted, and grouted before the new concrete is deposited.

3.06 CONCRETE FINISHING

A. Immediately upon the removal of forms, voids shall be neatly filled with cement mortar, non-shrink grout, or epoxy bonding agent and repair mortar as required for the application and as directed by the District Representative.

B. The surfaces of concrete exposed to view shall be smooth and free from projections or depressions.

C. Exposed surfaces of concrete not placed against forms, such as horizontal or sloping surfaces, shall be Screeded to a uniform surface, steel-troweled to density the surface, and finished to a light broom finish.

3.07 PROTECTION AND CURING OF CONCRETE

The Contractor shall protect all concrete against damage. Exposed surfaces of new concrete shall be protected from the direct rays of the sun by covering them with plastic film wrap and by keeping them damp for at least 7 days after the concrete has been placed, or by using an approved curing process. Exposed surfaces shall be protected from frost by covering with tarps for at least 5 days after placing.

3.08 REPAIRS TO DAMAGED CONCRETE SURFACES

Minor surface damage to hardened cast-in-place or precast concrete may be repaired, at the discretion of RMWD, using the specified materials in accordance with the manufacturer's recommendations and the following procedures:

A. Cast-in-place or precast concrete for manholes and vaults: Remove loose or deteriorated concrete to expose a fractured aggregate surface with an edge cut to a ninety degree angle to the existing surface. Clean all debris from the area, apply a 20 mil coat of epoxy bonding agent to the prepared surface, and place repair mortar while the epoxy is still wet and tacky. On horizontal surfaces, for repair depths greater than 2-inch, add aggregate to the repair mortar as recommended by the manufacturer. On vertical or overhead surfaces, for repair depths greater than 2-inch, apply the repair mortar in successive lifts, scarifying the lifts, allowing them to harden, and applying a scrub coat of the material prior to proceeding with the next lift. Cure the material as for concrete in accordance with this specification.

B. General Purpose: Remove loose and deteriorated concrete by mechanical means, sandblasting or high-pressure water blasting. Clean all debris from the area and apply non-shrink grout in a 1/4-inch minimum thickness, at the desired consistency, ranging from a dry pack, to a fluid-poured into a formed area, according to the application. Cure the material as for concrete in accordance with this specification.

3.09 EPOXY ADHESIVES FOR ANCHOR BOLT INSTALLATION

Anchor bolts grouted in place with an epoxy adhesive shall be installed using the specified materials in accordance with the manufacturer's recommendations and the following general procedures: Drill the hole with a rotary percussion drill to produce a rough, unpolished hole surface. The hole shall be sized to the manufacturer's recommendations and shall be approximately 1/4-inch wider than the diameter of the bolt, with a depth equal to 10 to 15 times the bolt diameter. Remove debris and dust with a stiff bristle brush and clean using compressed air. Utilizing a medium-viscosity epoxy for horizontal surfaces, and a gel-type non-sag epoxy for vertical surfaces, apply the material to fill the hole to approximately half its depth. Insert the bolt, forcing it down until the required embedment depth and projection length are attained and then twist the bolt to establish a bond. Secure the bolt firmly in place in the permanent position until the epoxy sets.

3.10 PROTECTIVE EPOXY COATING

Following core drilling at existing concrete structures, clean the exposed concrete surface and ends of reinforcing steel and apply two (2) coats of protective epoxy coating for a total dry film thickness of 10-15 mils. Allow the material to cure between coats and prior to continuing the installation through the penetration.

3.11 DAMP-PROOFING THE EXTERIOR OF CONCRETE STRUCTURES

Following completion of the exterior surfaces of manholes and vaults, including necessary repairs and piping penetrations into the structure, apply the specified material to prepared concrete surfaces in accordance with the manufacturer's recommendations. The surfaces to be coated shall be fully cured and free of laitance and contamination. The material shall be applied to all exterior surfaces below a point 12-inch above the water table or indications of seepage or moisture as directed by RMWD. Apply two 15 mil coats, curing between coats, prior to backfill and/or immersion in accordance with the manufacturer's recommendations.

3.12 THRUST AND ANCHOR BLOCKS

Concrete thrust and anchor blocks shall be placed against wetted, undisturbed soil in accordance with the Standard Drawing. The concrete shall be placed so that fittings and valves will be accessible for repairs or replacement. Prior to filling the pipeline with water, the concrete for thrust and anchor blocks shall cure for the following number of days:

Thrust Blocks	3 days minimum
Anchor Blocks	7 days minimum

A. Pipe Thrust:

The following table lists the minimum bearing area (in square feet) for the noted fitting for each pipe size. The area shown is for each 100psi of test pressure, assuming a soil bearing pressure of 2,000psi. (For instance, if the test pressure is required to be 250psi, multiply the value in the table by 2.5.)

Pipe Size	Tees and Dead Ends	90° Bend	45° Bend	22½° Bend	11¼° Bend
6-inch	3.7	5.3	2.9	1.5	0.7
8-inch	6.4	9.1	4.9	2.5	1.3
10-inch	9.7	13.7	7.4	3.8	1.9
12-inch	13.7	19.4	10.5	5.3	2.7
14-inch	18.4	26.0	14.1	7.2	3.6
16-inch	23.8	33.6	18.2	9.3	4.7
18-inch	24.9	42.2	22.9	11.7	5.9
20-inch	36.6	51.8	28.0	14.3	7.2
24-inch	52.3	73.9	40.0	20.4	10.2
30-inch	80.4	113.7	61.6	31.4	15.8

B. Thrust Block Placement and Sizing:

Thrust blocks shall be located at all unrestrained pipe fittings and bear against firm, undisturbed soil. The thrust blocks shall be centered on the fitting so that the bearing area is exactly opposite the resultant direction of the thrust, refer to the

Standard Drawings. Care shall be taken to prevent the placed thrust block concrete from eliminating maintenance access to the valve operators. All thrust block excavation, location, shape, and size shall be verified by RMWD prior to pouring concrete. The size shall be as indicated in Paragraph A above.

C. Anchor Block Placement and Sizing:

For all vertical bends in pipelines (downward bends) that do not have restrained joints, the fittings shall be retained in place by means of an anchor block. The block shall be sized to withstand the thrust exerted for the particular deflection angle at the required test pressure plus 10%. (Do not rely on the restraining benefit from the soil). RMWD shall verify the size chosen and the reinforcing steel required.

3.13 VALVE SUPPORT BLOCKS

Valve support blocks shall be installed as described below and in accordance with the Standard Drawings:

A. Support blocks below valves shall be cut into the side of the trench a minimum of 12-inch.

B. Support blocks shall extend up to the height of adjoining pipe and shall have a minimum depth below the valve of 12-inch.

C. Support blocks shall be installed so that the valves will be accessible for repairs.

3.14 HOT WEATHER REQUIREMENTS

A. During hot weather, give proper attention to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation in accordance with ACI 305 and the following.

B. When the weather is such that the temperature of the concrete as placed would exceed 90 °F, use ice or other means of cooling the concrete during mixing and transportation so that the temperature of the concrete as placed will not exceed 90°F.

C. Take precautions when placing concrete during hot, dry weather to eliminate early setting of concrete. This includes protection of reinforcing from direct sunlight to prevent heating of reinforcing, placing concrete during cooler hours of the day, and the proper and timely application of specified curing methods.

D. There will be no additional reimbursement to the Contractor for costs incurred for placing concrete in hot weather.

3.15 COLD WEATHER REQUIREMENTS

A. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather in accordance with ACI 306 and the following.

B. When the temperature of the surrounding atmosphere is 40°F or is likely to fall below this temperature, use heated mixing water not to exceed 140°F. Do not allow the heated water to come in contact with the cement before the cement is added to the batch.

C. When placed in the forms during cold weather, maintain concrete temperature at not less than 55°F. All materials shall be free from ice, snow, and frozen lumps before entering the mixer.

D. Maintain the air and the forms in contact with the concrete at temperatures above 40°F for the first five days after placing, and above 35°F for the remainder of the curing period. Provide thermometers to indicate the ambient temperature and the temperature 2 inches inside the concrete surface.

E. There will be no additional reimbursement made to the Contractor for costs incurred for placing concrete during cold weather.

-END OF SECTION-

SECTION 03315

GROUT

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall furnish all materials for grout in accordance with the provisions of this Section and shall form, mix, place, cure, repair, finish, and do all other Work as required to produce finished grout, in accordance with the requirements of the Contract Documents. The Contract Documents shall take precedence over these specifications.

B. The following type of grout shall be covered in this Section:

1. Non-Shrink Grout: This type of grout is to be used wherever grout is shown in the Contract Documents, unless another type is specifically referenced.

2. Cement Grout

3. Epoxy Grout

1.02 RELATED WORK SPECIFIED ELSEWHERE

RMWD	Standards Manual
Section 01300	Record Drawings and Submittals
Section 03300	Cast In Place Concrete

1.03 REFERENCE STANDARDS

A. Commercial Standards:

CRD-C 621 Corps of Engineers Specification for Non-Shrink Grout
ASTM C 109 Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or 50-mm Cube Specimens)
ASTM C 531 Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical- Resistant Mortars, Grouts, and Monolithic Surfaces
ASTM C 579 Test Methods for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfaces
ASTM C 827 Test Method for Early Volume Change of Cementitious Mixtures
ASTM D 696 Test Method for Coefficient of Linear Thermal Expansion of Plastics.

1.04 CONTRACTOR SUBMITTALS

A. The Contractor shall submit certified test results verifying the compressive strength, shrinkage, and expansion requirements specified herein; and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of non-shrink and epoxy grout used in the Work.

1.05 QUALITY ASSURANCE

A. Field Tests:

1. Compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the Engineer to insure continued compliance with these specifications.

2. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C 109 at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at 7 days, 28 days, and each additional time period as appropriate.

3. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C 579, Method B, at intervals during construction as selected by the Engineer. A set of three specimens will be made for testing at 7 days, and each earlier time period as appropriate.

4. All grout, already placed, which fails to meet the requirements of these specifications, is subject to removal and replacement at the cost of the Contractor.

5. The cost of all laboratory tests on grout will be borne by the Owner, but the Contractor shall assist the Owner in obtaining specimens for testing. However, the Contractor shall be charged for the cost of any additional tests and investigation on Work performed which does not meet the specifications. The Contractor shall supply all materials necessary for fabricating the test specimens.

B. Construction Tolerances: Construction tolerances shall be as specified in the Section 03300 – Cast-in-Place Concrete, except as modified herein and elsewhere in the Contract Documents.

PART 2 - PRODUCTS

2.01 CEMENT GROUT

A. Cement Grout: Cement grout shall be composed of one part cement, three parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 days shall be 4000 psi.

B. Cement grout materials shall be as specified in Section 03300 – Cast-in-Place Concrete.

2.02 PREPACKAGED GROUTS

A. Non-Shrink Grout

1. Non-shrink grout shall be prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Manufacturer’s instructions

shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout specified application.

2. Class A non-shrink grouts shall have a minimum 28-day compressive strength of 5000 psi; shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C-827; and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRD C 621.

3. Class B non-shrink grouts shall have a minimum 28-day compressive strength of 5000 psi and shall meet the requirements of CRD C 621.

4. Application:

    a. Class A non-shrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under all equipment base plates, and at locations where grout is specified in the contract documents; except, for those applications for Class B non-shrink grout and epoxy grout specified herein. Class A non-shrink grout may be used in place of Class B non-shrink grout for all applications.

    b. Class B non-shrink grout shall be used for the repair of all holes and defects in concrete members which are not water-bearing and not in contact with soil or other fill material and grouting under all base plates for structural steel members.

B. Epoxy Grout:

1. Epoxy grout shall be a pourable, non-shrink, 100 percent solids system. The epoxy grout system shall have three components: resin, hardener, and especially 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. Manufacturer's instructions shall be printed on each container in which the materials are packaged. Epoxy grout shall be BurkEpoxy Anchoring Grout by the Burke Company or approved equal.

2. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application.

3. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75 degrees F.

4. The epoxy grout shall develop a compressive strength of 5000 psi in 24 hours and 10,000 psi in seven days when tested in accordance with ASTM C 579, Method B. There shall be no shrinkage (0.0 percent) and a maximum 4.0 percent expansion when tested in accordance with ASTM C 827.

5. Application: Epoxy grout shall be used to embed all anchor bolts and reinforcing steel required to be set in grout, and for all other applications required in the Contract Documents.

2.03 CURING MATERIALS

A. Curing materials shall be as specified in Section 03300 – Cast-in-Place Concrete for cement grout and as recommended by the manufacturer of prepackaged grouts.

2.04 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where “dry pack” is called for in the Contract Documents, if shall mean a grout of that consistency; the type of grout to be used shall be as specified herein for the particular application.

B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

2.05 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 - EXECUTION

3.01 GENERAL

A. All surface preparation, curing, and protection of cement grout shall be as specified in Section 03300 – Cast-in-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete.

B. The manufacturer of Class A non-shrink grout and epoxy shall provide on-site technical assistance upon request.

C. Base concrete must have attained its design strength before grout is placed, unless authorized by the Engineer.

3.02 GROUTING PROCEDURES

A. Prepackaged Grouts: All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

B. Base Plate Grouting:

1. For base plates, the original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a one-inch thickness of grout or a thickness as shown on the Drawings.

2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and original pour of concrete shall be filled with non-shrink-type grout. The mixture shall be a trowelable consistency and tamped or rodded solidly into the space between the plate and the base concrete. A backing board or stop shall be provided at the back side of the space to be filled with grout. Where this method of placement is not practical or where required by the Engineer, alternate grouting methods shall be submitted for acceptance by the Engineer.

3.03 CONSOLIDATION

A. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

-END OF SECTION-

SECTION 03370

CONCRETE CURING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This Section includes furnishing and installing concrete curing as required.

B. The following are the only methods acceptable:

1. Water Spray
2. Wet Burlap Mat
3. Curing Blanket
4. Curing Compound

1.02 REFERENCES

A. The publications and standards referenced herein form a part of the Specifications.

B. Where a date is given for referenced standards, that edition shall be used. Where no date is given for referenced standards, the latest edition shall be used.

1.03 SUBMITTALS

A. Submittals shall be made in accordance with Specifications Section 01300, Submittals, and the following special provisions provided herein.

B. In addition, the following specific information shall be provided:

1. Method: The Contractor shall propose specific method(s) of curing intended to be used to comply with these Specifications for approval by RMWD.

2. Product Data: The Contractor shall furnish manufacturer's data and recommendations for specific use of each product proposed.

3. Test Reports and Certifications: The Contractor shall submit a manufacturer's certification verifying conformance to these Specifications and that all products in contact with potable water are NSF approved.

4. Quality Control Submittals: The Contractor shall furnish the following:

a. Commercial Products: Manufacturer's Certification of Compliance and includes test data showing compliance with the requirements of these Specifications.

PART 2 - PRODUCTS

2.01 CURING COMPOUND

A. The Contractor shall not use curing compound where additional finishes such as hardeners, paintings, and other special coatings are required.

B. Curing compound shall conform to current local, state, and federal air quality requirements.

C. The Contractor shall provide manufacturer's certification that curing compound is acceptable to the appropriate state and federal state agency of health department for use on structures to contain potable water. Curing compound shall be NSF/ANSI, USDA, FDA, or EPA approved for use on potable water applications.

D. Curing compound may be made from any combination of materials and by any process that will yield a product which can be used with safety under properly controlled conditions of use and which conforms to the requirements of these Specifications, provided that curing compound to be used on exposed surfaces shall be of an approved non-staining type.

E. The curing compound shall be a clear membrane-forming type with a fugitive dye, conforming to the requirements of ASTM C309, Type 1-D, Class B, all resin base.

F. When approved by the District Representative and prior to use, white pigmented curing compound shall conform to the requirements of ASTM C309, Type 2, Class B, wax-resin base or all-resin base.

G. Loss of water, when tested as specified in ASTM C309, shall not exceed 0.45 kilogram per square meter in 72 hours.

2.02 SHEET MATERIALS

A. Sheet materials for curing concrete using the curing blanket method shall conform to the requirements of ASTM C171 and these Specifications.

B. Polyethylene film shall be a minimum thickness of 4 mils.

PART 3 – EXECUTION

3.01 GENERAL

A. Curing:

1. All surfaces of concrete in structures, and the top surface of slabs on grade shall be kept wet 14 days using the wet-burlap-mat method or the water-spray method. The Contractor may have the additional option of using the curing-compound method, provided that where said surfaces are permanently exposed, curing compound shall be used only when approved by the District Representative, and when so approved, said curing compound shall be of a type that will not discolor the surface. The

Contractor may use the curing-blanket method for curing of the tops of slabs when approved by the District Representative.

2. Where wooden forms are used, they shall be wetted immediately before placing concrete and shall be kept moist until removed.

B. The entire surface to be cured shall be kept continuously and completely wet during the entire specified curing period whenever any water-curing method is used.

C. The operation of any wetting system or application of curing compound as herein specified shall not be permitted to interfere with the prompt rubbing or grinding down or other treatment or repair of surface irregularities immediately upon removal of forms, nor shall the operation of any wetting system or the application of the curing compound be delayed awaiting repairs to concrete surfaces and, if so required by the District Representative the curing operations shall be started immediately after the removal of forms, and any necessary repair work shall be done thereafter.

D. Unless otherwise approved by the District, all construction joints to which subsequently placed concrete is to adhere shall be water-cured until they are covered with concrete. If, after the specified curing period, further concrete placing against these joints is to be delayed for an extended period of time, the joints shall be wetted continuously for a minimum period of 24 hours immediately preceding the placement of adjoining concrete. Curing compound shall not be applied to the surfaces of such construction joints and, where curing compound has been applied to these surfaces, it shall be entirely removed by wet sandblasting just prior to the placing of the new concrete. Wherever formed surfaces will receive bond preventing material, the concrete surfaces shall have been water-cured until such bond preventing material has been applied.

3.02 METHODS

A. Water-Spray Method: Surfaces to be cured by the water-spray method shall be tightly closed off by bulkheads, or other means, or entirely surrounded by tight enclosures, and the surfaces shall be kept moist by an adequate sprinkling or spray system, or other suitable means, for 14 days immediately following the removal of forms or following the surface finishing in the case of unformed surfaces.

B. Wet-Burlap-Mat Method: Surfaces to be cured by the wet-burlap-mat method shall be thoroughly wetted and covered with wet burlap mats as soon as the forms have been stripped or as soon as the concrete has set sufficiently to avoid marring the surface. Thereafter, the burlap and the concrete surface shall be kept wet for 14 days.

C. Curing-Blanket Method:

1. Surfaces to be cured by the curing-blanket method shall be thoroughly wetted and then covered with curing blankets as soon as the concrete has set sufficiently to avoid marring the surface. The curing blankets shall remain in place for 14 days. Should the curing blankets become torn or otherwise ineffective, the Contractor shall replace damaged sections.

2. Waterproof paper shall be laid with the edges butted together and with the joints between strips sealed with 2 inch wide strips of sealing tape or with the edges lapped not less than 3 inches and fastened together with waterproof cement to form continuous watertight joints.

3. Polyethylene sheets shall be laid with edges butted together and the joints sealed with 1-inch wide strips of acetate tape.

4. White burlap-polyethylene sheeting shall be laid with the wetted burlap in contact with the concrete. The polyethylene layer shall be sealed at the joints in accordance with this Section.

5. During the curing period, no traffic of any nature or depositing of objects, temporary or otherwise, shall be permitted on the curing blankets.

D. Curing Compound Method:

1. All surfaces to be cured by the curing-compound method shall be sprayed thoroughly, completely, and uniformly with two coats of curing compound at the rate for each coat of not less than 1 gallon to each 250 square feet of surface. All curing compound shall be furnished by the Contractor and shall be in accordance with the requirements specified herein. The curing compound shall be sprayed on the concrete surfaces using approved equipment having separate lines to the nozzles for material and for compressed air.

2. When used on an unformed concrete surface, application of the first coat of curing compound shall be commenced immediately after finishing operations have been completed. When curing compound is used on a formed concrete surface, the surface shall first be moistened with a fine spray of water immediately after the forms have been removed and continued until the surface does not readily absorb further water. As soon as the surface film of water has disappeared and there is an approach to surface dryness, the first coat of curing compound shall be applied. In the event that application of curing compound is delayed on either formed or unformed surfaces, the surface shall be kept continuously moist until the compound has been applied or the specified period of water curing has elapsed. As soon as the first coat has become dry, a second coat shall be applied in the same manner and of the same quality as the first. Direction of application of second coat shall be perpendicular to the first coat.

3. Precaution shall be taken by the Contractor to avoid damage to coatings of curing compound for a period of not less than 28 days. Any such damage shall be repaired immediately to the satisfaction of RMWD.

4. Curing compound shall not be diluted by the addition of solvents or thinners nor shall it be altered in any manner. Curing compound that has become chilled to such an extent that it is too viscous for satisfactory application shall be heated until it has proper fluidity, provided that in no case shall the compound be heated to a temperature higher than 100°F. Heating shall be accomplished by steam, or by placing the container in a hot-water bath, or by other approved methods. Curing compounds shall not be heated by direct exposure of the container to fire.

3.03 CURING AND PROTECTION IN COLD WEATHER

The Contractor shall conform to the cold weather concreting procedures specified in Specifications Section 03300, Cast-in-Place Concrete.

3.04 CURING AND PROTECTION IN HOT WEATHER

The Contractor shall conform to the hot weather concreting procedures specified in Specifications Section 03300, Cast-in-Place Concrete.

3.05 PROTECTION OF CURED CONCRETE

Concrete shall be protected from damage as specified in Specifications Section 03300, Cast-in-Place Concrete.

3.06 CONCRETE FINISHES

A. For pump room floor finish concrete surfaces with a steel trowel finish without local depressions or high points and apply a light hair-broom finish. Do not use stiff bristle brooms or brushes. Leave hair-broom lines parallel to the direction of slab drainage.

-END OF SECTION-

SECTION 04220

REINFORCED CONCRETE BLOCK MASONRY

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The Contractor shall provide concrete masonry and appurtenant work, complete, in accordance with the contract documents.
B. Work included in this section includes:

1. Concrete block masonry.
2. Installing reinforcing steel in masonry.
3. Grout and mortar for masonry.
4. Shoring, bracing, and scaffolding incidental to work of this section.
5. Setting and incorporating into masonry all bolts, anchors, inserts, and ledgers.
6. Building in of frames, vents, pipes, conduits, and inserts.
7. Continuous inspections, test specimens and samples of material, as specified.
8. Pointing, cleaning, and protection.
9. Submittals.

1.02 RELATED SECTIONS

A. The work of the following sections apply to the work of this section. Other sections, not referenced below, shall also apply to the extent required for proper performance of this work.

1. Section 3200 – Reinforcing Steel
2. Section 03300 – Cast-In-Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. California Building Code (CBC), Latest Edition
B. International Building Code (IBC), Latest Edition
C. Commercial Standards, Latest Edition

1. ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures

2. ACI 530 Building Code Requirements for Concrete Masonry Structures.

1.04 SUBMITTALS

A. Samples of concrete masonry unit colors with texture ranges as indicated shall be submitted to the Construction Manager for selection of the color in accordance with the requirements of Specification Section 01300.

1.05 QUALITY ASSURANCE

A. Applicable Standards: concrete masonry shall conform to the CBC and other applicable codes and standards of governing authorities.
B. Concrete block masonry units shall be sampled and tested in accordance with ASTM C-140.
C. Testing of Mortar and Grout: The Contractor shall have the mortar and grout tested by a recognized testing laboratory approved by the Construction Manager to ensure compliance with the specifications and the governing codes. Test reports shall be submitted to the Construction Manager in accordance with Specification Section 01300.
D. Tests shall be taken at the following times:

    1. At the start of masonry work, at least two test samples each of mortar and grout shall be taken on three successive working days.
    2. At any change in materials or job conditions, at least two samples of each modified material, grout, and mortar shall be tested.
    3. Four random tests each of mortar and grout shall be made. The random test samples shall be taken when requested by the Construction Manager.
    4. Additional samples and tests may be required whenever, in the judgement of the Construction Manager, additional tests (beyond the random tests) are necessary to determine the quality.

E. The costs of test and test reports shall be by the Contractor at no additional cost to the Owner. The costs of the additional tests and reports, when such reports verify compliance with the contract documents, will be paid by the Owner. When tests or reports do not verify compliance, the cost of all additional tests and reports shall be paid by the Contractor at no additional cost to the Owner.
F. Test samples shall be stored in a moist environment until tested, unless directed otherwise by the Construction Manager or the testing laboratory. Tests shall be in accordance with the IBC Standard for mortar. The grout and mortar strengths shall be not less than the minimum strengths indicated herein.
G. Inspection by a certified Special Inspector employed by the Owner and approved by the Building Official, with the costs borne by the Owner, will be required where necessary to conform with code requirements. The Special Inspector shall demonstrate competence for the operation requiring special inspection to the Building Official and structural engineer per the CBC. The Contractor shall notify the Construction Manager at least 24 hours in advance of the needed inspection. The Contractor shall provide copies of inspection reports to the Construction Manager and Building Official.
H. Weather Conditions: Concrete masonry units shall not be placed when air temperature is below 40 degrees F and shall be protected against direct exposure to the wind and sun when erected when the ambient air temperature exceeds 99 degrees F in the shade with relative humidity less than 50 percent.
I. Product Storage: Cement, lime, and other cementitious materials shall be delivered to the site and stored in dry, weather-tight sheds or enclosures, in unbroken bags, barrels, or other approved containers, plainly marked and labeled with the manufacturers' names and brands. Mortar and grout shall be stored and handled in a manner which will prevent the inclusion of foreign materials and damage by water or dampness. Masonry units shall be handled with care to avoid chipping and breakage and shall be stored as directed in the Masonry Design Manual. Materials stored on newly constructed floors shall be stacked in such a manner that the uniformly-distributed loading does not exceed 30

pounds per square foot. Masonry materials shall be protected from contact with the earth and exposure to the weather and shall be kept dry and clean until used.

SECTION 2: PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Concrete masonry units shall conform to ASTM C-90, Grade N, Type I, hollow load bearing units with maximum linear shrinkage of 0.6 percent from standard to oven-dried condition. Units shall be medium weight units with a net area compressive strength of 2,800 psi, unless directed otherwise.
B. Unless otherwise noted on the drawings, concrete masonry units shall be 8 inch by 8 inch by 16 inch modular size and with faces as shown on the drawings. The color of the concrete masonry units shall be chosen by the Owner from the manufacturer's standard color chart.
C. All bond beam, corner, lintel, sill, and other specialty shaped blocks shall be provided and used where required or necessary. Specially shaped non-structural blocks may be constructed by saw cutting. The color and texture of specially shaped blocks shall match that of adjacent units.

2.02 MORTAR

A. Mortar for concrete block masonry shall be Type S per Table 2 of TMS 602 (latest edition), with a minimum 28 day compressive strength of 1,800 psi. Proportions shall be one part Portland cement, ¼ to ½ part lime paste or hydrated lime and damp, loose sand in an amount (by volume) of not less than 2 ¼ or more than three times the sum of the volumes of cement and lime used, and with the precise amount of water required to produce the required workability and strength.
B. Mortar color shall match block color.

2.03 GROUT

A. Grout shall conform to ASTM C476 and contain a mixture of cement, sand, pea gravel and water, which will completely fill all voids in the wall. Grout shall have a minimum compressive strength of 2,500 PSI at 28 days. Where the grout space is less than 4 inches, pea gravel shall be omitted.
B. Admixtures may only be used when approved by the Construction Manager. When it has been approved for use, it shall be used in accordance with the manufacturer's published recommendations for the grout.

2.04 MATERIALS FOR MORTAR AND GROUT

A. Portland cement shall be Type II, low alkali, conforming to ASTM C-150.
B. Lime paste shall be made with pulverized quicklime or with hydrated lime, which shall be allowed to soak not less than 72 hours before use; except, that hydrated lime processed by the steam method shall be allowed to soak not less than 24 hours and shall be made by adding the lime to the water. In lieu of hydrated lime for paste for use in mortar the hydrated lime may be added in the dry form. Hydrated lime shall be Type S, conforming to ASTM C-207. Pulverized quicklime shall conform to ANSI/ASTM C5, shall pass a NO. 20 sieve, and 90 percent shall pass a NO. 50 sieve.

C. Sand shall conform to ASTM C-144. Coarse aggregate shall conform to ASTM C-404.
D. Water for mixing shall be clear potable water.
E. Reinforcing steel shall be deformed bars conforming to ASTM A-614, Grade 60.
F. Admixture for mortar shall be BASF PS_235 or Rheomix-235; Sika Co., "Sika Red Label" or equal. The admixture shall not be determined detrimental to the bonding or help the process of efflorescence.
G. Admixture for grout shall be Sika Co., "Sika Grout Aid", Type II; BASF "Pozzolith" normal or equal.

SECTION 3: EXECUTION

3.01 GENERAL

A. Measurements for mortar and grout shall be accurately made. Shove measurements are not acceptable. Mortar proportions shall be accurately controlled and maintained.

3.02 CONSTRUCTION – GENERAL

A. All work shall be performed in accordance with the provisions of the applicable code for reinforced concrete hollow-unit masonry.
B. Set or embed all anchors, bolts, reglets, sleeves, conduits, or other items in work as required.
C. All block cutting shall be by machine.
D. Masonry units shall be supported off ground and shall be covered to protect them from rain. Only clean, dry, uncracked units shall be incorporated into the work.
E. All reinforcing steel shall be cleaned of all loose rust and scale and all oil, direct, paint laitance or other substances which may be detrimental to or reduce bonding of the steel and concrete.
F. Immediately before starting work, the concrete upon which the masonry will be laid shall be cleaned with water under pressure.
G. Full mortar joint for first course shall be provided.
H. Units shall be shoved tightly against adjacent units to assure good mortar bond.
I. The Contractor shall provide safe and adequate scaffolding, planking, ladders, and/or ramps conforming to all applicable CAL/OSHA State of California Construction Safety Orders.

3.03 MASON'S IRON WORK

A. The Contractor shall furnish, set and build into the masonry, all iron work necessary for the masonry construction and which is enclosed in the masonry.
B. The Contractor shall set and build into the masonry all items which are furnished and located by other trades, or indicated on the drawings, such as bolts, sleeves for securing the work of other trades, metal attachments, sleeves, inserts and similar items. Setting shall consist of the bedding or setting in mortar or dry pack all items to be set hereunder.
C. The Contractor shall build into the masonry all items furnished, located, and set by others, such as door frames, vents, conduits, pipes, and the like. Building into masonry shall consist of filling-in with mortar or grout around all items to be built into masonry including hollow metal door frames. The Contractor shall set and build-in all such items so that there will be no voids anywhere and so that the items are installed rigid, solid and held accurately and securely in place.

D. The Contractor shall bear full responsibility for the accurate placement of all mason's iron work. The Contractor shall fully an solidly grout anchors in place. Unless otherwise noted, the Contractor shall provide embedment of not less than 2/3 of the wall thickness.

3.04 EQUIPMENT

A. All equipment for mixing and transporting the mortar shall be clean and free from set mortar, dirt, and other foreign matter.

3.05 MIXING

A. Mortar shall be mixed by placing ½ of the water and sand in the operating mixer, following which the cement, lime, and remainder of the sand and water shall be added. After all ingredients are in the mixer, they shall be mechanically mixed for not less than 5 minutes. Retempering shall be done on the mortar board by adding water within a basin formed within the mortar, and the mortar reworked into the water. Mortar which is not used within one hour shall be discarded.

3.06 ERECTION OF CONCRETE BLOCK MASONRY

A. Masonry work shall be erected in-plane, plumb, level, straight, and true to dimensions shown and executed in accordance with acceptable practices of the trade.
B. Unless indicated otherwise, masonry shall be laid up in straight uniform courses with running bond.
C. All masonry shall be erected to preserve the unobstructed vertical continuity of the cells measuring not less than 3 inch by 3 inch in cross section. Walls and cross webs shall be full bedded in mortar. All head (or end) joints shall be solidly filed with mortar for a distance in from the face of the wall or not less than the thickness of the longitudinal face shells.

3.07 SHORING AND BRACING

A. All shoring and bracing shall be provided as required for work. Shoring and bracing shall be constructed to required shapes and sizes, capable of supporting and sustaining the loads to which they will be subjected without failure or deflection. Shores and bracing shall be left in place until concrete masonry can safely carry all required live and dead loads.

3.08 JOINTS

A. Vertical and horizontal joints shall be uniform and approximately 3/8 inch wide. Exterior joints and interior exposed block joints shall be concave-tooled to a dense surface. Special care shall be used in tooling joints so as to match existing construction, where applicable. Interior or exterior non-exposed masonry and masonry behind plaster shall have flush joints.

3.09 CLEANOUTS

A. Cleanout opening shall be provided at the bottoms of all cells to be filled at each lift or pour of grout, where such lift or pour is over 4 ft. in height. Any overhanging mortar or other obstructions or debris shall be removed from the insides of such cell walls. The

cleanouts shall be sealed before grouting and after inspection. Cleanout opening shall match the finished wall in exposed masonry.

3.10 REINFORCEMENT

A. Deep cut bond beam blocks shall be used where horizontal reinforcing steel is embedded. H-block beams may be used at locations other than openings.
B. Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding 192 diameters of the reinforcement.

3.11 GROUTING

A. All cells shall be filled solidly with grout. Grouting shall not be started until the wall has cured for a minimum of 24 hours. Maximum grout pour height shall be 12 ft. poured in maximum 5-foot lifts.
B. All grout shall be consolidated at time of pouring by puddling or vibrating. Where the grouting operation has been stopped for one hour or longer, horizontal construction joints shall be formed by stopping the grout pour 1 ½ inches below the top of the uppermost unit.

3.12 PROTECTION

A. Wall surfaces shall be protected from droppings or mortar or grout during construction.

3.13 FINISHING AND CLEANING

A. Masonry shall not be wet-finished unless exposed to extreme hot weather or hot wind and then only by using a nozzle-regulated fog spray sufficient only to dampen the face but not of such quantity to cause water to flow down over the masonry.
B. Finish masonry shall be cleaned and pointed in a manner satisfactory to the Construction Manager.
C. All exposed to view interior and exterior colored masonry work shall be cleaned by light sandblasting to remove all stains and other imperfections.
D. All exposed masonry surfaces of openings and windows and door openings such as sills, heads, and jambs shall be finish block surfaces, not formed surfaces, unless otherwise indicated. Closed bottom bond beam blocks shall be used at heads and sills. Pour holes may be used at the sill under window frame and where approved by the Construction Manager.

-END OF SECTION-

SECTION 05500

MISCELLANEOUS METALS

PART 1 GENERAL

1.01 DESCRIPTION

This section includes furnishing and installing miscellaneous metal work as shown on the Standard Drawings and specified in this Section.

1.02 REFERENCE STANDARD

The publications listed below form part of this specification to the extent referenced and are referred in the text by the basic designation only. Reference shall be made to the latest edition of said standards unless otherwise called for.

AWS D1.1 / D10.4	Welding Procedure Specifications / Recommended Practices for Welding
ASTM A36 / A108	Specification for ESE(T) Structural Steel, Steel Bar, Carbon & Alloy Cold-Finished
ASTM A283	Specification for Carbon Steel Subjected to Sulphidation Process
ASTM A380	Standard Practice for Cleaning, Descaling & Passivation of Stainless Steel
ASTM A276	Specification for Stainless Steel Bars & Shapes
ASTM A479	Specification for Stainless Steel Bars & Shapes for use in Boilers/Other Press. Vessels
ASTM A312	Specification for Seamless, Welded & Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A554	Specification for Welded Stainless Steel Mechanical Tubing
ASTM A564	Specification for Hot-Rolled & Cold Finished Age-Hardening Stainless Steel Bars/Shapes
ASTM E2016	Specification for Industrial Woven Wire Cloth
ASTM B209	Specification for Aluminum & Aluminum-Alloy Sheet & Plate
ANSI B1.1	Unified Screw and Pipe Threads
ASTM A307	Specification for Carbon Steel Bolts, Studs, & Threaded Rod Tensile Strength
ASTM A563	Specification for Carbon & Alloy Steel Nuts
ASTM F436	Specification for Hardened Steel Washers
ASTM A193 / A194	Specification for Alloy-Steel and Stainless Steel Bolting for High Temps/Pressure
ASTM F593 / F594	Specification for Stainless Steel Bolts, Hex Cap Screws & Studs
AWS A5.1/A5.17	Specification for Carbon Steel Electrodes & Fluxes for Submerged Arc Welding
AWS A5.4/ A5.9/ A5.10	Specification for Stainless Steel Electrodes for Shielded Metal Arc Welding
ASTM A143	Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel
ASTM A384	Standard Practice for Safeguarding Against Warpage & Distortion During Hot-Dip Galv. of Steel Assem.
AWS D10.12	Mild Steel Pipe
AWS B2.1	SWPS-N for Gas Tungsten Arc Welding Austenitic Stainless Steel
ASTM A123 / A153	Specification for Zinc Coatings on Iron & Steel Products

1.03 SUBMITTALS

A. Submittals shall be made in accordance with Specification Section 01300, Contractor Submittals, and the following special provisions provided herein.

B. Shop Drawings. Before beginning fabrication of miscellaneous metal articles, the Contractor shall submit complete shop and erection drawings showing details of methods, materials, and finishes proposed for use. Shop drawings shall give complete information necessary for the fabrication of the component parts of the articles, including the location, type, and size bolts and welds. They shall clearly distinguish between shop and field bolts and welds.

C. Test Reports and Certification documents shall be submitted as follows:

1. Welding Procedure Specifications (WPS), per AWS D1.1, for welding procedures proposed for use in making production welds.

2. Welding Procedure Qualification Record (PQR) to support welding procedures proposed for production welds not otherwise prequalified.

3. Welding Performance Qualification for welders and welding operators to be employed on the Work.

4. Certified mill test reports for chemistry and mechanical properties.

5. Manufacturer's certification verifying conformance to these Specifications and that all products in contact with potable water are NSF-approved.

1.04 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall take reasonable care in the proper handling and storage of articles or materials during erection operations to avoid accumulation of dirt and foreign matter. The Contractor shall remove from the articles or materials, dust, dirt, or other foreign matter that accumulates during construction. Coated surfaces shall be protected from abrasion or other damage during handling, storing, and erecting.

B. Materials taken from stock by the Contractor shall be of a quality at least equal to that required by the ASTM specifications applicable to the classification covering the intended use and shall be supported by test reports prepared at the mill where the material was manufactured or at a testing laboratory approved by the RMWD.

PART 2 MATERIALS

2.01 STEEL

A. Carbon Steel

1. Structural shapes shall be in accordance with ASTM A36.

2. Bars and shapes shall be in accordance with ASTM A36 or ASTM A108 Grade 1018.

3. Plate 2 inches and less in thickness shall be in accordance with ASTM A36 or ASTM A283 Grade C or Grade D.

B. Stainless Steel

1. All welded stainless steel materials shall be pickled and passivated after fabrication in accordance with the requirements of ASTM A380. The Contractor shall use Avesta, or equal, pickling and passivating solution, for fieldwork.

2. Unless otherwise shown on the Drawings, materials in contact with water, intermittently or continuously, or in a wet or moist environment shall be stainless steel, Type 316 or 316L, where welding is required.

3. Stainless steel bars and shapes shall be in accordance with ASTM A276 Type 316 or Type 316L where welding is required, unless otherwise specified or shown on the Drawings.

4. Stainless steel plate, sheet, and strip, Type 316 or Type 316L where welding is required, unless otherwise specified or shown on the Drawings.

5. Rolled stainless steel shapes shall be in accordance with the requirements of ASTM A479, Type 316, or 316L where welding is required, heat treatment waived, unless otherwise specified or shown.

6. Stainless steel pipe shall be in accordance with ASTM A312 Type 316L.

7. Stainless steel tubing shall be in accordance with ASTM A554 Type MT316L.

8. Where shown on the Drawings, age-hardened stainless steel shall be in accordance with ASTM A564 Type 630, cold finished. Heat-treatment or age hardening shall be conducted at 900°F.

9. Stainless steel wire cloth shall conform to the requirements of ASTM E2016, Type 316.

C. Aluminum plate and sheet shall be in accordance with ASTM B209, Alloy No. 5052 H32.

D. Fasteners

1. Threads for bolts and nuts shall be in accordance with ANSI B 1.1.

   a. Threads for bolts 1-inch and less in diameter shall be coarse-thread series and threads for bolts 1 1/8-inch and greater in diameter shall be the 8-pitch thread series.

   b. The fit shall be Class 2 free fit; except that Class 3 medium fit shall be provided in holes tapped for studs.

2. Unless otherwise shown on the Drawings, bolts shall have heavy hexagon heads and heavy hexagon nuts.

3. The lengths of studs and bolts, excluding anchor bolts, shall provide a projection of not less than 1/4-inch nor more than 1/2-inch through the nut when it is drawn tight; however, in exposed locations the projection shall be not more than 1/4-inch.

4. Carbon Steel Nuts and Bolts

   a. Carbon steel bolts, anchor bolts, and U-bolts, not in contact with water shall be in accordance with ASTM A307, Grade A.

   b. Carbon steel nuts not in contact with water shall be in accordance with ASTM A563.

   c. Steel washers shall be in accordance with ASTM F436.

d. Carbon steel bolts greater than 1-inch in diameter shall be the 8-pitch thread series and shall be ferritic steel in accordance with ASTM A193, Grade B7. Accompanying nuts shall be in accordance with ASTM A194, Grade 2H.

5. Stainless Steel Fasteners

a. Except as otherwise specified or shown on the Drawings, stainless steel fasteners shall be used where the material will be immersed in water, intermittently or continuously, or in moist-environment installations.

b. Type 316 or 316N stainless steel fasteners shall be in accordance with ASTM A193 Grade B8MA or Grade B8MNA for bolting and stud material, and ASTM A194 Grade 8MA or Grade 8MNA for nuts. Fasteners for age-hardened stainless steel shall be manufactured in accordance with ASTM F593 and F594 Type 630.

c. Stainless steel washers shall conform to ASTM F436 except that they shall be punched from steel conforming to ASTM 167 Type 316 or machined from bar stock conforming to ASTM A276 Type 316.

d. Stainless steel studs, bolts, nuts, and washers shall be stamped indicating the type of stainless steel.

E. Welding Rods

1. Welding rods for welding carbon steel shall be E70XX low-hydrogen, in accordance with AWS A5.1 or A5.17 for welding carbon steel.

2. Electrodes for welding stainless steel shall be Type E316L in accordance with AWS A5.4 or AWS A5.9

3. Electrodes for welding stainless steel to carbon steel shall be Classification Number E309L or E312 in accordance with AWS A5.4 or A5.9.

4. Electrodes for welding aluminum shall be filler alloy 5356 in accordance with AWS A5.10.

F. Concrete anchors shall be in accordance with Specification Section 03300, Concrete Anchors.

G. Anti-Galling Compound

1. The anti-galling compound to be used on threads of stainless steel fastener assemblies shall be a compound certified by ANSI/NSF or EPA, for use in potable water systems.

2. Acceptable Products:

a. Ramco TRX-Synlube, Ramco Anti-Seize

b. Husk-It, Husky Lube-O-Seal

c. TRIPAC 2000

d. OAE

I. Security Fence

1. Security fence shall be galvanized steel with powder-coated black finish with curved style finish. Panels shall not exceed 8x6 ft. System shall include, posts, post caps, and connector brackets. Fence Post shall be 2.5".

2. Provide two-rail curved top panels.

3. Manufacture shall provide a minimum 20 year warranty.

4. Provide Versai V2 Commercial fencing manufactured by Fortress Building Products or approved equal.

5. Install per manufactures recommendations.

2.02 FABRICATION OF MISCELLANEOUS METALWORK

A. The Contractor shall take the necessary precautions as described in ASTM A143 and ASTM A384 during fabrication of articles to be galvanized, to properly fabricate and prepare the material to prevent embrittlement, warpage, and distortion.

1. Violation of the provisions of this paragraph will be sufficient cause for rejection of the Work.

2. Steel tubing with cover plates welded at both ends or other enclosed assemblies shall have vent and drain holes drilled at locations on the assembly approved by the Engineering Manager. The holes shall be drilled during fabrication and before galvanizing.

B. All edges, corners, and welds shall be struck and deburred.

2.03 FABRICATION - WELDING OF CARBON STEEL

A. Except for the modifications set forth in this Section, the welding of structures or articles fabricated from carbon steel shall be in accordance with the AISC Manual of Steel Construction and AWS D1.1 as referenced therein.

B. Electroslag and electrogas welding procedures will not be permitted.

C. Allowable unit stresses for base metals and for effective areas of weld metal for application to structures shall be as shown in the AISC Manual of Steel Construction.

D. Joints to be welded by automatic machines shall be abrasive-blasted to white metal in accordance with SSPC-SP5.

E. Electrodes for shielded metal arc welding (SMAW) shall not be larger than 1/4-inch for shop welding and not larger than 3/16-inch for field welding.

F. The depth of each pass shall not exceed 1/8-inch for manual welding, and the weld puddle width shall not exceed three times the electrode diameter or 3/8-inch, whichever is less.

G. Welding of pipe or tubing shall be in accordance with the recommendations of AWS D10.12.

H. Runoff tabs shall be removed by hand flame-cutting or other means as close to the edge or the finished member as practical, followed by grinding to a smooth surface contiguous with the adjacent metal.

2.04 FABRICATION - WELDING OF STAINLESS STEEL

Welding of structures or articles fabricated from stainless steel shall be in accordance with the following:

A. Welding on austenitic stainless steel shall be performed by the shielded metal arc process using direct current.

B. Electrodes for welding austenitic stainless steels shall be in accordance with AWS A5.4 Classification Number E316L. Electrodes for welding stainless steel to carbon steel shall be Classification Number E309L or E312 electrodes.

C. Weld procedures shall be qualified in accordance with AWS B2.1.

D. Welding of stainless pipe or tubing shall be in accordance with the recommended practices of AWS D10.4.

E. Stainless steel to carbon steel welds performed in the field will not require stress-relieving heat treatment provided the interpass temperature does not exceed 350°F.

F. Stress-relieving of austenitic stainless steel where deemed necessary by Engineering Manager, shall be performed at 750°F for 4 hours, plus an additional 30 minutes for each additional inch over 1/2-inch weld section thickness, or a full solution anneal at 1900°F shall be performed with rapid quench.

G. Stainless steel welds shall be deburred and ground smooth using grinding wheels of aluminum oxide. Carborundum or other carbon bearing wheels are not acceptable for use on stainless steel surfaces. Wire brushing of stainless steel surfaces shall be performed only with stainless steel brushes. Grind wheels and brushes used to clean stainless steel shall not have been used on carbon steel surfaces.

H. After shop fabrication stainless steel shall be cleaned, descaled, and passivated in accordance with ASTM A380.

2.05 SHOP FINISHES

A. Galvanizing

1. Galvanizing shall have an average weight per square foot of 2.0 ounces and not less than 1.8 ounces per square foot.

2. Except where otherwise specified, galvanizing shall be performed after fabrication, including cutting, punching, welding, and drilling, has been completed.

3. Prior to galvanizing, items shall be cleaned by abrasive blasting to white metal in accordance with SSPC-SP5.

   a. Weld flux residue, weld splatter, and minor weld defects not removed by the abrasive blasting shall be removed by mechanical means.

b. After abrasive blasting and mechanical cleaning, items shall be fluxed and immediately hot dipped.

4. Galvanizing shall be done in the largest possible subassemblies consistent with the appearance of the completed item and with the prevention of warpage of the product.

5. Galvanizing shall be repaired in accordance with one of the methods specified in Part 3 of this Section.

6. Where galvanized light-gauge sheet goods are specified, upset edges of factory die-punched holes need not have the bare edges re-galvanized and the galvanized coating adjacent to such die-punched edges need not be repaired.

B. Aluminum

1. Aluminum shall be coated in accordance with Specification Section 09900, Painting and Coating Systems.

2. Where specified, aluminum materials shall receive a hard anodized finish after all fabrication work (holes, bends, etc.) has been completed.

PART 3 EXECUTION

3.01 INSTALLATION

A. Installation and anchorage details for miscellaneous metal items shall be as shown on the Drawings. Details not shown shall be developed by the Contractor and indicated on the submittal shop drawings.

B. Anti-galling compound shall be used each time stainless steel fasteners are assembled or reassembled and shall be applied in the fastener threads in accordance with the manufacturer's printed recommendations.

C. Security fence shall be installed per the manufacturer's recommendations.

3.02 REPAIR OF GALVANIZED SURFACES

Areas of galvanizing damaged during fabrication, shipping, erection, or any other time prior to acceptance of the Work shall be prepared and recoated by one of the following methods:

A. Parts damaged in the shop shall be removed from the site, stripped of existing coating, cleaned, and re-galvanized in accordance with ASTM A123 or A153 as applicable.

B. Field or shop repair areas shall be cleaned and recoated with a 2.0 mil coating of zinc alloy using meltable zinc-based alloy bars (hot bar process).

1. The damaged area shall be thoroughly cleaned using a wire brush, a light grinding action or mild abrasive blasting. The cleaning shall extend beyond the damaged area to lap the undamaged galvanized coating at least 1/2-inch.

2. Weld flux residue, and weld splatter of a size or type that cannot be removed by blast cleaning shall be removed by chipping, scaling or other mechanical means.

3. The cleaned area shall be preheated to at least 600°F but not more than 750°F. The

surrounding galvanized area shall not be burned. The area to be repaired shall be wire brushed during this preheat.

4. The cleaned preheated area shall be rubbed with the repair alloy stick to deposit an evenly distributed layer of the zinc alloy.

5. The repaired area shall be wiped with a damp cloth to remove flux residue.

6. Dry –film thickness shall be verified using a magnetic or electromagnetic-type gauge.

C. Shop or field-damaged areas shall be cleaned and recoated with a 4.0 mil minimum coating of zinc, using sprayed zinc (metalizing process).

1. Zinc wire used in repair shall contain not less than 99.98% zinc.

2. The surface to be repaired shall be blast cleaned to white metal in accordance with SSPC-SP5. The area to be blast cleaned shall extend at least 1/2-inch onto the surrounding sound coating area.

3. Weld flux residue and weld splatter of a size or type that cannot be removed by blast cleaning shall be removed by chipping, scaling, or other mechanical means.

4. Sprayed coating shall be applied within 2 hours after surface preparation has been completed and before any visible deterioration (flash-rust) has occurred.

5. The coating shall be applied to the clean and dry surface by metal spraying pistols fed with zinc wire or zinc powder.

6. The surface of the sprayed zinc shall be of uniform texture, free of lumps, coarse areas, and loosely adhered particles.

7. Dry film thickness shall be verified using a magnetic or electromagnetic-type, gauge.

D. In the field, for areas where the hot bar or metalizing process methods cannot be used, and with the permission of District Engineer, the damaged areas shall be repaired with multiple coats of an approved coating such as Rustoleum Zinc Rich Cold Galvanizing Aerosol; CRC Zinc-It; Spray-on #740 zinc-rich; Sherwin Williams #140 Zinc-Rich; OAE.

1. The damaged area shall be cleaned and recoated with an organic zinc-rich paint to a minimum dry film thickness (DFT) of 6.0-mils applied in two coats.

2. The surface to be repaired shall be blast cleaned to white metal in accordance with SSPC-SP5. The area to be blast cleaned shall extend at least 1/2-inch onto the surrounding sound coating area.

3. Weld flux residue and weld splatter of a size or type that cannot be removed by blast cleaning shall be removed by chipping, scaling or other mechanical means.

4. In areas where abrasive blasting cannot be used or cannot effectively clean the required area, power disk sanding or other cleaning methods shall be used, subject to the approval of the Engineering Manager.

5. Apply paint containing zinc dust to the prepared area as recommended by the paint manufacturer.

6. Dry film thickness shall be verified using a magnetic or electromagnetic-type gauge.

-END OF SECTION-

SECTION 07140

FLUID-APPLIED MEMBRANE WATERPROOFING

PART 1 GENERAL

1.01 DESCRIPTION

This section includes Fluid-Applied Membrane Waterproofing on concrete and masonry surfaces as shown on the Drawings and specified in this Section. Work includes substrate preparation and bridging, and sealing air leakage and water intrusion pathways and gaps.

1.02 PERFORMANCE REQUIREMENTS

A. Cold fluid applied bitumen-modified polyurethane waterproofing system is intended to perform as a continuous barrier against liquid water and to flash or discharge to the exterior incidental water. Membrane system is not long-term UV resistant and is intended to receive an overburden of concrete, tile in a cementitious setting bed, pavers in a sand setting bed, pavers on supporting pedestals, or soil/growing media, and shall accommodate movements of building materials as required with accessory sealant materials at locations such as: changes in substrate, perimeter conditions and penetrations. Installed waterproofing membrane system shall not permit the passage of water, and will withstand the design pressures calculated in accordance with the most current revision of ASCE 7.

B. Manufacturer shall provide all primary waterproofing materials that are physically and chemically compatible when installed in accordance with manufacturers current application requirements.

1.03 SUBMITTALS

A. Submittals shall be made in accordance with Specification Section 01300, Contractor Submittals, and the following special provisions provided herein.

B. Product Data: For Each Product.

C. Shop Drawings. Manufacturer’s standard details and shop drawings for the specified system.

D. Manufacturer’ Certification: Certification showing full time quality control of production facilities and that each batch of material is tested to ensure conformance with the manufacturer's published physical properties.

VOC Certification: Manufacturer’s certification that all waterproofing system products meet current Volatile Organic Compound (VOC) regulations as established by the State of California; and stating total VOC content, in grams per liter, for all system components (i.e. primers, adhesives, coatings, etc.).

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Manufacturer shall demonstrate qualifications to supply materials of this section by certifying the following:

1. Membrane Manufacturer shall have available an in-house technical staff to assist the contractor when necessary in the application of the products and site review of the assembly.

B. Installer's Qualifications: The Contractor shall demonstrate qualifications to perform the Work of this Section by submitting certification or license by the waterproofing membrane manufacturer as a trained and authorized applicator of the product the installer intends to use.

C. Source Limitations: All components listed in this section shall be provided by a single manufacturer or approved by the primary waterproofing manufacturer.

D. Materials Compatibility: All materials included in the waterproofing assembly, as well as associated materials adhered to/applied beneath the waterproofing membrane shall have been tested and verified to be compatible. Include written testing documentation and test reports if requested by Architect.

E. Applicable Regulations: Comply with local code and requirements of authorities having jurisdiction. Do not exceed VOC regulations as established by the State in which they are being installed; including total VOC content, in grams per liter, for all system components (i.e. primers, adhesives, coatings, and similar items).

F. Waterproofing Terminology: Refer to ASTM D1079 and the glossary of the National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual for definitions of waterproofing terms related to this section.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver all waterproofing materials to the site in original containers, with factory seals intact.

B. Store all pail goods in their original undamaged containers in a clean, dry location within their specified temperature range.

C. Do not expose materials to moisture in any form before, during, or after delivery to the site. Reject delivery of materials that show evidence of contact with moisture.

D. Remove manufacturer supplied plastic covers from materials provided with such. Use "breathable" type covers such as canvas tarpaulins to allow venting and protection from weather and moisture. Cover and protect materials at the end of each work day. Do not remove any protective tarpaulins until immediately before the material will be installed.

E. Materials shall be stored above 60-95°F (15-35°C) a minimum of 24 hours prior to application.

1.06 PROJECT CONDITIONS

A. Weather: Proceed with waterproofing only when existing and forecasted weather conditions permit. Membrane application should not proceed when precipitation is imminent. Ambient temperatures shall be above 36°F (2°C) when applying the waterproofing system.

B. All surfaces to receive the waterproofing membrane shall be free from visible water, dew, frost, snow and ice. Application of waterproofing membrane shall be conducted in well ventilated areas.

C. Application on Green Concrete:
Horizontal: 48 hours or walkable conditions
Vertical 24 hours after forms removed

D. Waterproofing Membrane:

1. Waterproofing membrane is not intended to be exposed or in contact with a constant temperature below -25°F (-31.7°C) or in excess of 200°F (93.3°C). See technical data sheets for limitations, i.e., hot pipes and vents or direct steam venting.
2. Specified waterproofing membrane is VOC compliant. Consult container, packaging labels and Safety Data Sheets (SDS) for specific safety information.
3. Some low molecular weight alcohols can soften. Any exposure to foreign materials or chemical discharges shall be presented to membrane manufacturer for evaluation to determine any impact on the waterproof membrane assembly performance prior to warranty issuance.

E. Contractor shall ensure adequate protection during installation of the waterproofing system.

1.07 WARRANTY

A. Warranty: Provide manufacturer's standard warranty. Materials warranty shall be for a minimum of one year starting at the date of Substantial Completion. System warranty shall be for the following duration in accordance with specified system**.**

PART 2 MATERIALS

2.01 WATERPROOFNG SYSTEM

A. Sikalastic 320 NS, SG, or SL by Sika Corp or approved equal.

2.02 MEMBRANES AND COATINGS

A. Base coat and top coat membranes shall be low in VOC's, and be a one component elastomeric polyurethane membrane that may be brush or roller applied. Membrane shall have the following physical properties and conforms to ASTM D7311-07: Standard Specification for a single component, cold fluid applied, moisture cure, bitumen modified, polyurethane membranes.

B. Liquid and Cured Film Property Requirements:

Standard Measurement / Grade	SL	NS	SG
ASTM D-624, Die C: Tear Resistance (psi)	55 ± 15	90 ± 15	90 ± 15
ASTM D-412: Elongation at Break (%)	550 ± 50	600 ± 25	600 ± 25
ASTM D-412: Tensile Strength (pli)	330 ± 20	350 ± 15	350 ± 15
ASTM D-2240: Hardness (Shore A)	30 ± 5	30 ± 5	30 ± 5
ASTM D-2697: Total Volume Solids (%)	95 ± 2	95 ± 2	86 ± 2
ASTM D-236: Total Weight Solids (%)	99 ± 2	96 ± 2	88 ± 2
ASTM D-2369-81: VOCs (g/l)	45	46	89
ASTM E96-15: Water Vapor Transmission (perms)	1 ± 0.2	1 ± 0.2	1 ± 0.2
Viscosity (Poise @ 80°F)	30 ± 10	350 ± 100	150 ± 50
Specific Gravity	1.19	1.19	1.19

2.03 MEMBRANE REINFORCEMENT

A. Reinforcement for the waterproofing membrane system shall be a non-woven, needle-punched polyester fleece specifically designed to provide greater impact resistance and greater resistance to excessive thermal and structural movement while maintaining elasticity and membrane film integrity .

B. Supplemental reinforcement of the waterproofing membrane system shall be a nylon mesh specifically designed for local reinforcement of the waterproofing membrane at structural cracks, expansion joints and transitions between dissimilar materials .

2.4 FILLET BEAD AND PENETRATION SEALANT

A. Sealant for fillet bead applications and membrane penetrations hall be one or two part polyurethane sealants suitable for fillet bead transition compound to be applied prior to the installation of the membrane system at changes in substrate direction, sealing reglet terminations, cracks in the substrate, and penetrations of the waterproofing system.

2.05 PRIMERS

A. Use a manufacturer approved primer, where required.

2.06 REPAIR AND PATCHING

A. Cementitious repair mortar to repair bug holes, spalled areas, and other non-structural surface defects, to fill uneven areas and birdbaths, or to repitch decks shall be a two component, polymer-modified, Portland cement, fast-setting, trowel-grade mortar.

2.07 DRAINAGE MAT

B. Dimpled core polystyrene drainage mat with a non-woven (420) and woven (720) polypropylene filter fabric bonded to the topside of the mat, and a bonded protection sheet on the underside of the mat. To be installed between the waterproofing membrane and extruded polystyrene insulation.

C. Geonet polypropylene composite drainage mat with a non-woven polypropylene filter fabric bonded to the topside of the mat, and a bonded protection sheet on the underside of the mat. To be installed between the waterproofing membrane and extruded polystyrene insulation.

D. Impermeable dimpled polystyrene drainage perforated core with a bonded to a root resistant non-woven polypropylene filter fabric on the top side and non-woven polypropylene membrane protection fabric on the bottom side. The core is installed dimpled side down to allow water retention within the cups. Excess water is collected and conveyed to a proper collection system, helping to control drainage flow. To be installed between the waterproofing membrane and extruded polystyrene insulation.

2.08 EXTRUDED POLYSTYRENE INSULATION

A. Extruded polystyrene foam board insulation, either flat stock or tapered, meeting the requirements of ASTM 578 Type VI (40 psi – stone ballast or pavers in sand bed/direct application), Type VII (60 psi – concrete pavers on pedestals), or Type V (100 psi – superimposed loads).

2.09 FILTER FABRIC

A. Non-woven needle-punched polyester UV-stabilized mat, 3 oz./sq.yd., used between the extruded polystyrene insulation and overburden.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the Work of this section. Notify District in writing of any discrepancies. Commencement of the Work in an area shall mean Installer's acceptance of the substrate.

B. Surfaces shall be sound, clean and free of standing water, oil, grease, dirt, excess mortar or other contaminants. Fill voids, gaps and spalled areas in substrate to provide an even plane. Strike masonry joints full flush.

3.02 SURFACE PREPARATION

A. Verify that the deck is clean and smooth, free of depressions, waves, or projections, and properly sloped to drains, valleys, eaves, scuppers or gutters. Verify that all openings or penetrations through the intended substrate are secured back to solid blocking. Ensure all preparatory Work is complete prior to applying membrane.

B. Mechanical fasteners used to secure sheathing boards or penetrate sheathing boards shall be set flush with sheathing and fastened into solid backing.

C. All surfaces shall be blown clean using an air compressor to remove any remaining loose debris.

D. All cracks and voids greater than 1/16 inch shall be routed and caulked with a Sikaflex sealant. Allow to cure per waterproofing membrane manufacturer's technical data sheets prior to over-coating with the specified waterproofing membrane system.

E. At all inside corners, gaps or voids at the juncture of the deck and penetrations apply a minimum 3/4 inch fillet bead of sealant and allow to cure per waterproofing membrane manufacturer's technical data sheets prior to installing the waterproofing membrane system.

F. Sealants used in detailing can be over coated once tack free.

G. Membrane shall be self-terminating but membrane terminations can be established prior to project start-up and documented in shop drawings. Terminations can occur in raked-out mortar joints, saw cut terminations or under installed counter-flashing materials.

H. Use tape lines to achieve a straight edge detail.

3.03 SUBSTRATE PREPARATION

A. Acceptable substrates include concrete, concrete block, solid wood/plywood sheathing, and metal.

B. Structural Concrete and Masonry:

1. Acceptable concrete substrates are limited to poured in place concrete decks.
2. Minimum deck thickness for structural concrete is 4 inches (10.2 cm).
3. Concrete surface to be light broom finish or equivalent.
4. Curing agents shall be checked for compatibility with specified waterproofing materials. Most curing agents shall be completely removed from the substrate by grinding, scarifying, or other mechanical means.
5. Concrete and masonry surfaces shall be low-pressure (5,000 psi or less) power-washed in accordance with ICRI Guideline No. 03732: Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays to remove all dirt, debris or surface contamination that would compromise bonding of the specified waterproofing membrane system. Remove oil or grease with solvents, or detergent and water. Rinse surface clean of remaining cleaning agents.

C. Metal Decking:

1. Metal profile decks shall be sound and secured to purlins, bar joists, etc. A ½" thick thermal barrier shall be installed and secured over all metal profile decks in accordance with wind uplift requirements.

D. Metal Surfaces:

1. Exposed drain bowls, pipes, and other metal surfaces shall be cleaned by power tool cleaning (SSPC SP-3) to remove corrosion deposits back to a clean, bright metal followed by a solvent wipe prior to application of the specified primer.

3.04 PRIMING

A. Metal

1. Apply primer for metal surfaces. To clean and prepared drain bowls and other metal surfaces by brush or roller at the application rate shown on the technical data sheet to achieve an overall wet film thickness of 8 mils. **High porosity and roughness of the substrate will decrease coverage rates.**
2. Allow to cure and dry in accordance with manufacturer's technical data sheets.

B. PVC

1. Apply Primer to clean and prepared PVC surfaces by brush or roller at the application rate of 100-150 SF/gal. **High porosity and roughness of the substrate will decrease coverage rates.**
2. Allow to cure and dry in accordance with manufacturer's technical data sheets.

3.05 MEMBRANE REINFORCEMENT

A. Reinforcement of Cracks, Plywood and Cover Board Joints/Seams, and Base/Curb Flashing Transitions:

1. For all locations where the specified membrane system is to be applied directly to the substrate surface, reinforcement of cracks and joints prior to applying the specified membrane system is conditional on the terms agreed to in a given warranty
2. For all horizontal-to-vertical transitions, provide a ¾" x ¾" Sikaflex polyurethane sealant cant.
3. Back roll reinforcement to fully embed reinforcement into the wet liquid polyurethane membrane. Add more liquid membrane as needed to fully embed the reinforcement.
4. Ensure reinforcement is not in tension during embedment.

3.06 COLD FLUID APPLIED MEMBRANE APPLICATION

A. Install waterproofing membrane system in accordance with current technical data sheets and in accordance with warranty guideline requirements.

B. Apply base embedment coat to horizontal deck and vertical wall surfaces by brush or with 1/2 inch – 3/4 inch nap roller to achieve a continuous and uniform minimum wet film thicknesses as specified in warranty guideline requirements.

C. Immediately lay specified conformable reinforcement into the wet base embedment resin coat.

D. Apply pressure to the membrane reinforcement with a roller as appropriate to fully embed and saturate the membrane reinforcement into liquid waterproofing material. Remove air pockets from under the membrane by rolling them out.

E. Apply additional liquid material as required to ensure desired millage and the membrane reinforcement is fully embedded and has conformed to the substrate without tenting or visible pinholes.

F. Overlap sheets of Fleece membrane reinforcement 3 inches at side laps and 6 inches at end laps.

G. Extend membrane reinforcement vertically at adjacent wall surfaces in accordance with project details and specifications.

H. When using polyester fleece reinforcement, immediately apply the resin top coat wet-on-wet when product is mixed with water. If product is not mixed with water, apply reinforced system in two separate coats with 16-24 hours in between coats. DO NOT mix sprayable product with water when using an airless sprayer and/or pump. This could cause material to cure inside the pump.

I. Apply top coat by nap roller or brush to achieve a continuous and uniform minimum wet film thickness as specified in warranty guideline requirements.

J. Install all flashings in accordance with manufacturer's construction details.

3.07 PARAPET AND WALL FLASHINGS

A. Clean, prepare and prime if necessary substrate surfaces ready to receive membrane.

B. All parapet, wall, and curb flashings shall be provided with a sealant bead membrane application.

C. Terminate waterproofing membrane system at raked-out mortar joints, termination saw cut joint, or under installed counter-flashing materials. Seal all mortar joints and saw cut joints with polyurethane sealant.

D. Install metal counter flashings in accordance with details.

3.08 DRIP EDGES AND OTHER METAL FLANGED FLASHING

A. Clean, prepare and prime metal flange surfaces ready to receive membrane.

B. Metal flanges are typically encapsulated between two membrane layers, usually by providing membrane flashing as a stripping ply over the metal flange, with the field or flashing membrane extending beneath the metal flange. It is also acceptable to install the stripping ply under the metal flange, and extend the field or flashing membrane over the metal flange.

3.09 DRAINS

A. Clean, prepare and prime surfaces ready to receive membrane applications. Block drain bowl opening to avoid waterproofing material from entering the drainage system.

B. Remove strainer baskets and clamping rings from the drain bowl assembly. Temporarily replace the bolts back into assembly to avoid miss-alignment of connections after membrane applications are completed.

C. Extend the liquid waterproofing material and membrane reinforcement directly into the throat of the prepared drain.

D. Remove drain blocks and allow the waterproofing system to fully cure dry prior to re-connecting the drain bowl assembly.

3.10 PENETRATIONS

A. Clean, prepare and prime surfaces ready to receive membrane. Ensure that penetrations are secured to prevent movement.

B. Apply a cant bead of sealant the base of penetrations and apply membrane vertically up the penetration 6-8 inches.

3.11 EXPANSION JOINTS

A. Expansion joints are formed separately from the membrane.

3.12 APPLICATION OF PENETRATION SEALANT

A. Seal reglet-based membrane terminations, heads of exposed mechanical fasteners, around penetrations, duct work, electrical and other apparatus extending through the waterproofing membrane with specified penetration sealant.

3.13 FLOOD TEST

A. Upon the completion of the waterproofing membrane system and associated terminations the contractor shall flood test the system. Provide temporary stops and plugs for the drains within the test area. Flood test with a minimum 2 inches of water for no less than 24 hours.

B. Repair and retest the system for no less than 24 hours, report all deficiencies to the District. Remove temporary stops and plugs. No other Work is to proceed without prior direction from the District.

3.14 PROTECTION

A. Protect waterproofing Work from other trades until completion.

B. Stage materials in such a manner that avoids foot traffic over completed waterproofed areas.

C. Provide temporary walkways and platforms to protect completed Work from traffic and point loading during the application process.

D. Provide temporary membrane tie-ins and water-stops at the end of each workday and remove prior to commencement of work the following day.

3.15 PREFABRICATED COMPOSITE DRAINAGE AND PROTECTION MAT

A. Install the drainage mat when it can be followed immediately by the installation of the extruded polystyrene insulation and overburden. If the drainage mat cannot be installed within one week of membrane application, a protection course must be applied over the membrane to protect from other trade work and UV radiation.

B. Install the drainage mat on horizontal and vertical surfaces in accordance with the product data sheet. Lay out and position drainage mat, and allow to lay flat. Cut and closely fit drainage mat to perimeter and penetrations.

C. Overlap filter fabric from adjacent sheets/rolls, and bond all fabric overlaps with sealant. Install supplemental filter fabric as required to ensure filter fabric continuity at flashing locations.

3.16 INSTALLATION OF EXTRUDED POLYSTYRENE INSULATION

A. Before the application of the insulation, any damage or deterioration to the composite drainage and protection mat shall be repaired.

B. Loose lay insulation in a staggered manner, and tightly butt together all insulation boards. The maximum acceptable joint width is 3/8 inch. Cut and closely fit insulation within ¾ inches to perimeter and penetrations.

C. For multi-layer insulation applications, the bottom layer shall be the thickest layer and shall be a minimum of 2 inches thick. Stagger the joints of each insulation layer.

D. Vertical insulation applications can be spot-adhered to the drainage mat and to additional insulation layers, utilizing an acceptable adhesive.

E. Do not install damaged insulation boards.

3.17 FILTER FABRIC

A. Install filter fabric on horizontal and vertical surfaces over the extruded polystyrene insulation in accordance with the product data sheet.

B. Lay out and position filter fabric. Cut and closely fit filter fabric to perimeter and penetrations, extending the filter fabric vertically to the height of the overburden.

C. Overlap filter fabric to achieve 6 inch side and end laps. As required, bond all fabric overlaps with sealant to ensure filter fabric continuity prior to and during overburden installation.

3.18 TRAFFIC-BEARING OVERBURDEN

A. Install traffic-bearing overburden, if required, in accordance with specifications.

3.19 CLEAN-UP

A. Work areas are to be kept clean, clear and free of debris at all times.

B. Do not allow trash, waste, and/or debris to collect on the work area. Trash, waste, and/or debris shall be removed from the work area on a daily basis.

C. All tools and unused materials shall be collected at the end of each workday and stored properly off of the finished waterproofed surface and protected from exposure to the elements.

D. Dispose of or recycle all trash and excess material in a manner conforming to current EPA regulations and local laws.

E. Properly clean the finished deck surface after completion, and make sure the drains and gutters are not clogged.

F. Clean and restore all damaged surfaces to their original condition.

-END OF SECTION-

SECTION 09900

PAINTING AND COATING

PART 1 GENERAL

1.1 DESCRIPTION

This section described the requirements for the preparation of surfaces and subsequent application of protective coatings. The Contractor shall furnish all labor, materials and equipment required for satisfactory completion of all items contained herein. The Contractor shall furnish all necessary safety equipment and protective clothing, as well as be responsible for proper instruction and supervision of their use.

1.2 SUBMITTALS

Contractor shall furnish submittals in accordance with the requirements of Section 1 – General Conditions. The following submittals are required:

A. Submit a chart of the manufacturer's available colors for color selection well in advance of painting operation.

B. Submit manufacturer's data sheets showing the following information:

1. Recommended surface preparation.

2. Minimum and maximum recommended dry-film thicknesses per coat for prime, intermediate, and finish coats.

3. Percent solids by volume.

4. Recommended thinners.

5. Statement verifying that the selected prime coat is recommended by the manufacturer for use with the selected intermediate and finish coats.

6. Application instructions including recommended application, equipment, humidity, and temperature limitations.

7. Curing requirements and instructions.

C. Submit certification that all coatings conform to applicable local Air Quality Management District rules and regulations for products and application.

PART 2 MATERIALS

2.1 GENERAL

A. All materials shall be those of current manufacture and shall meet all applicable regulations for the application and intended service. All coats of any particular coating system shall be of the same manufacturer and shall be approved by the manufacturer for the intended service. In the event that a product specified herein is no longer

manufactured or does not meet current regulations, the Contractor shall provide a substitute, currently manufactured product of at least equal performance which meets all applicable regulations, subject to the Engineering Manager's approval, at no additional cost.

B. All materials shall be delivered to the Project Site in their original, unopened containers bearing the manufacturer's name, brand, and batch number. Standard products of manufacturers other than those specified will be accepted when it is proved to the satisfaction of the Engineering Manager, they are equal in composition, durability, usefulness and convenience for the purpose intended.

Ameron Corrosion Control Division, Brea, CA
ICI Devoe Coatings, Strongsville, OH
Tnemec Company, Inc., Kansas City, MO, 64141

C. All surfaces to be coated or painted shall be in the proper condition to receive the material specified before any coating or painting is done. No more sandblasting or surface preparation than can be coated or painted in a normal working day will be permitted. All sharp edges, burrs, and weld spatter shall be removed. All concrete and masonry surfaces shall cure 30 days prior to coating or painting.

D. Surface preparation, prime coatings, and finish coats for the various systems are specified herein. Unless otherwise noted, all intermediate and finish coats shall be of contrasting colors. It is the intent that the coating alternates specified herein serve as a general guide for the type of coating desired.

E. Not all the equipment, conditions, and coating systems listed below are necessarily applicable to this project.

2.2 VALVES

A. Exterior Coating: Coat ferrous valves located above ground, in vaults or in structures the same as the adjacent piping. If the adjacent piping is not coated, then coat valves per this Specification section unless otherwise noted. Apply the specified prime coat at the place of manufacture. Apply intermediate and finish coats in the field. Finish coat shall match the color of the adjacent piping. Coat handwheels and floor stands the same as the valves. Coat the exterior of buried metal valves at the place of manufacture per this specification.

B. Exterior Coating (Above ground):
Shop prime coat: Tnemec Series 1 Omnithane applied at 2.5 to 3.5 mils DFT.
Touch-up (Field): Tnemec Series 1 Omnithane applied at 2.5 to 3.5 mils DFT.
Intermediate Coat: Tnemec Series V69 Epoxoline II applied at 3.0 to 5.0 mils DFT.
Finish Coat: Tnemec Series 1075 Endura-Shield II @ 2.0 to 3.0 mils DFT.

C. Exterior Coating (Buried):
Shop prime coat: Tnemec Series 1 Omnithane applied at 2.5 to 3.5 mils DFT.
Shop Intermediate Coat: Tnemec Series V69 Epoxoline II applied at 4.0 to 6.0 mils DFT.
Shop Finish Coat: Tnemec Series V69 Epoxoline II applied at 4.0 to 6.0 mils DFT.

D. Interior Lining: Valves 4-inches and larger shall be coated on their interior metal surfaces excluding seating areas and bronze and stainless-steel pieces. Sandblast surfaces in accordance with SSPC-SP-10 (near white blast cleaning). Remove all protuberances which may produce pinholes in the lining. Round all sharp edges to be coated. Remove any contaminants which may prevent bonding of the lining. Coat the interior ferrous surfaces using one of the following methods:

1. Apply powdered thermosetting epoxy per the manufacturer's application recommendations to a thickness of 10 to 12 mils.

2. Apply two (2) coats of polyamide epoxy to a dry-film thickness of 10 to 12 mils total. Follow the manufacturer's application recommendations including minimum and maximum drying time between the required coats.

3. All epoxy lining shall be applied at the factory by the manufacturer of the valve and shall meet current Volatile Organic Compound (VOC) content regulations. Epoxy lining for potable water valves shall also be listed by National Sanitation Foundation (NSF) for contact with potable water.

4. Test the valve interior linings at the factory with a low-voltage holiday detector. The lining shall be holiday free.

2.3 METAL, INTERIOR AND EXTERIOR, NORMAL EXPOSURE

A. General: The Contractor shall paint all exposed steelwork, non-galvanized handrails, exposed pipework, fittings, all mechanical equipment, pumps, motors, doors, door frames and window sash with this coating system. All metalwork previously given a shop prime coat approved by the Engineering Manager shall be touched up as required in the field with an approved coating.

B. Surface Preparation: All exterior metal surfaces which are to be painted shall be commercial blast cleaned per Specification SP-6 (commercial blast cleaning) except as otherwise specified, in locations where sandblasting would damage previously coated surfaces and installed equipment, and in locations where dry sandblasting is prohibited. The above locations in which SP-6 commercial sandblasting is not possible shall be given a SP-3 power tool cleaning. This sandblasting shall be done not more than 8 hours ahead of the painting, subject to humidity and weather conditions between the time of sandblasting and painting operations. If any rusting or discoloration of sandblasted surfaces occurs before painting, such rusting or discoloration shall be removed by additional sandblasting. Sandblasted surfaces shall not be left overnight before painting.

C. Coating:

1. Prime coat or spot prime coat: Tnemec Series 18 Enviro-Prime applied at 2.0 to 3.5 mils DFT.

2. Intermediate Coat: Tnemec Series 1028 Tufcryl Gloss Acrylic applied at 2.0 to 2.5 mils DFT.

3. Finish Coat: Tnemec Series 1028 Tufcryl Gloss Acrylic applied at 2.0 to 2.5 mils DFT.

4. Total dry-film thickness of the complete system shall be 6.0 to 8.5 mils DFT.

2.4 METAL, SUBMERGED OR INTERMITTENTLY SUBMERGED

A. General: All submerged metalwork, gates, equipment, valves, exposed pipework and all other metalwork within areas which will be submerged, except as noted hereinafter, shall be painted with this coating system.

B. Surface Preparation: All metal surfaces shall be field sandblasted according to SSPC-SP-10 (near white blast cleaning).

C. Coating:

1. Coating (Potable water):

Prime coat: Tnemec Series V140 or V140F Pota-Pox Plus applied at 4.0 to 6.0 mils DFT.
Intermediate coat: Tnemec Series V140 or V140F Pota-Pox Plus applied at 4 to 6 mils DFT.
Finish coat: Tnemec Series V140 or V140F Pota-Pox Plus applied at 4 to 6 mils DFT.
Total dry-film thickness of the complete system shall be 12.0 to 18.0 mils.

2. Coating (Non-potable):

Primer: Tnemec Series V69 Epoxoline II applied at 4 to 6 mils DFT.
Intermediate coat: Tnemec Series V69 Epoxoline II applied at 4 to 6 mils DFT.
Finish coat: Tnemec Series V69 Epoxoline II applied at 4 to 6 mils DFT.
Total dry-film thickness of the complete system shall be a 12.0 to 18.0 mils DFT.

NOTE: Tnemec Series V140 or V140F can also be used for Non-Potable system.

2.5 METAL, SEVERE EXPOSURE TO MOISTURE OR CHEMICAL FUMES

A. Surface Preparation: All metal surfaces shall be field sandblasted according to SSPC-SP-10 (near white blast cleaning).

B. Coating:

1. Exterior Coating:

Shop prime coat: Tnemec Series 90-97 Tneme-Zinc applied at 2.5 to 3.5 mils DFT.
Touch-up (Field): Tnemec Series 90-97 Tneme-Zinc applied at 2.5 to 3.5 mils DFT.
Intermediate Coat: Tnemec Series V69 Epoxoline II applied at 3.0 to 5.0 mils DFT.
Finish Coat: Tnemec Series 1075 Endura-Shield II @ 2.0 to 3.0 mils DFT.

2. Interior Coating:

Shop prime coat: Tnemec Series 90-97 Tneme-Zinc applied at 2.5 to 3.5 mils DFT.
Touch-up (Field): Tnemec Series 90-97 Tneme-Zinc applied at 2.5 to 3.5 mils DFT.

Intermediate Coat: Tnemec Series V69 Epoxoline II applied at 4.0 to 6.0 mils DFT.

3. Finish Coat: Tnemec Series V69 Epoxoline II applied at 4.0 to 6.0 mils DFT.

2.6 METAL, HIGH-TEMPERATURE EXPOSURE

A. General: Engine mufflers, exhaust systems and other metal surfaces subjected to high temperatures shall be coated with this system.

B. Surface Preparation: Surface shall be field sandblasted in accordance with SSPC-SP-10 (near white blast cleaning).

C. Coating (Tnemec Alternate): One coat of Tnemec Series 90-96 Tneme-Zinc to a total dry-film thickness of 2.5 to 3.5 mils.

D. Coating (ICI Devoe Coatings Alternate): One coat of Catha-Coat 304V Zinc to a dry-film thickness of 2 to 4 mils.

2.7 METAL, GALVANIZED, ALUMINUM, COPPER, OR BRASS

A. Surface Preparation: Surfaces shall be solvent cleaned in accordance with SSPC-SP-1 (solvent cleaning) and SSPC-SP- (Brush off Blast cleaning). Next, apply recommended coating or paint for the particular surface to be coated.

B. Coating Interior Exposed:
Prime coat: Primer: Tnemec Series V69 Epoxoline II applied at 2 to 3 mils DFT.
Finish coat: Tnemec Series V69 Epoxoline II applied at 2 to 3 mils DFT.
Total try-film thickness of the complete system shall be 4.0 to 6.0 mils.

C. Coating Exterior Exposed:
Prime coat: Primer: Tnemec Series V69 Epoxoline II applied at 2 to 3 mils DFT.
Finish coat: Tnemec Series 1075 Endura-Shield II applied at 2 to 3 mils DFT.
Total try-film thickness of the complete system shall be 4.0 to 6.0 mils.

D. Coating (Sinclair Alternate) 7113 Wash Primer applied at ½ mil dry-film thickness.

2.8 METAL, BURIED

A. General: The Contractor shall coat all buried metal which includes valves, bolts, nuts, structural steel and fittings. It does not include steel storage reservoirs.

B. All buried flanges, fittings, and nuts and bolts shall be wrapped per AWWA C-217 and wrapped with polyethylene encasement per AWWA C – 105. Nuts and Bolts shall be individually wax taped per RMWD Standard Drawing CP-9 notes. Buried Valves shall be wrapped with polyethylene encasement per AWWA C-105.

C. Surface Preparation: Sandblast to SSPC-SP-6 (commercial blast cleaning)

D. Coating (Tnemec Alternate): Prime Coat: Tnemec Series 46H-413 Hi-Build Tneme-Tar applied at 8.0 to 10.0 mils DFT. Finish Coat: Tnemec Series 46H-413 Hi-Build Tneme-Tar applied at 8.0 to 10.0 mils DFT. Total dry-film thickness shall be 16.0 to 20 mils.

2.9 MASONRY, EXTERIOR, NORMAL EXPOSURE

A. General: All exterior masonry surfaces subject to normal exposure shall be painted with this system.

B. Surface Preparation: Surfaces shall be free of dirt, dust, grease, or other deleterious matter before coating. All cracks and voids shall be filled with a suitable caulking material compatible with the specified coating.

C. Coating (Tnemec Alternate): Prime Coat: Tnemec Series 180 W.B. Tneme-Crete, 4.0 to 6.0 mils DFT. Finish Coat: Tnemec Series 180 W.B. Tneme-Crete, 4.0 to 6.0 mils DFT. Total dry-film thickness shall be 8 to 12 mils.

D. Coating (ICI Devoe Coatings Alternate): Two (2) coats of Devflex 4020 Acrylic, 2.5 to 3.5 mils dry-film thickness, each. Total dry-film thickness shall be 6 mils minimum.

2.10 MASONRY, INTERIOR

A. Surface Preparation: For concrete surfaces, surfaces to be coated must be sandblasted according to SSPC-SP-7 (brush-off blast cleaning) with 60-80 mesh sand and air pressure 50-60 psi to remove all cement glaze and residue of form release agents and provide a uniform surface profile of approximately 1 mil. Fill voids, holes, and pits with Tnemec Series 104 H.S. Epoxy sprayed and backrolled to create a void-free surface or (Devoe Coating) Tru-Glaze 4015 Epoxy applied as required. Vacuum clean or air blast surface prior to coating. Surfaces shall cure a minimum of 28 days prior to coating.

B. Interior Coating (Tnemec Alternate): CMU Coating System: Block Filler / Prime Coat: Tnemec Series 130 Envirofill applied at 60 to 115 sq ft/gal to create a void-free surface. Intermediate coat: Tnemec Series V69 Epoxoline II applied at 4 to 6 mils DFT. Finish coat: Tnemec Series V69 Epoxoline II applied at 4 to 6 mils DFT. Total dry-film thickness of the complete system shall be a minimum of 8-12 mils not including block filler.

C. Concrete System: Filler Coat: Tnemec Series 218 Mortar-Clad as required to fill bugholes and cracks in concrete. Intermediate coat: Tnemec Series V69 Epoxoline II applied at 4 to 6 mils DFT. Finish coat: Tnemec Series V69 Epoxoline II applied at 4 to 6 mils DFT. Total dry-film thickness of the complete system shall be a minimum of 8-12 mils not including filler.

2.11 MASONRY, SEVERE EXPOSURE

A. General: This system is for interior and exterior masonry surfaces subject to severe exposure or chemical attack.

B. Surface Preparation: Surfaces to be coated must be sandblasted according to SSPC-SP-7 (brush-off blast cleaning) with 60-80 mesh sand and air pressure of 50-60 psi to remove all cement glaze and residue of form release agents and provide a uniform surface profile of approximately 1 mil. Fill voids, holes, and pits with Tnemec Series 104 H.S. Epoxy sprayed applied as required. Vacuum clean or air blast surface prior to coating. Surfaces shall cure a minimum of 28 days prior to coating.

C. Coating (Tnemec Alternate): CMU Coating System: Block Filler / Prime Coat: Tnemec Series 130 Envirofill applied at 60 to 115 sq ft/gal to create a void-free surface. Intermediate coat: Tnemec Series 104 H.S. Epoxy applied at 6 to 8 mils DFT. Finish coat: Tnemec Series 104 H.S. Epoxy applied at 6 to 8 mils DFT. Total dry-film thickness of the complete system shall be a minimum of 12-16 mils not including block filler.

D. Concrete System: Filler Coat: Tnemec Series 218 Mortar-Clad as required to fill bug holes and cracks in concrete. Intermediate coat: Tnemec Series 104 H.S. Epoxy applied at 6 to 8 mils DFT. Finish coat: Tnemec Series 104 H.S. Epoxy applied at 6 to 8 mils DFT. Total dry-film thickness of the complete system shall be a minimum of 12-16 mils not including filler.

2.12 CONCRETE FLOORS

A. General: Includes specified concrete floors subject to moisture and pedestrian traffic.

B. Surface Preparation: Surfaces to be coated must be sandblasted in accordance with SSPC-SP-7 (brush-off blast cleaning) with 60-80 mesh sand and air pressure of 50-60 psi to remove all cement glaze and residue or other agents and provide a uniform surface profile of approximately 1 mil.

C. Coating (Tnemec Alternate): Floor Coating: Prime Coat: Series 201 Epoxoprime applied at 4.0 to 6.0 mils DFT. Intermediate Coat: Tnemec Series 280 Tneme-Glaze at 6 to 8 mils DFT. Finish Coat: Tnemec Series 280 Tneme-Glaze at 6 to 8 mils DFT. Total dry-film thickness shall be 16.0 to 22 mils.

2.13 WOODWORK - INTERIOR AND EXTERIOR

A. General: The Contractor shall paint all interior and exterior wood including, but not limited to, doors, frames, panels, sash and trim.

B. Surface Preparation: Surfaces shall be clean, dry, and free of all contaminants. All surfaces shall be sanded smooth. Knots, pitch pockets, and other bleed points shall be sealed with a shellac-based sealer after areas are scraped clean and sanded. Holes and imperfections shall be spot-primed, filled with plastic wood filler, and sanded smooth. All surfaces shall be dusted clean prior to coating. Moisture content shall be tested using an electronic moisture meter and shall not exceed 15%.

C. Coating (Tnemec Alternate): Interior & Exterior Coating: Prime coat: Tnemec Series 151-1051 Elastic-grip FC applied at 1 mil DFT. Intermediate Coat: Tnemec Series 1029 Tufcryl Semi-Gloss applied at 1.5 to 2.0 mils DFT. Finish Coat: Tnemec Series 1029 Tufcryl Semi-Gloss applied at 1.5 to 2.0 mils DFT. Total dry-film thickness of the complete system shall be 4.0 to 5.0 mils DFT.

2.14 PLASTER, DRYWALLS - INTERIOR

A. Surface Preparation: Surfaces shall be free of dirt, dust, grease, or other deleterious matter before coating. All cracks and voids shall be filled with a suitable spackling material compatible with the specified coating.

B. Coating (Tnemec Alternate): Coating: Prime coat: Tnemec Series 51-792 Sealer applied at 1 to 2 mils dry-film thickness. Finish coats(2): Tnemec Series 6 Tneme-Cryl applied at 2 to 3 mils dry-film thickness, each. Total dry-film thickness shall be 5.0 to 8 mils.

PART 3 EXECUTION

3.1 GENERAL

A. The Contractor shall arrange with the Engineering Manager so that all surface preparation may be inspected and approved prior to the application of any coatings.

B. The Contractor is hereby notified that the Engineering Manager will inspect the Work prior to the expiration of the warranty period and all defects in workmanship and material shall be repaired by the Contractor, at his own expense.

3.2 WORKMANSHIP

A. It is the intent of the Specifications that finishes shall be provided which meet standards for best grades of painting. Drop cloths shall be placed where required to protect floors, surfaces and equipment from spatter and dropping, not to receive paint or coatings.

B. The Contractor shall take all necessary precautions to protect all adjacent Work and all surrounding property and improvements from any damage whatsoever as a result of the painting and coating operation.

C. Only good, clean brushes and equipment shall be used, and all brushes, buckets, and spraying equipment shall be cleaned immediately at the end of each painting period.

D. Each coat of paint shall be of the consistency as supplied by the manufacturer, or thinned, if necessary, and applied in accordance with manufacturer's instructions. Each coat shall be well brushed, rolled or sprayed to obtain a uniform and evenly applied finish. Work shall be free from "runs", "bridges", "shiners", or other imperfections due to faulty intervals. Particular care shall be taken to obtain a uniform unbroken coating over all bolts, threads, nuts, welds, edges and corners. Paint shall not be applied in extreme heat, in dust or smoke laden air, or in damp or humid weather, unless written permission of the Engineering Manager is obtained.

E. If paint is applied by spray, the air pressure used shall be within the ranges recommended by both the paint and spray equipment manufacturers. Spray painting shall be conducted under controlled conditions and the Contractor shall be fully responsible for any damage occurring from spray painting.

F. Care shall be exercised not to damage adjacent Work during sandblasting operations. Stainless steel need not be sandblasted. Blasted surfaces shall not be left overnight before coating. All dust shall be removed from the surface following sandblasting.

3.3 APPLICATION PROCEDURES

A. Surfaces to be Coated: All surfaces of materials furnished and constructed are to be painted or coated per the Specifications except as indicated below.

B. Surfaces Not To Be Coated: The following surfaces shall not be coated unless otherwise noted on the Plans and shall be fully protected when adjacent areas are painted:

Aluminum grating	Grease fittings	Nameplates on machinery
Aluminum surfaces	Hardware	Pipe interior*
Bearings	Lighting fixtures	Shafts
Brass and copper tubing, submerged*	Machined surfaces	Stainless steel
Buried pipe	Metal letters	Switch plates
Couplings	Mortar-coated pipe & fittings	

*unless specifically required on the Plans or elsewhere in the Specifications

C. Protection of Surfaces Not To Be Coated: Surfaces not intended to be painted shall be removed, masked, or otherwise protected. Drop cloths shall be provided to prevent paint materials from falling on or marring adjacent surfaces. Working parts of mechanical and electrical equipment shall be protected from damage during surface preparation and painting process. Openings in motors shall be safely masked to prevent paint and other materials from entering the motors. All masking materials shall be completely removed, and surfaces cleaned at completion of painting operations.

D. Weather Conditions:

1. Paint shall not be applied in the rain, wind, snow, mist, and fog or when steel or metal surface temperatures are less than 5°F above the dew point.

2. Paint shall not be applied when the relative humidity is above 80%, the air temperature is above 90°F, or the temperature of metal to be painted is above 125°F.

3. Alkyd, chlorinated rubber, inorganic zinc, silicone aluminum, or silicone acrylic paints shall not be applied if air or surface temperature is below 50°F or expected to be below 50°F within 24 hours.

4. Epoxy, coal tar epoxy, acrylic latex, and polyurethane paints shall not be applied on an exterior or interior surface if air or surface temperature is below 50°F or expected to drop below 50°F within 24 hours.

3.4 SURFACE PREPARATION

A. General: Sandblast or prepare only as much surface area as can be coated in one day. All sharp edges, burrs, and weld spatter shall be removed. Epoxy-coated pipe that has been factory coated shall not be sandblasted.

B. SSPC Specifications:

1. Wherever the words "solvent cleaning", "hand tool cleaning", "wire brushing", or "blast cleaning" or similar words are used in the Specifications or in paint manufacturer's specifications, they shall be understood to refer to the applicable SSPC (Steel Structures Paint Council, Surfaces Preparation Specifications, ANSI A159.1) Specifications listed below:

SP-1	Solvent Cleaning	SP-6	Commercial Blast Cleaning
SP-2	Hand Tool Cleaning	SP-7	Brush-Off Blast Cleaning
SP-3	Power Tool Cleaning	SP-8	Pickling
SP-5	White Metal Blast Cleaning	SP-10	Near White Blast Cleaning

2. Oil and grease shall be removed from aluminum and copper surfaces in accordance with SSPC SP-1 using clean cloths and cleaning solvents.

3. Weld spatter and weld slag shall be removed from metal surfaces. Rough welds, beads, peaked corners, and sharp edges including erection lugs shall be ground smoothly in accordance with SSPC SP-2 and SSPC SP-3.

4. Welds shall be neutralized with a chemical solvent that is compatible with the specified coating materials using clean cloths and chemical solvent.

C. Abrasive Blast Cleaning:

1. Dry abrasive blast cleaning shall be used for metal surfaces. Do not recycle or reuse contaminated blast particles.

2. Dry clean surfaces to be coated by dusting, sweeping, and vacuuming to remove residue from blasting. Apply the specified primer or touch-up coating within the period of an 8-hour working day. Do not apply coating over damp or moist surfaces. Reclean prior to application of primer or touch-up coating any blast cleaned surface not coated within said 8-hour period.

3. Prevent damage to adjacent coatings during blast cleaning. Schedule blast cleaning and coating such that dust, dirt, blast particles, old coatings, rust, mill scale, etc., will not damage or fall upon wet or newly coated surfaces.

3.5 PROCEDURES FOR THE APPLICATION OF COATINGS

A. The recommendations of the coating manufacturer shall be followed, including the selection of spray equipment, brushes, rollers, cleaners, thinners, mixing, drying time, temperature and humidity of application, and safety precautions.

B. Coating materials shall be kept at a uniform consistency during application. Each coating shall be applied evenly, free of brush marks, sags, runs, and other evidence of poor workmanship. A different shade or tint shall be used on succeeding coating applications to indicate coverage where possible. Finished surfaces shall be free from defects or blemishes.

C. Only thinners recommended by the coating manufacturer shall be used. If thinning is allowed, do not exceed the maximum allowable amount of thinner per gallon of coating material.

D. 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.

E. Apply primer immediately after blast cleaning and before any surface rusting occurs, or any dust, dirt, or any foreign matter has accumulated. Reclean surfaces by blast cleaning that have surface colored or become moist prior to coating application.

1. Paint Mixing: Multiple-component coatings shall be prepared using all the contents of each component container as packaged by the paint manufacturer. Partial batches shall not be used. Multiple-component coatings that have been mixed beyond their pot life shall not be used. Small quantity kits for touch-up painting and for painting other small areas shall be provided. Only the components specified and furnished by the paint manufacturer shall be mixed. For reasons of color or otherwise, additional components shall not be intermixed, even within the same generic type of coating.

2. Field Touch Up of Shop-Applied Prime Coats: Organic Zinc Primer: Surfaces that are shop primed with zinc rich primers shall receive a field touch up of organic zinc primer to cover all scratches or abraded areas. Organic zinc coating system shall have a minimum volume solids of 62% and a minimum zinc dust content of 83% by weight in the dried film. Coating shall be of urethane type and shall be manufactured by the prime coat and finish coat manufacturer.

3. Other Primers: Surfaces that are shop primed with other than organic zinc primer shall receive a field touch up of the same primer used in the original prime coat.

3.6 DRY-FILM THICKNESS TESTING AND REPAIR

A. Special Instructions to the Contractor: The Contractor shall furnish to the District at no charge for use during execution of the Work, necessary dry-film thickness gauge and electrical flaw detection equipment. The Contractor shall perform the holiday (pinholes) inspection in the presence of the Engineering Manager, and the Contractor shall monitor wet film measurements throughout the application of each coat of coating.

B. Coating Thickness Testing: Coating thickness specified for steel surfaces shall be measured with a magnetic-type dry-film thickness gauge. Dry-film thickness gauge shall be provided as manufactured by Mikrotest or Elcometer. Each coat shall be checked for the correct dry-film thickness. Measurement shall not be made until a minimum of eight hours after application of the coating. Non-magnetic surfaces shall be checked for coating thickness by micrometer measurement of cut and removed coupons. Contractor shall repair coating at all locations where coupons are removed.

C. Holiday Testing: The finish coat (except zinc primer and galvanizing) shall be tested by the Contractor for holidays and discontinuities with an electrical holiday detector of the low-voltage, wet-sponge type. All testing shall be done in the presence of the Engineering Manager and conducted per manufacturer's written recommendations. All Holiday testing shall be in conformance with NACE RP 0188-88 / RP 0490.

D. Repair: If the item has an improper finish, color, insufficient film thickness, or holidays, the surface shall be cleaned and top-coated with the specified paint material to obtain the specified color and coverage. 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. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

3.7 CLEANUP

Upon completion of all painting and coating Work, the Contractor shall remove all surplus materials and rubbish. The Contractor shall repair all damage and shall leave the premises in a clean and orderly condition.

-END OF SECTION-

SECTION 09961

FUSION-BONDED EPOXY LINING AND COATING

PART 1 GENERAL

1.1 DESCRIPTION

This section includes materials, application, and testing of one part, fusion-bonded, heat cured, thermosetting, 100% solids epoxy lining and coating on steel, cast iron, and ductile iron equipment, such as valves, flexible pipe couplings, fittings, structural steel, and steel pipe. Do not apply fusion-bonded epoxy to aluminum, brass, bronze, copper, plastic, rubber, or stainless steel surfaces.

1.2 RELATED WORK SPECIFIED ELSEWEHRE

A. RMWD Standard Drawings
B. Painting and Coating - 09900

1.3 SUBMITTALS

Contractor shall furnish submittals in accordance with the requirements of Section 1 – General Conditions. The following submittals are required:

A. Submit a chart of the manufacturer's available colors for color selection well in advance of painting operation.

B. Submit manufacturer's catalog literature and product data sheets, describing the physical and chemical properties of the epoxy coating. Describe application and curing procedure.

C. Submit coating application test records for measuring coating thickness and holiday detection for each item or pipe section and fitting. Describe repair procedures used.

PART 2 MATERIALS

2.1 PIPING AND EQUIPMENT SURFACES

The Contractor shall require the suppliers to provide bare pipe and equipment that is free of salts, oil, and grease to the coating applicator.

2.2 SHOP APPLIED EPOXY LINING AND COATING

Lining and coating shall be a 100% solids, thermosetting, fusion-bonded, dry powder epoxy resin. Provide: Scotchkote 134 or 206N, Lilly Powder Coatings "Pipeclad 1500 Red," H.B. Fuller 1F-3003, or approved equal. Epoxy lining and coating shall meet or exceed the following requirements:

Hardness (Minimum)	Barcol 17 (ASTM D 2583) Rockwell 50 ("M" Scale)
Abrasion Resistance (Minimum)	1,000 cycles: 0.05 gram removed 5,000 cycles: 0.115 gram removed ASTM D 1044, Tabor CS 17 wheel, 1,000 gram weight
Adhesion (Minimum)	3,000 psi (Elcometer)
Tensile Strength	7,300 psi (ASTM D 2370)
Penetration	0 mil (ASTM G 17)
Adhesion Overlap Shear, 1/8-inchsteel panel, 0.010 glue line	4,300 psi (ASTM D 1002)
Impact (Minimum Value)	100 inch-pounds (Gardner 5/8-inch diameter tup)

2.3 FIELD APPLIED EPOXY COATING FOR PATCHING

Use a two-component, 80% solids, liquid resin, such as Scotchkote 306 or approved equal.

PART 3 EXECUTION

3.1 GENERAL - SHOP APPLICATION OF FUSION-BONDED EPOXY

A. Grind surface irregularities, welds, and weld spatter smooth before applying the epoxy. The allowable grind area shall not exceed 0.25 square foot per location, and the maximum total grind area shall not exceed 1 square foot per item or piece of equipment. Do not use any item, pipe, or piece of equipment in which these requirements cannot be met.

B. Remove surface imperfections, such as slivers, scales, burrs, weld spatter, and gouges. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4-inch.

C. Uniformly preheat the pipe, item, or piece of equipment prior to blast cleaning to remove moisture from the surface. The preheat shall be sufficient to ensure that the surface temperature is at least 5°F above the dew point temperature during blast cleaning and inspection.

D. Sandblast surfaces per SSPC SP-5. Protect beveled pipe ends from the abrasive blast cleaning.

E. Apply a phosphoric acid wash to the pipe, item, or piece of equipment after sandblasting. The average temperature, measured in three different locations, shall be 80°F to 130°F during the acid wash procedure. The acid wash shall be 5% by weight phosphoric acid solution. The duration in which the acid is in contact with the surface shall be determined by using the average temperature as tabulated below:

Pipe Temperature (°F)	Contact Time (seconds)
80	52
85	45
90	36
95	33
100	28
105	24
110	21
130	10

After the acid wash has been completed, remove the acid with demineralized water having a maximum conductivity of 5 micromhos/cm at a minimum nozzle pressure of 2,500 psi.

F. Apply lining and coating by the electrostatic spray or fluidized bed process. Minimum thickness of lining or coating shall be 12 mils. Heat and cure per the epoxy manufacturer's recommendations. The heat source shall not leave a residue or contaminant on the metal surface. Do not allow oxidation of surfaces to occur prior to coating. Do not permit surfaces to flash rust before coating.

3.2 SHOP APPLICATION OF FUSION-BONDED EPOXY TO PIPE

A. In addition to the above requirements, apply lining and coating per AWWA C213 except as modified herein.

B. Grind 0.020-inch (minimum) off the weld caps on the pipe weld seams before beginning the surface preparation and heating of the pipe.

3.3 QUALITY OF LINING AND COATING APPLICATIONS

The cured lining or coating shall be smooth and glossy, with no graininess or roughness. The lining or coating shall have no blisters, cracks, bubbles, underfilm voids, mechanical damage, discontinuities, or holidays.

3.4 GENERAL - SHOP TESTING OF LINING AND COATING

A. Test linings and coatings with a low-voltage wet sponge holiday detector in accordance with AWWA C213. If the number of holidays or pinholes for flat or smooth surfaces such as pipe is fewer than one per 10 square feet of coating surface, repair and retest. If the number of holidays or pinholes for valves, couplings, and fittings, 12 inches and smaller, is 5 or less per item, repair and retest. Repair the holidays and pinholes by applying the coating manufacturer's recommended patching compound to each holiday or pinhole and retest. If the number of holidays or pinholes exceeds these allowable quantities, remove the entire lining or coating and recoat the pipe or item and retest.

B. Measure the coating thickness at three locations on each item or piece of equipment or pipe section using a coating thickness gauge calibrated at least once per eight-hour shift. Record each measured thickness value. Where individual measured thickness values are

less than the specified minimum thickness, measure the coating thickness at three additional points around the defective area. The average of these measurements shall exceed the specified minimum thickness value, and no individual thickness value shall be more than 2 mils below or 3 mils above the specified minimum value. If a section of the pipe, item, or piece of equipment does not meet these criteria, remove the entire lining or coating and recoat the entire item or piece of equipment.

C. The District's Representative will conduct in the field an independent inspection of the lining and coating for compliance with the above criteria. Coated items failing his inspection will be cause for rejection.

3.5 SHOP TESTING OF LINING AND COATING OF PIPE

In addition to the above requirements, check for coating defects on the weld seam centerlines. There shall be no porous blisters, craters, or pimples lying along the peak of the weld crown.

3.6 FIELD REPAIRS

Patch scratches and damaged areas incurred while installing fusion bonded epoxy coated items with a two-component, 80% solids (minimum), liquid epoxy resin. Wire brush or sandblast the damaged areas per SSPC SP-10. Lightly abrade or sandblast the lining or coating on the sides of the damaged area before applying the liquid epoxy coating. Apply a two-part epoxy coating to damaged linings and coatings to areas smaller than 20 square inches. Patched areas shall overlap the parent or base coating a minimum of 1/2-inch. If a damaged area exceeds 20 square inches, remove the entire lining and coating and recoat the entire item or piece of equipment and retest. Apply the liquid epoxy coating to a minimum dry-film thickness of 12 mils.

-END OF SECTION-

SECTION 11000

GENERAL EQUIPMENT REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope: Equipment under this division includes providing and testing the equipment specified under Division 11 and on the Drawings, submittals operation and maintenance manuals and in conformance with all Sections of the Specifications.

B. Equipment Lists: Equipment lists, where presented in these Specifications and shown on the Drawings, are included for the convenience of the Construction Manager and Contractor and are not intended to represent a rigorous and precise listing of all equipment, devices and material to be provided under this contract. The Contractor agrees to rely upon his own material and equipment takeoff lists for this purpose.

1.2 QUALITY ASSURANCE

A. Arrangement: The arrangement of equipment shown on the Drawings is based upon information available to the Engineer at the time of design and is not intended to show exact dimensions peculiar to a specific manufacturer. The Drawings are, in part, diagrammatic, and some features of the illustrated equipment installation may require revision to meet actual equipment installation requirements. Structural supports, foundations, connected piping and valves shown may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions and alternations. Substantiating calculations and drawings shall be submitted prior to beginning the Work.

B. Control Devices: Control devices, wiring, starters, and other electrical items provided with mechanical equipment shall in general conform to Joint Industry Council (JIC) Electrical Standards for Mass Production Equipment EMP-1-1967 and the requirements specified, including those in Division 16 and the particular equipment sections.

C. References:

This Section references 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.

AFBMA	Methods of Evaluating Load Ratings of Ball and Roller Bearings
ANSI B 1.1	Unified Inch Square Threads
ANSI B 2.1	Pipe Threads (except Dupeal)
ANSI 16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 125
ANSI B 18.2.1	Square and Hex Bolts and Screws, including Askew Head Bolts, Hex Cap Screws, and Log Screws
ANSI B 18.2.2	Square and Hex Nuts

1.3 SUBMITTALS

A. General: The submittal for each individual equipment or groups of related equipment shall be in accordance with the General Conditions, Section J – Shop Drawing Submittals.

B. Required Submittal Data:

The following information shall be submitted for each item of equipment. Additional data, specific to individual equipment items are listed under individual specification sections.

1. The proposed equipment shall be identified by the equipment numbers listed in the Specifications and Drawings.

2. Manufacturer and manufacturer's type designation.

3. Any exceptions to these Specifications along with justification for each exception.

4. Manufacturer's catalog data confirming rated capacity, horsepower, efficiency and electrical requirements.

5. Shop Drawings.

6. Predicted performance curves developed for the specific application. In the case of rotating equipment, performance curves shall show speed, capacity, pressure and power for all specified conditions.

7. Motor submittal data as required under Section 16150. Cross-sectional views of machines showing details of construction.

8. Data and calculations required to justify selection of size of components such as shafts, bearings and peripheral equipment necessary to conform to these Specifications.

9. Parts lists, with materials of construction.

10. Installation requirements, showing clearances required for maintenance purposes.

11. Details of all appurtenances to be furnished with the specified item.

1.4 INFORMATION TO BE PROVIDED

Information shall be provided for each item of equipment as specified under individual Specification sections.

1.5 PROTECTION DURING SHIPMENT

A. Each item of equipment shall be shipped to the site of the Work with either the manufacturer's shop applied prime coating or a vinyl paint prime coating. The prime coating shall be applied over clean dry surfaces in accordance with the paint manufacturer's recommendations. The prime coating will serve as a base for field-applied finish coats.

B. Bearing housings shall be wrapped or otherwise sealed to prevent contamination by grit and dirt, and ventilation and other types of openings shall be taped closed.

PART 2 PRODUCTS

2.1 FLANGES AND PIPE THREADS

A. Flanges on the equipment shall conform in dimension, drilling and pressure class to the piping to which it will connect and to the conditions it will be exposed to.

B. Threaded flanges shall have a standard taper pipe thread conforming to ANSI B 2.1. Unless otherwise specified, flanges shall be flat faced.

C. Flange assembly bolts shall be heavy pattern, hexagonal head, carbon steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B 18.2.1 and B 18.2.2. Threads shall be Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B 1.1.

2.2 BEARINGS

A. Unless otherwise specified, equipment bearings shall be oil or grease lubricated, ball or roller type, designed to withstand the stresses of the service specified. Each bearing shall be rated in accordance with the latest revisions of AFMBA Methods of Evaluating Load Ratings of Ball and Roller Bearings for one of the following classes of B-10 rating life:

Class	Hours of Operation
M1	8,000
M2	20,000
M3	50,000
M4	100,000
M5	200,000

B. Unless otherwise specified, equipment shall have bearings rated for Class M3 life.

C. Grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with easily accessible grease supply, flush, drain and relief fittings. To the greatest extent practical, extension tubes shall be used and the grease injection fittings at the ends of the extension tubes shall be nested together to provide the greatest ease for access and servicing. Grease supply fittings shall be standard hydraulic alemite type.

D. Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb heat energy normally generated in the bearing under a maximum ambient temperature of 60 degrees C and shall be equipped with a filler pipe and an external level indicator gauge.

2.3 COUPLINGS

A. Unless otherwise specified in the particular equipment sections, equipment with a driver greater than 1/2 HP, and where the input shaft of a driven unit is directly connected to the output shaft of the driver, shall have its two shafts connected by a flexible coupling which can accommodate angular misalignment, parallel misalignment and end float, and which cushions shock loads and dampens torsional vibrations. The flexible member shall consist of a tire with synthetic tension members bonded together in rubber. The flexible member shall be attached to flanges by means of clamping rings and cap screws, and the flanges shall be attached to the stub shaft by means of taperlock bushings which shall give the equivalent of a shrunk-on fit. There shall be no metal-to-metal contact between the driver and the driven unit. Each coupling shall be sized and provided as recommended by the coupling manufacturer for the specific application, considering horsepower, speed of rotation, and type of service.

B. Where torque or horsepower capacities of couplings of the foregoing type is exceeded, Thomas-Rex, Falk Steel Flex, or equal, couplings will be acceptable provided they are sized in accordance with the equipment manufacturer's recommendations and sizing data are submitted. They shall be installed in conformance to the coupling manufacturer's instructions.

2.4 GUARDS

A. Exposed moving parts shall be provided with guards which meet the requirements of CAL/OSHA. Guards shall be fabricated of solid 14-gauge steel. Guards shall be galvanized after fabrication and shall be designed to be readily removable to facilitate maintenance of moving parts. Reinforced holes shall be provided.

2.5 CAUTION SIGNS

A. Equipment with guarded moving parts which operates automatically or by remote control shall be identified by signs reading "CAUTION – AUTOMATIC EQUIPMENT MAY START AT ANY TIME". Signs shall be constructed or corrosion proof material with a heavy-duty porcelain enamel finish. Letters shall be white on a red background. Signs shall be installed near guarded moving parts.

2.6 NAMEPLATES

A. Nameplates shall be provided on each item of equipment and shall contain the specified equipment name or abbreviation. Equipment nameplates shall be engraved or stamped on corrosion resistant material and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins.

2.7 LUBRICANTS

A. The Contractor shall provide for each item of mechanical equipment a supply of the lubricant required for the commissioning period. Lubricants shall be of the type recommended by the equipment manufacturer and shall be products of the Owner's current lubricant supplier. The Contractor shall limit the various types of lubricants by consolidating them, with the equipment manufacturer's approval, into the least number of different types. Not less than 90 days before the date shown in his construction schedule

for starting, testing and adjusting equipment, the Contractor shall provide the Owner with three (3) copies of a list showing the required lubricants, after consolidation, for each item of mechanical equipment. The list shall show estimated quantity of lubricant needed for a full year's operation, assuming the equipment will be operating continuously.

PART 3 EXECUTION

3.01 INSTALLATION

A. Each item of equipment provided shall be installed and tested within the tolerances recommended by the equipment manufacturer. Installation and testing shall be certified by the manufacturer.

-END OF SECTION-

SECTION 11050

EQUIPMENT MOUNTING

PART 1 GENERAL

1.1 DESCRIPTION

This Section includes mounts, supports, and the anchorage for all equipment, piping and accessories.

1.2 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: All tanks, piping, equipment, supports and anchorages shall be designed by the Contractor in accordance with requirements of Zone 4 of the Uniform Building Code (UBC) and Structural Engineering Association of California (SEAOC), latest edition, unless specified herein. All elements required to resist the calculated forces described herein shall be provided by the Contractor.

B. Calculations and Shop Drawings: Calculations and shop drawings shall be submitted for all of the Work required above in accordance with the General Conditions, Shop Drawing Submittals. All calculations must be made and signed by a civil or structural engineer currently registered in the State of California. Because all anchorage of equipment is to be made in poured-in-place concrete elements, it is imperative that types of anchorage be coordinated with the concrete subcontractor so that anchorage may be installed at time of pouring. If calculations and anchorage details are not submitted prior to pouring of concrete, the Contractor will become responsible for any strengthening of concrete and/or anchorage elements because of superimposed seismic loading.

PART 2 PRODUCTS

2.1 GENERAL

All equipment located on floor slabs or exterior to building shall be mounted on concrete pads. Where a steel or cast base is shown or specified between the equipment and the concrete pedestal, it shall be hot-dip galvanized after fabrication.

2.2 CAST IRON BASES

A. Cast iron bases do not require galvanizing but must be coated in accordance with the requirements specified in Section 09900. All fasteners requiring connections to the base shall be terminated by nuts welded to the bottom side of the base and plugged with cork, plastic plugs or grease, or acorn nuts. In no case shall the fastener terminate only into the metal base.

2.3 CONCRETE PEDESTALS

A. Concrete pedestals shall be a minimum of two (2) inches larger than the steel or cast base but shall be large enough to provide adequate edge distance for seismic anchorage as calculated by the Contractor. All conduits, piping connections, drains, etc., shall be enclosed by the concrete base. No conduits, piping connections, drains, etc., will be accepted which rise directly from the floor.

PART 3 EXECUTION

3.01 INSTALLATION

A. Equipment: Except where a higher lateral force is required by code, each piece of equipment installed shall be anchored to resist a minimum lateral seismic force of 60 percent of the operating weight of the equipment. This force shall be considered acting at the center of gravity of the piece under consideration. No equipment shall be anchored to vertical structural elements without written approval of the Engineer.

B. Non-vibrating isolation equipment shall be anchored directly to the support floor system. In addition to the anchorage, all equipment shall be internally designed so that all static and moving parts are anchored to the supporting framework to resist the imposed seismic force. All forces must be transmitted to the base in order to be anchored as required.

C. Equipment, tanks, piping supports and anchorage located outside the buildings shall be designed to comply with the UBC, latest edition.

D. Piping: All piping, raceways, accessories, and appurtenances furnished with the equipment shall be anchored to resist a lateral seismic force of 60 percent of its operating weight without excessive deflection. This force shall be considered acting at the center of gravity of the piece under consideration.

E. Piping with flexible connections and/or expansion joints shall be anchored such that the intended uses of these joints are maintained in the piping system.

F. Ductwork: All ductwork for heating, ventilating and air conditioning and for mechanical equipment shall be anchored to the floor system(s) to resist a lateral seismic force of 60 percent of the operating weight.

-END OF SECTION-

SECTION 13025
FACTORY-BUILT BOOSTERPUMP STATION (OWNER PROVIDED)

PART 1 GENERAL REQUIREMENTS

1.1 SCOPE OF WORK

A. The Contractor shall take delivery of (FOB jobsite) and install three pre-engineered factory-built and delivered water pump station and one factory-built emergency power generator, in modular buildings with base frame and all necessary internal piping, valves, fittings, supports, control valves, pumps, motors, and controls, plus corresponding pump cans, valves and suction header, and all other necessary appurtenances as shown on the plans and specified herein.

B. The barrel sleeves, concrete slabs, and all sitework and buried infrastructure inaccessible after placement of the pump stations and generator shall be constructed prior to delivery of the pump stations and generator. The Contractor shall be responsible to set the modular buildings over the barrel sleeves and base slabs, install the pumps and make all the internal and external connections including the power service through the service conduit of the modular building, and provide the main water discharge connections, and other work as may necessary and as listed in the Section for CONTRACTORS INSTALLATION REQUIREMENTS to a make a completely operational and functioning pump station.

C. Contractor to install all owner provided equipment. Submittal Packages for each pump station are provided in the Attachment.

1.2 CONTRACTOR INSTALLATION REQUIREMENTS

A. The Contractor shall take care to install the barrel sleeves plumb and square to prevent installation issues when the pump building is installed.

B. Upon delivery of the pump and generator buildings, the contractor shall provide a crane and spreader bars to unload and set the stations on the foundations. Following the setting of the buildings, the Contractor will be required to anchor the buildings to the foundations. The Contractor shall supply the anchor bolts. Anchor clips will be provided by the pump station manufacturer. The Contractor will be required to set the pumps/motors into place through the pump roof hatches and into the pump barrels after the building is set. The Contractor shall connect the pumps to the barrels and pump discharge piping at the direction of the pump station manufacturer. Hardware for connections shall be provided by the pump station manufacturer.

1.3 SHIPPING AND DELIVERY

A. See Specification Section 01040 Project Coordination.

B. The specified equipment shall be delivered by the manufacturer FOB Destination and the pump station manufacturer shall take full responsibility for the condition and completeness of the equipment upon its delivery. If a site or multiple sites are not ready when the owner-furnished equipment is to be delivered, the manufacturer will deliver the buildings to the District Headquarters and the Contractor will be responsible for all shipping and delivery from the District Headquarters to the Project sites.

C. The Engineer shall hold the right to inspect the equipment prior to unloading and setting so as to assure the quality and condition of the equipment is in no way deficient.

D. If in the view of the Engineer, the equipment is deficient when delivered, delivery shall be refused, and the pump station manufacturer shall resolve all deficiencies at no cost to the Owner.

1.4 FACTORY START-UP AND TRAINING SERVICE

A. The pump station manufacturer is directly responsible for station start-up and operator training. Their scope of work is provided in the approved EFI submittals provided in appendices. The Contractor shall be responsible for coordination with EFI when startup and commissioning of the pump station is ready. If the Contractor's scope of work is not finished or is defective during EFI's startup and commissioning visits, the Contractor will be responsible for additional costs related to additional visits by EFI. Third party contractors, agents or representatives are not allowed to start up the station nor any of the internal equipment. The following requirements apply:

1. Start-up Factory Service Technician shall be a regular employee of the pump station manufacturer.

2. The pump station manufacturer shall provide two (2) copies of the complete Operation & Maintenance Manual in electronic form.

PART 2 PRODUCTS AND COMPONENTS

A. The complete approved submittal, including shop drawings, for each pump station are provided in the appendices.

-END OF SECTION-

SECTION 13110

CORROSION CONTROL FOR BURIED PIPING

PART 1 - GENERAL

1.01 SCOPE

This specification section addresses the materials, installation and testing for basic corrosion control and monitoring facilities required on most buried metallic piping. The corrosion control facilities include in this specification section are: corrosion test stations, joint bonding, insulating flange kits, casing test stations, wire and cable, exothermic welds, and simple sacrificial anode installations. Large piping projects or projects requiring large sacrificial anode or impressed current cathodic protection systems will require more detailed drawings and specifications.

1.02 REFERENCE STANDARDS

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designations only.

ANSI/ASME B16.21-16	Nonmetallic Flat Gaskets for Pipe Flanges
ASTM C94-2121	Ready –Mix Concrete
ASTM D1248-16	Polyethylene Plastics Molding and Extrusion Materials
ASTM D2220-17	Polyvinylchloride Insulation for Wire and Cable, 75º Operation
AWWA C217-09	Cold-Applied Petrolatum Tape and Petroleum Wax Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Buried Steel Water Pipelines
NACE SP0169-13	Standard Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NACE SP0286-07	Standard Practice; Electrical Isolation of Cathodically Protected Pipelines
NEMA LI-1-1991	Industrial Laminate Thermosetting Products
MIL-C-18480B	Coating Compound, Bituminous, Solvent, Coal Tar Base
UL 83-17	Thermoplastic-Insulated Wires
UL 486-18	Wire Connectors and Soldering Lugs for Use with Copper Conductors

1.03 RELATED WORK SPECIFIED ELSEWHERE

RMWD	Standard Drawings CP-1 through CP-17
RMWD	Standard Specifications and Drawings
Project Specific	Cathodic Protection Specifications and Drawings
Section 02223	Trenching, Backfilling, and Compacting
Section 03300	Cast-in-Place Concrete
Section 15056	Ductile Iron Pipe and Fittings
Section 15076	CML&C Steel Pipe

1.04 SUBMITTALS

A. Submit shop drawings in accordance with RMWD Standard Specifications.

B. Submit five (5) copies of manufacturer's catalog data and descriptive literature for all material items listed below and included in the project. Show dimensions and materials of construction by specification reference and grade where applicable.

1.05 DUCTILE IRON PIPE ENCASEMENT

A. Unless otherwise specified all ductile iron pipe shall be fully encased in 8 mil (0.008 inches) polyethylene sheet material in accordance with AWWA C105 Method A and STD SPEC 15056. The plastic encasement shall be installed without pinholes or tears and shall be fully protected from damage during backfilling. All pipe sections shall be fully inspected by RMWD before the pipe is backfilled.

B. **ZINC AND EPOXY COATING**

In lieu of polyethylene protective wrapping, ductile iron pipe shall have 1 mil of zinc applied to its exterior in accordance with EN 545/ISO 2531. Zinc shall be applied to achieve a man mass of 130g/m2 min (with local minimum of 110g/m2). A 3 mil epoxy coating shall be applied over the zinc deposit to provide mechanical protection of the zinc. This epoxy shall be provided in a color suitable for identifying the pipe for its intended application (i.e. blue = potable water). All fittings and angle points must be wrapped with polyethylene protective wrapping. **Prior approval from the District Representative is required for zinc and epoxy use.**

PART 2 - MATERIALS

2.01 TEST STATIONS

A. At-Grade Test Station:

1. Concrete Box: At-grade test boxes shall be round, pre-cast concrete with dimensions of 13-1/2-inch O.D. by 8-inch I.D. by 12-inches high, similar to Christy G5 Utility Box with a cast iron supporting ring and lid, and shall have sufficient strength to support occasional H-20 vehicular traffic. The lid shall

be 10-inches O.D. and cast with the legend "CORROSION" using letters not less than 1-1/2-inch high.

2. Concrete Pad: Test boxes mounted in un-paved areas shall be mounted in a reinforced 26-inches square by 4-inches thick concrete pad constructed of ASTM C94 Ready-Mix concrete. Rebar shall be No. 4. A concrete pad is not required where the test box is placed in pavement.

3. Brass Tags: Wire identification tags shall be 1½-inch diameter, 18 Ga. brass discs with a 3/16-inch diameter hole and die stamped with ¼-inch characters. Tags shall be attached to test wires with un-insulated AWG No. 14 solid copper wire. Tag legend shall be as indicated in the project drawings or RMWD Standard Drawings.

4. Marker Post: See paragraph 2.01 B. 4.

B. Post Mounted Test Station:

1. Enclosure: Post-mounted enclosures shall be constructed of one piece molded fiberglass and conform to NEMA 4X. The enclosure shall have a hinged cover with quick-release lockable latches and a seamless foam gasket. All hardware shall be stainless steel. Hinges shall be corrosion resistance polyester or stainless steel piano hinge. Size as follows unless specified differently in the project drawings:

No. of Wires	Size (inside)	Acceptable Product
2 or 3 wires	5.5x4.0x5.0”	Hoffman A-645JFGQRR
4 or 5 wires	7.5x6.0x5.28”	Hoffman A-865JFGQRR

2. Panel: The mounting panel shall be fiberglass, micarta or laminated phenolic sheet cross-laminated for resistance to warpage and weathering. Minimum panel thickness shall be 3/16-inch. Panel shall be mounted off of the back of the enclosure to allow sufficient access to make up wire terminals.

3. Components: All terminal lugs shall be solid brass. Provide a properly sized terminal lug for all wires. See RMWD Standard Drawings or Cathodic Protection Detail Drawings for wiring configuration and wire labels.

4. Post: Post shall be seasoned, construction heart garden grade redwood, 4-inches by 4-inches by 5-feet long, and surfaced on four sides. Cut a ¾-inch chamfer in all 4 top edges. Paint post with 2 coats of epoxy. Color shall be white as approved by the District.

5. Conduit: 2-inch diameter galvanized rigid steel conduit per UL 6 approximately 4-feet long with long radius sweeps. Fittings shall be galvanized rigid steel per UL 514.

6. Brass Tags: See paragraph 2.01.A.3.

7. Concrete Base: ASTM C-94 ready mix concrete.

2.02 PREPACKAGED MAGNESIUM ANODES

A. Magnesium Anode (High Potential): unless otherwise specified anodes shall be high potential prepackaged magnesium alloy ingot of the following chemical composition:

Aluminum	0.010%
Manganese	0.50 to 1.30%
Copper	0.02% MAX
Nickel	0.001% MAX
Iron	0.03% MAX
Other	0.05% Each or 0.3% MAX Total
Magnesium	Remainder

Magnesium Anode (Standard Potential): If the Project Design Documents call out standard potential magnesium anodes the ingot shall have the following chemical composition:

Aluminum	5.3 to 6.7%
Manganese	0.15 to 0.70%
Zinc	2.5 to 3.5%
Copper	0.02% MAX
Nickel	0.002% MAX
Iron	0.003% MAX
Silicon	0.10% MAX
Other	0.05% Each or 0.3% MAX Total
Magnesium	Remainder

B. Anode Weight: Unless otherwise specified the ingot weight of prepackaged magnesium anodes shall be 48 pounds. The anode ingot shall have a trapezoidal cross section and be approximately 32-inches long. Other anode ingot weights (with different cross sections and dimensions, typically 32 or 17 pounds) may be specified in the Projects Design Documents.

C. Anode Backfill: Each magnesium anode shall be prepackaged in a permeable cloth bag with a backfill of the following composition:

Gypsum	75%
Powdered Bentonite	20%
Anhydrous Sodium Sulfate	5%

D. Backfill grains shall be capable of 100% passing through a 100-mesh screen. The backfill shall be firmly packed around the anode by mechanical vibration to a density, which will maintain the magnesium ingot in the center of the cloth bag and surrounded by at least one inch of backfill.

E. Prepackage Weight: The total packaged weight of 48-pound (ingot weight) magnesium anodes and backfill shall be approximately 105 pounds. The cloth bag diameter shall be 8-inches. The packaged weight and diameter of other anode sizes shall be as indicated in the RMWD Standard Drawings.

F. Anode Lead Wire: Unless otherwise indicated, anode lead wire shall be AWG No. 12 stranded copper wire with HMWPE insulation conforming to UL Standard 83. Wire shall be connected to the strap core with silver solder. The connection shall be mechanically secured before soldering and shall have at least one and one-half (1.5) turns of wire at the connection. The connection shall then be insulated by filling the remainder of the recess with electrical potting compound. Anode lead wire shall be of sufficient length to extend from the anode to the designated termination point without a splice. Wires with cut or damaged insulation will not be accepted and replacement of the entire lead will be required at the Contractor's expense.

2.03 SHUNTS

Shunts used in the anode test boxes shall be 0.01 ohms resistance and rated at 6 amperes capacity and accurate to plus or minus 1%. Use Holloway Type RS shunt unless otherwise specified.

2.04 WIRE AND CABLE

A. General: All DC wires shall be stranded copper with high molecular weight polyethylene (HMWPE) insulation suitable for direct burial in corrosive soil and water conforming to UL 83 and ASTM Standards B3 or B8. HMWPE insulation shall conform to the requirements of ASTM D1248 Type 1, Class C. Wires with cut or damaged insulation will not be accepted and replacement of the entire length of wire will be required at the Contractor's expense.

B. Test Leads: Unless otherwise indicated, test wires shall be AWG No. 8 HMWPE wire. Each test lead shall be of sufficient length to extend from the attachment to the pipe or structure to the test box without a splice.

C. Bond Wires: Bond wires shall be AWG No. 2, No. 4, or No. 6 HMWPE depending on the pipe diameter and as indicated in the RMWD Standard Drawings or directed by the District Representative. Bond wires shall be as short as possible.

2.05 LEAD WIRE CONNECTORS

A. Terminal Lugs: Terminal lugs shall be solder-less, UL 486 copper or brass and sized to accommodate the wire.

B. Split-bolt Connectors: Split bolt connectors shall be UL 486 copper or brass and sized to accommodate the lead wire and shunt being used.

2.06 INSULATING FLANGE KITS

A. General: Insulating flange kits shall consist of Type E, full face gaskets, insulating sleeves and double washers (steel and dielectric) on each end. All insulating material shall be of the type designated by the manufacturer as suitable for the operating temperature and pressure of the service.

B. Gaskets: Unless otherwise indicated, insulating gaskets shall be dielectric neoprene faced phenolic. Note that the sealing surfaces of both flanges must be compatible with the gasket.

C. Sleeves: Use full-length sleeves except for installation on threaded studs where half-length sleeves are required. For installation on threaded bolts, i.e., at butterfly valve flange bonnets and bases, the sleeves shall be half-length. Use 1/32inch thick G10 epoxy glass tube material as per NEMA LI-1 unless directed otherwise by the RMWD.

D. Washers: Insulating washers shall be 1/8-inch thick G10 epoxy glass sheet material per NEMA LI-1.

E. Steel Washers: Steel washers shall be 1/8-inch thick cadmium plated or zinc plated carbon steel.

2.07 PIPELINE CASING INSULATORS

A. Body: The casing insulator body shall be constructed of a 12-inch wide steel band with a heat-fused plastic (PVC) coating with a minimum thickness of 10 mils. The steel band shall be flanged with stainless steel tightening bolts and nuts. The body shall be provided with a ribbed PVC liner to protect the pipe coating and prevent slippage.

B. Runners: 2-inch wide reinforced plastic (18,000 psi compressive strength). Runners are attached with stainless steel nuts on 3/8-inch threaded studs that are welded to the steel band before coating. The bolt holes shall be counterbored and filled with epoxy.

C. Acceptable Products: Use PSI Model A12G-2 or equal. Wooden skids or high-density polyethylene casing insulators are not acceptable.

2.08 CASING END SEALS

A. Type: End seals shall be either a heat shrinkable sleeve type or the mechanical link type. End seals shall provide full dielectric isolation and a watertight seal between the casing and the carrier pipes. Pre-molded casing seals held in place by an external band of metal or other material are not acceptable.

B. Heat Shrinkable Seal: Heat shrinkable sleeve shall have a minimum tensile strength of 2,500 psi and be resistant to abrasion, corrosive gases and be able to tolerate typical expansion and contraction of the casing and carrier pipes. Provide a separate non-conductive support skirt or transition padding that will allow a smooth transition of the heat shrink material from casing to carrier diameter. Watertight seals on both the casing and the carrier pipes are required. Use Raychem Caseal or Canusa CSK Casing Seal Kit.

C. Mechanical Link Seal: Articulated mechanical annular seal shall include EPDM rubber seal elements, non-metallic pressure plates and Type 316b stainless steel nuts and bolts for tightening. When compressed a full watertight seal is required. Use link-Seal Model “C” or District approved equivalent.

2.09 WAX TAPE WRAP

A. Surfaces Requiring Wax Tape: All buried piping system surfaces not coated with the primary pipe coating such as flanges, valves, couplings, insulating flanges, adapters, uncoated pipe spools or specialty fittings.

B. Material and Application Standard: Petrolatum wax tape coating system per AWWA C217 with plastic outer wrap.

C. Primer: The flange and bolt surfaces shall be prime coated with a blend of petrolatum, plasticizer, inert fillers, and corrosion inhibitor having a paste like consistency. The primer shall be Trenton WaxTape Primer, Denso Paste, or equivalent.

D. Wax Tape: Flange covering material shall be a synthetic felt tape saturated with a blend of petrolatum, plasticizers, and corrosion inhibitors that is easily formable over irregular surfaces. A compatible petrolatum filler shall be used to smooth over irregular surfaces. The WaxTape shall be Trenton #1 WaxTape, Densyl Tape wrap, or RMWD approved equivalent.

E. Outer Covering: The primed and wax-tape wrapped flange shall be wrapped with a plastic tape covering consisting of three (3) layers of 1.5 mil, polyvinylidene chloride or PVC, high cling, conformable membranes The outer covering shall be Trenton Poly-Ply, Denso Poly-Wrap or equivalent.

2.10 EXOTHERMIC WELD KITS AND WELD COATING

A. Weld Kits: Wire-to-pipe connections shall be made by the exothermic welding process. Weld charges and mold size shall be as specified by the manufacturer for various pipe sizes and surface configurations. Weld charges for use on cast and ductile iron are different from those used on steel. Care shall be taken during installation to be sure correct charges are used. Welding charges and molds shall be the product of a manufacturer regularly engaged in the production of such materials. Weld charges for steel pipelines shall have green caps and weld charges for cast or ductile iron shall have orange caps.

B. Weld Cap Primer: Weld cap primer shall be an elastomer-resin based corrosion resistant primer for underground services such as Royston Roybond Primer 747 or District approved equal.

C. Weld Caps: Exothermic welds shall be sealed with a pre-fabricated plastic cap filled with formable mastic compound on a base of elastomeric tape. Weld caps shall be Royston Handy Cap 2 or District approved equal.

D. Weld Cap Overcoating: Weld caps and the surrounding area shall be overcoated with a cold-applied, black, thixotropic material containing plasticized coal tar

pitch, solvents, and special fillers per MIL-C-18480A such as Protecto Wrap 160/160H, or Tape-Coat TC Mastic. Apply to at least 20 mils thickness.

2.11 PLASTIC WARNING TAPE

Plastic warning tape for all horizontal cable trench runs shall be a minimum of yellow, 4 mils thick and 6-inches wide, inert plastic film designed for prolonged use underground. The tape shall have the words "Caution: Cathodic Protection Cable Below" or similar, clearly visible along its entire length.

2.12 MORTAR

Mortar used to repair concrete coated pipe after attachment of bond or pipe test lead wires shall be the fast drying, non-shrinkable type.

2.13 BARRIER POSTS

Where indicated protective barrier post shall be 6-inch SCH 40 steel pipe concrete filled. Pipe height, 3-feet by 3-inches, embedded depth 4-feet by 3-inches in a concrete footing. Paint OSHA safety yellow epoxy or as indicated.

PART 3 - EXECUTION

3.01 GENERAL

Except as directed differently below, the installation of corrosion control and monitoring facilities shall conform to NACE Publication SP0169 (Revised 2013) Recommended Practice, Control of External Corrosion on Underground and Submerged Metallic Piping Systems and NACE SP-0286 Electrical Isolation of Cathodically Protected Pipelines. The installation of impressed current cathodic protection facilities and large sacrificial anode systems is not included in this document.

3.02 TEST BOXES

A. At-Grade Test Boxes:

1. Location: The atgrade test boxes shall be installed directly over the pipeline if possible. If the pipeline is in a paved roadway install behind the curb and out of traffic lanes. Test boxes can be embedded in the sidewalk just beyond the curb or placed in a concrete pad in the planter strip or just beyond the sidewalk. RMWD shall approve test station locations.

2. Installation: Mount test box flush with pavement or 1-inch higher than grade in grass or landscaped areas with the concrete pad domed to make a smooth transition to grade at the perimeter of the pad. The bottom of the box shall be native soil. Do not place rock, gravel or cement inside the box. All wires shall be properly identified with brass tags and cut off such that there is approximately 18-inches of slack wire above finish grade and coiled inside the test box. Keep the inside of the test box clear of all debris and other foreign material.

3. Wire Identification: Brass identification tags shall be securely attached to each of the wires in the test box. Tags shall be stamped in ¼-inch characters with RMWD and the size-material-service of the pipe to which the test leads are attached. For example RMWD 18”-STL-PW. Brass tags on wires in insulating flange test boxes shall be stamped with the additional identification of “N”, “S”, “E”, or “W” for North, South, East or West to indicate on which side of the insulating flange the wires are attached. Attach tags with bare No. 14 copper wire.

4. Concrete Pad: In unpaved areas the test box shall be mounted in a reinforced concrete pad 26-inches square by 4-inches deep constructed of ASTM C94 ReadyMix concrete. Rebar shall be No. 4 steel placed as shown in the drawings.

5. Marker Posts: Redwood marker posts are required wherever at grade anode test boxes are utilized in a remote area. Paint the post with two (2) coats of white epoxy. Locate marker post within 6-inches of the test box or as directed by RMWD. On the side facing the at grade test box, stencil on the post in 2-inch high black letters the words “CORROSION”.

B. Post Mounted Test Boxes:

1. Location: locate redwood post directly above the pipeline, if possible, but not in a roadway or in a location that clearly obstructs existing access or is particularly susceptible to damage. RMWD shall approve test station locations.

2. Post and Footing: Excavate a 12-inch diameter by 20-inch deep hole. Center the post and test box in the hole and fill the hole with concrete. The post shall be true vertical. The concrete shall be class C. Dome concrete slightly to prevent ponding water next to wood post.

3. Test Box and Conduit: Connect 2inch galvanized conduit to the test box enclosure with a threaded flange and collar connection. Attach test box to the redwood post using mounting brackets and threaded fasteners or wood screws through the back of the test box. Attach conduit to the post with conduit clamps and wood screws if necessary. Insert all test leads in the galvanized conduit and run into test box prior to setting the post in concrete.

4. Wire Identification: Brass identification tags shall be installed and marked per paragraph 3.02.A.3.

3.03 INSTALLING MAGNESIUM ANODES

A. General: Anodes shall be installed at locations as shown on the Drawings or as directed by RMWD. Care shall be taken to ensure that the cloth bag is not damaged and no backfill material lost during installation. Each magnesium anode shall be centered in the cloth bag. It may be necessary to recenter the anode in the cloth bag by rolling it on the ground prior to installation. Each magnesium anode shall be lowered into the hole using a sling or rope and placed

vertically at the bottom of the hole. Do not lower, transport, handle or lift the anode by the lead wire.

B. Primary Excavation Method: Prepackaged magnesium anodes shall be installed in a vertical augured hole of 12-inches in diameter. The depth of the hole shall be 12 feet as measured from the finish surface to the bottom of the anode unless otherwise specified by the District Representative.

C. Alternate Excavation Method: If the 12 foot depth cannot be obtained or if vertical auguring cannot be accomplished due to heavy rock, RMWD shall be notified for possible adjustment to the designed depth, position, and orientation of the anodes. Backhoe excavations must be approved by RMWD.

D. Relative Position: In general, anodes shall be offset from the steel pipe as far as possible while staying within RMWD's right-of-way. A minimum offset of 10 feet shall be used unless otherwise indicated on the Corrosion Protection Detail Drawings or directed by RMWD. At no time shall an anode be installed outside of the pipeline right-of-way or District's easement. Anodes shall not be installed such that a foreign metallic pipe is between the protected pipe and the anode.

E. Anode Soaking (Augured Holes): Once the prepackaged anode is in the hole, water shall be poured into the hole so that the anode is completely covered with water. Allow to soak for at least 15 minutes. Stonefree native soil shall then be used to backfill the anode hole. Do not use imported sand for backfilling. The anode hole shall be backfilled in stages and carefully tamped to ensure that no voids exist around the bag and that the bag and anode lead wire is not damaged. After backfill is level with the top of the anode, a minimum of 15 gallons of water shall be poured into the hole to completely saturate the soil backfill. More water shall be added if it is suspected that the backfill is not completely saturated. Care must be taken to avoid damage to the anode and anode lead wire.

F. Anode Soaking (Backhoe Installations): Prepackaged must be pre-soaked in water for at least 15 minutes before installing in the trench. After covering the anode with native, rock-free soil (approximately 3-inches over the anode) the anode and initial backfill shall be further soaked with 15 to 20 gallons of water and allowed to soak for 15 minutes. The remainder of the trench shall be backfilled with native soil.

G. Wire Tags: Anode wires are not tagged.

3.04 INSTALLING ANODE LEAD WIRES

A. Lead Wire: Anode lead wire shall be long enough to reach from the anode to the anode test box without a splice. Anode lead wires shall terminate individually in the appropriate anode test box. Care shall be taken not to damage the lead wire through the installation process.

B. Wire Trenching: See paragraph 3.06.D. If anode wire insulation is damaged during installation, the wire and anode shall be replaced unless wire splices or insulation repairs are approved by RMWD . Anode replacement shall be at the Contractor's expense.

C. Wire Splicing and Insulation Repairs: See paragraph 3.07 for general wire splice and insulation repair requirements. Neither splices nor insulation repairs shall be allowed unless specifically approved by RMWD.

3.05 EARTHWORK

See Specification Section 02200 for earthwork requirements.

3.06 WIRE AND CABLE

A. General: No less than two (2) test wires shall be attached to the pipe at each designated test site. All test wires shall terminate in a test box without a splice. A minimum of 18-inches of slack wire shall be coiled at the wire-to-pipe connection and in at-grade test boxes for each test wire. At post-mounted test stations slack wire shall be provided inside the box to the extent possible and with one 8-inch diameter loop at the below-grade entrance to the conduit.

B. Connection to Pipe: Connections of copper wire to the pipeline shall be made with exothermic weld charges or by brazing. Welding charges shall be the product of a manufacturer regularly engaged in the manufacture of the material. Manufacturer's recommend cartridge size and type shall be used. Each weld shall be installed, tested and coated as described below.

1. Preparation of Wire: Use a cutter to prevent deforming wire ends. Remove only enough insulation from the wire to allow the weld connection to be made. Do not use a hacksaw for cutting.

2. Preparation of Metal: Remove all coating, dirt, grime and grease from the metal pipe at weld location by wire brushing and/or use of suitable safe solvents. Clean the pipe to a bright, shiny surface free of all serious pits and flaws by use of mechanical grinder or a file. The area of the pipe where the attachment shall be made must be absolutely dry. Failure to provide a dry surface for welding will result in a poor quality weld and could result in serious injury to the workperson. Do not cut reinforcing rods when preparing metal surface for wire attachment.

3. Attachment of Wire to Pipe: The attachment of copper wire shall be made using an exothermic weld as shown on the Standard Drawings. The wire shall be held at 30° to 45° angle to the surface when welding. Only one (1) wire shall be attached with each weld.

4. Testing of All Completed Welds: As soon as the weld has cooled, the weldment shall be tested for strength by striking a sharp blow with a two pound hammer while pulling firmly on the wire. All unsound welds are to be rewelded and retested. All weld slag shall be removed from the weldment.

5. Coating of All Completed Welds: Thoroughly clean by wire brushing the area to be coated. The area must be completely dry. Apply the weld cap primer and the weld cap. Overcoat the weld cap with a bituminous mastic coating material in accordance with the manufacturer's recommendations. Completely coat the weld, all bare pipe surfaces around the weld and any

exposed copper wire. Allow sufficient time to dry prior to repair of the mortar coating on steel pipe.

6. Mortar Repair: On mortar coated pipe, the mortar coating shall be repaired after the bituminous weld coating has dried, using fastsetting, non-shrinkable mortar to restore the original outside diameter of the pipe at each weld location.

C. Plastic Lined Pipe: Do **not** weld test or bond wires directly to plastic lined pipe (sewer or reclaimed water). Wires must be attached to factory installed bonding pads per RMWD Standard Drawings.

D. Wire Trenching and Backfill:

1. Depth: All buried horizontal test or anode lead runs shall be installed at a minimum depth of 24-inches.

2. Backfill: The bottom 2-inches of the finished trench shall be sand or stonefree earth. The first 3-inches of the backfill shall be sand or stone-free earth placed directly on the wires. The remainder of the trench shall be backfilled with native earth with a maximum stone size of 2-inches and compacted as specified in Standard Specification 02223.

3. Damaged Wire: Care shall be taken when installing wire and backfilling trench so that insulation is not broken, cut, nicked, or bruised. If wire insulation is damaged during installation, it shall be replaced completely at the Contractor's expense.

4. Warning Tape: Plastic warning tape shall be installed over all wire runs 12-inches below grade.

E. Wire Splices or Repairs

1. Approval: No wire splices or insulation repairs shall be made unless approved by the District Representative.

2. Splices: The minimum amount of insulation shall be removed from each wire end. Brass crimp or split-bolt connectors shall be used. The splice shall be encased in a plastic mold filled with insulating resin such as 3M Scotchcast splice kits.

3. Insulating Repairs: Depending on the severity of the insulation damage repairs shall be made with electrical tape or with a splice kit as determined by the District Representative.

4. Inspection: All splices and insulation repairs shall be inspected by the District Representative before they are buried.

3.07 CONTINUITY BONDING:

A. General: All joints on buried steel pipe shall be metallically continuous by welding or bonding. DIP joints may also be bonded if directed by the Project Documents

or RMWD. Joints to be bonded include all unwelded pipe joints and mechanical joints including flanges (except insulating flanges), valves, couplings, adapters and special fittings. All bonding shall be done with single conductor, stranded copper jumper wires with HMWPE insulation. Bond wires shall be as short as possible with only minimal slack. All pipe reaches with one or more unwelded joints (or one or more bonds) will be tested for continuity.

B. Pipe Joints: At least two (2) wires are required for each steel or ductile iron pipe bond. Two (2) wires shall be installed unless otherwise specified. Three (3) wires may be required at valves, couplings, special fittings and across unwelded joints on pipe larger than 24-inches. Bond wire sizes may be No. 2, 4 or 6. Use No. 4 bond wires unless indicated otherwise in the project drawings.

C. Mechanical Joints and Fittings: All flanges and in-line fittings (valves, couplings, etc.) shall be completely bridged by at least two (2) bond wires. Three (3) wires may be required on fittings larger than 24-inches. One additional No. 6 HMWPE wire is required from the pipe (on either side) to the fitting. Bond wire sizes may be No. 2, 4 or 6. Use No. 4 bond wires unless indicated otherwise in the project drawings.

D. Wire Attachment Method: Bond wire attachment, testing and subsequent coating of the welds shall be as specified in paragraph 3.06.B.

E. Wire Attachment Location: Bond wires can either be attached to the pipe or pipe cylinder directly to the outside edges of flanges that are welded to the pipe. Bond wires shall not be attached to valve bodies, but instead to the flange of the valve.

3.08 INSULATING FLANGE KITS

A. Flange Kits: Insulating kits shall be installed as shown on drawings and as recommended by the manufacturer. Moisture, soil, or other foreign matter must be carefully prevented from contacting any portion of the mating surfaces prior to installing insulator gasket. If moisture, soil, or other foreign matter contacts any portion of these surfaces, the entire joint shall be disassembled, cleaned with a suitable solvent and dried prior to reassembly.

B. Spool Assembly: All direct buried insulating kits, greater than 20-inches in diameter, shall be pre-installed and tested on the pipe spool prior to installing the spool in the ditch. If possible, all smaller size direct buried insulating kits shall be similarly pre-installed and tested.

C. Handling of Gasket: Care shall be taken to prevent any excessive bending or flexing of the gasket. Creased or damaged gaskets shall be rejected and removed from the job site.

D. Alignment: Alignment pins shall be used to properly align the flange and gasket.

E. Bolt Tightening: The manufacturer's recommended bolt-tightening sequence shall be followed. Bolt insulating sleeves shall be centered within the insulation washers so that the insulating sleeve is not compressed and damaged.

F. Testing: All insulating flanges must be tested by a qualified Corrosion Technician or Engineer and accepted by the District Representative. All buried insulating flanges must be tested prior to wax tape wrap coating and backfilling. The assembled flange shall be tested as described below.

G. Wax Tape Coating: After testing and RMWD acceptance, the insulating flange shall be fully wrapped with petrolatum wax tape as indicated in this specification section.

3.09 SUPPLEMENTARY INTERIOR LINING AT INSULATING FLANGES

A. General: Supplementary linings are required **only** where called out in the drawings or Project Design Documents. It is the contractor's responsibility to determine and verify which insulating flanges require supplementary internal lining.

B. Extent of lining: the interior of the pipeline shall be lined with a supplementary epoxy lining for a distance of two (2) pipe diameters in each direction away from an insulating flange. At an insulated flange on a valve, the supplementary lining shall be applied (for a distance of two pipe diameters) only to the pipe directly adjacent to the insulating flange.

C. Surface Preparation: The surface preparation of the mortar lining shall consist of wire brushing (hand or power) or water blasting to remove the latence and all loose mortar to provide a clean abraded surface for adhesion of the lining. The surface shall be clean and free of dust and standing water but not necessarily dry.

D. Mixing: The two-part epoxy paint shall be thoroughly mixed per the manufacturer's recommendations but at a minimum of two (2) minutes by hand or with a mechanical mixer before being applied by brush.

E. Pot Life: A typical pot life is 30 minutes. The lining material shall not be applied after its useful pot life.

F. Application: Application of undiluted lining material shall be by spray, roller or brush until a maximum coating thickness of 20 mils is achieved. Each ensuing coat shall be applied before the previous coat fully cures, usually within 3 to 6 hours. Typically, this material is applied at the rate of 140 square feet per gallon. This would ordinarily produce the required coating with a total of two (2) coats. However, the 20-mil minimum thickness shall be satisfied regardless of the number of applications necessary to achieve it.

G. Inspection: Each pipe spool to which the supplementary lining is applied must be inspected and accepted by RMWD prior to assembly.

3.10 CASING INSTALLATIONS

A. Casing Insulators: The number and orientation of runners on each casing insulator shall be as recommended by the manufacturer depending on pipe size. The spacing between insulators shall be determined by the civil or structural engineer.

B. End Seals: Heat shrinkable or mechanical link seals shall be installed in accordance with the manufacturer's recommendations. Remove all contaminants and debris from the annulus. Seals must be watertight.

C. Casing Test Stations: Test stations (4-wire) shall be installed on all casings. Use two (2) each No. 10 HMWPE wires on the casing and two (2) each No. 8 HMWPE wires on the carrier pipe unless otherwise directed. Use post-mounted or at-grade test stations as indicted in the project drawings or as directed by RMWD.

3.11 EARTHWORK

See Specification 02200 for earthwork requirements.

PART 4 - SYSTEM TESTING

4.01 TEST LEADS AND BOND WIRES

A. Responsibility: The Contractor shall be responsible for testing all test leads and bond wire welds.

B. Test Method: All completed wire connection welds shall be tested for strength by striking the weld with a sharp blow with a 2-pound hammer while pulling firmly on the wire. Welds failing this test shall be re-welded and re-tested. Wire welds shall be spot tested by RMWD. After backfilling pipe, all test lead pairs shall be tested using a standard ohmmeter or resistance meter for broken welds. Bond wires shall be tested through continuity testing described below.

C. Acceptance: The resistance between each pair of test leads shall not exceed 150% of the total wire resistance as determined from calculations based on published wire resistance data and an estimate of test wire length.

4.02 ANODE INSTALLATIONS

A. Responsibility: The contractor must provide the proper rated potential anode, sufficient anode lead wire length and the proper anode hole depth. The Contractor's Corrosion Engineer shall test each installed anode for wire connection integrity and for open-circuit potential for witness and approval by the District.

B. Notification: The Contractor shall notify RMWD at least five (5) days in advance of the start and completion of the anode installations, including anodes and test stations.

C. Cathodic Protection Performance Test Method: The performance of the cathodic protection system shall be tested by the Contractors Corrosion Engineer for witness and approval by the District. The testing shall include: measurement of all open-circuit anode potentials; pipe-to-soil potentials at each test station and other locations as necessary before the anodes are connected; initial anode currents after connecting anode leads to the pipe leads; and the pipe-to-soil potential at each previously tested site with all anodes connected. Pre- and post cathodic protection potentials at midpoints between anode beds are required as necessary

to verify that the pipeline is fully protected. Adequate protection shall be as defined in NACE SP-0169.

D. Field Report: All system deficiencies shall be listed and described in one or more field test reports and presented to the Contractor for repairs.

E. Acceptance: The system will be accepted if all anodes, test stations, and supporting facilities are installed properly. Cathodic protection performance, with the exception of materials and installation deficiencies, is not the Contractor's responsibility.

4.03 WIRE TRENCHING

A. Responsibility: RMWD at their discretion, shall inspect wire trenches and backfill material and methods.

B. Test Method: The depth, trench bottom padding and backfill material shall be visually inspected prior to backfilling.

C. Acceptance: Conformance with project specifications.

4.04 INSULATOR TESTING

A. Responsibility: Insulating flanges shall be inspected and tested by the Contractors Corrosion Engineer for witness and approval by the District. Buried insulators must be tested and approved prior to application of wax tape and backfilling. Large diameter insulators shall be tested on the spool prior to installation in the ditch.

B. Test Method: The assembled flange shall be tested with an insulator testing device (i.e., Gas Electronics Model 601 Insulation Checker) specifically designed for this purpose. Additionally, the pipe-to-soil potential, using a high impedance voltmeter and suitable reference cell, shall be measured on each side of the insulator after installation in the trench but before backfilling. Potential testing can only be done on piping that has been installed in the ditch.

C. Acceptance: The installation shall be considered complete when the insulator testing device indicates that no shorts or partial shorts are present and when the potential tests indicate greater than 20-millivolt pipe-to-soil potential difference across the flange. (Note that this test may not be valid if the pipe on each side of the insulator is in contract through interconnection piping or through contacts to the electrical grounding system.) If shorts are detected the Contractor shall assist RMWD in finding partial shorts or shorted bolts. All disassembly and re-assembly necessary to gain approval from the RMWD shall be done at the Contractor's expense.

4.05 PIPELINE CONTINUITY

A. Responsibility: The Contractor's Corrosion Engineer shall test the continuity of all sections of buried steel pipe that contains non-welded pipe joints or mechanical joints or fittings for witness and approval by the District. All such joints are

required to be bonded per this specification. Bonded DIP also requires continuity testing.

B. Test Method: Resistance shall be measured by the linear resistance method. A direct current shall be impressed from one end of the test section to the other (test station to test station) using DC power supply (battery). A voltage drop is measured with the direct current applied. The resistance (R) is calculated using the equation R = dV/I, where dV is the voltage drop and I is the current.

C. Acceptance: Acceptance is reasonable comparison of the measured resistance with the calculated or theoretical resistance. The measured resistance shall not exceed the theoretical resistance by more than 30%. The Contractor shall submit calculations of the theoretical resistance and the measured resistance for each section of pipe tested.

D. Deficiencies: If discontinuity or high resistance is found between sections of pipe tested, it is the Contractor's responsibility to locate, excavate, and repair all bonds that are found to be discontinuous. Continuity tests shall be repeated after repairs are made. **Note:** Discontinuities may be difficult and expensive to locate and may require several excavations to expose pipe joints and attach temporary test leads for progressive continuity testing. Accordingly, the Contractor shall exercise due care in installing continuity bonds and shall schedule continuity testing as early as possible so that discontinuity location and repairs, if necessary, do not conflict with road paving operations.

4.06 TEST STATIONS

A. Responsibility: The Contractor's Corrosion Engineer will inspect all test station installations for compliance with this specification. The Contractor's Corrosion Engineer will test all wires for continuity and proper connection for witness and approval by the District.

B. Test Method: Test stations will be visually inspected. Wire continuity will be tested by potential and resistance measurements.

C. Acceptance: Installation in accordance with this specification and good workmanship and verification that all wires are properly connected.

4.07 WAX TAPE COATING

A. Responsibility: The Contractor's Corrosion Engineer shall inspect all completed wax tape wrapping for compliance with these specifications prior to backfilling for witness and approval by the District.

B. Test Method: Inspection shall be visual.

C. Wax Tape Acceptance: Wax tape applications shall be accepted if: the application conforms with this specification; there are no voids or gaps under the wax tape; stud-ends, nuts, couplings rods and all irregular surfaces are individually wrapped such that there is complete coverage with the petrolatum material; the outer wrap is complete and tightly adhering to the wax tape; and the application is done in a good manner.

D. Supplementary Lining Acceptance: Internal supplementary linings must cover the specified length of pipe and must be well bonded to the substrate and free of voids or damage.

4.08 CASING ISOLATION

A. Responsibility. The Contractor's Corrosion Engineer shall test the isolation between the carrier pipe and the casing and verify that there is no metallic contact between the two structures for witness and approval by the District.

B. Method. Two test methods are required. Structure-to-soil potentials of each structure shall differ by more than 30 millivolts with the reference cell located in the same place. Resistance between the two structures, measured with a megger or other suitable resistance meter, shall exceed 25 ohms. Additional or alternate test methods recommended by the Contractor shall be approved by the District Representative.

C. Notification for Testing. The Contractor shall notify RMWD at least five (5) days in advance of plans to test the isolation between the carrier pipe and the casing.

D. Acceptance. Complete metallic isolation is required. Under no conditions will a metallic short between the carrier pipe and the casing be allowed.

4.09 DEFICIENCIES

Deficiencies: Any deficiencies or omissions in materials or workmanship found by these tests shall be rectified by the Contractor at their expense. Deficiencies shall include but are not limited to: broken or missing test leads; improper or unclean wire trench backfill; inadequate pipeline continuity; shorted or partially shorted insulators or casings; lack of 18-inch slack wire in at-grade test boxes; improperly mounted or located test boxes; improper wire identification; poorly applied wax tape or supplementary lining; and other deficiencies associated with the workmanship, installation and non-functioning equipment.

-END OF SECTION-

SECTION 15000

PIPING COMPONENTS

PART 1 – GENERAL

1.01 WORK INCLUDED

The Work of this Section includes providing fittings, hangers, supports, anchors, expansion joints, flexible connectors, insulation, lining and coating, testing, disinfection, and accessories.

1.02 SUBMITTALS

A. General: Submittals shall be in accordance with Section 01300 - Submittals.

B. Shop Drawings: Shop drawings shall include the following information:

1. Shop drawings showing dimensions and details of pipe joints, fittings, fitting specials, valves and appurtenances.

2. Detailed layout, spool, or fabrication drawings showing pipe spools, spacers, adapters, connectors, fittings, and pipe supports.

1.03 OWNER'S MANUAL

A. The following shall be included in the OWNER'S MANUAL in compliance with Section 01300:

1. Manufacturer's product data.

2. Manufacturer's installation instructions.

3. Manufacturer's certification of compliance.

4. Statement from the pipe fabricator certifying that all pipe will be fabricated subject to a Quality Control Program.

5. Outline of Quality Control Program.

1.04 INSPECTION, TESTING AND WELDING

A. Inspection: Products shall be inspected at the manufacturer's plant.

B. Tests: Materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards.

C. Welding Requirements: Welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D10.9. Welding procedures shall be required for longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.

D. Welder Qualifications: Welding shall be performed by skilled operators who have had adequate experience in the methods and materials to be used and have been qualified under the provisions of ANSI/AWS D10.9 by an independent approved testing agency not more than 6 months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the Work shall be used in qualification tests.

1.05 FACTORY TESTING

A. Product Testing: Products shall be tested at the factory for compliance with the indicated requirements.

B. Witnesses: RMWD reserves the right to witness factory tests.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.

B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

PART 2 – PRODUCTS

2.01 GENERAL

A. Miscellaneous Small Pipes: Miscellaneous small pipes and fittings shall comply with Section 15000.

B. Coating: Pipes above ground or in structures shall be field-painted in accordance with Section 09900 and Section 09961.

C. Pressure Rating: Except as otherwise indicated, piping systems shall be designed for 150 percent of the maximum indicated pressure.

D. Grooved Piping Systems: Grooved couplings on buried piping must be bonded. Grooved fittings, couplings, and valves shall be from the same manufacturer.

2.02 PIPE FLANGES

A. Flanges: Where the design pressure is 150 psi or less, flanges shall conform to either ANSI/AWWA C207 Class D or ANSI B16.5 150-lb class. Where the design pressure is greater than 150 psi, up to a maximum of 275 psi, flanges shall conform to either ANSI/AWWA C207 Class E, Class F, or ANSI B16.5 150-lb

class. Where the design pressure is greater than 275 psi up to a maximum of 700 psi, flanges shall conform to ANSI B16.5 300-lb class. Flanges shall be attached to the pipe in accordance with ANSI/AWWA C207.

B. Blind Flanges: Blind flanges shall comply with ANSI/AWWA C207. Blind flanges for pipe sizes 12 inches and larger shall include lifting eyes in form of welded or screwed eye bolts.

C. 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.

D. Flange Bolts: Bolts and nuts shall comply with Section 05500. Studs and bolts shall extend through the nuts a minimum of 1/4-inch. All-thread studs may be used only on valve flange connections where space restrictions preclude the use of regular bolts.

2.03 THREADED INSULATING CONNECTIONS

A. General: Threaded insulating bushings, unions, and couplings shall be used for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are indicated.

B. Materials: Threaded insulating connections shall be of nylon, Teflon, polycarbonate, polyethylene, or other non-conductive materials, and shall have ratings and properties suitable for the service and loading conditions indicated.

2.04 MECHANICAL-TYPE COUPLINGS (GROOVED OR BANDED PIPE)

General: Cast mechanical-type couplings shall be provided where shown. Bolts and nuts shall conform to Section 05500. Gaskets for mechanical-type couplings shall be compatible with the piping service and fluid utilized in accordance with the coupling manufacturer's recommendations. The wall thickness of all grooved piping shall conform with the coupling manufacturer's recommendations suitable for the highest pressure indicated.

2.05 FLEXIBLE COUPLINGS

General: Grooved type flexible couplings shall be provided where shown. Housing shall be ductile iron conforming to ASTM A-536. Bolts and nuts shall conform to Section 05500. Gaskets for flexible couplings shall be compatible with the piping service and fluid utilized in accordance with the coupling manufacturer’s recommendations. The wall thickness of all piping shall conform with the coupling manufacturer's recommendations suitable for the highest pressure indicated.

2.06 SLEEVE-TYPE COUPLINGS

A. Construction: Sleeve-type couplings shall be installed where indicated and shall include steel bolts, without pipe stop, and shall be sized to fit the pipe and fittings indicated. The middle ring shall be not less than 1/4-inch in thickness and shall be either 5 or 7 inches long for standard steel couplings, and 16 inches long for long-

sleeve couplings. The followers shall be single-piece contoured mill section 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 pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket. Bolts and nuts shall conform to Section 05500. Buried sleeve-type couplings shall be epoxy-coated at the factory.

B. Pipe Preparation: The ends of the pipe, where indicated, shall be prepared for flexible steel couplings. Plain ends for use with couplings 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. Gaskets: Gaskets for sleeve-type couplings shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. Gaskets for wastewater and sewerage applications shall be Buna "N," grade 60, or equivalent suitable elastomer. The rubber in the gasket shall comply with the following:

1. Color - Jet Black

2. Surface - Non-blooming

3. Durometer Hardness - 74 V 5

4. Tensile Strength - 1000 psi Minimum

5. Elongation - 175 percent Minimum

The gaskets shall resist deterioration caused by impurities normally found in water or wastewater. Gaskets shall comply with ASTM D 2000, AA709Z, meeting Suffix B13 Grade 3, except as otherwise indicated. Gaskets shall be compatible with the piping service and fluid utilized.

D. Restrained Joints

1. Harnesses for flexible sleeve type couplings shall be in accordance with the requirements of the appropriate reference standards and standard practices.

2. Mechanical and Push-On Joints: Restraints shall be provided where shown and may be provided in lieu of concrete thrust blocks.

a. Mechanical joint restraint mechanisms shall consist of individually activated multiple gripping devices which incorporate breakoff actuating units and permanent nuts for future disassembly. Pressure ratings shall be:

(1) Ductile Iron Pipe

(a) 3 to 6 inch diameter: 350 psi (2:1 safety factor)

(b) 18 to 48 inch diameter: 250 psi (2:1 safety factor)

(2) PVC Pipe

(a) 3 to 36 inch diameter: full pressure rating or pressure class of pipe (2.5:1 safety factor).

(b) Push-on joints for steel pipes shall be in accordance with the appropriate reference standards and standard practice.

(c) Restrained push-on joints for all other pipe materials shall be comprised of two rings with connecting rods. The restraint ring shall be on the spigot, and a plain or slit bell ring shall be on the bell. Pressure ratings shall be:

(1) Ductile Iron Pipe

(a) 3 to 6 inch diameter: 350 psi (2:1 safety factor)

(b) 18 to 48 inch diameter: 250 psi (2:1 safety factor)

(2) PVC Pipe

(a) 3 to 10 inch diameter: 200 psi (4:1 safety factor)

(b) 12 inch diameter: 150 psi (4:1 safety factor)

(c) 14 to 16 inch diameter: 235 psi (2:1 safety factor)

(d) 18 to 30 inch diameter: 165 psi (2:1 safety factor)

(e) 36 inch diameter: 125 psi (2:1 safety factor)

(3) Dimensions of push-on bell restraints shall be compatible with ANSI/AWWA C150 and C900 or C905 for ductile iron or PVC pipe, respectively.

d. Restraint glands shall be of ductile iron conforming to ASTM A 536. Dimensions of the glands shall be compatible with standard mechanical joint bell and tee head bolts conforming to ANSI/AWWA C111 and C153, respectively.

e. Bolts and nuts shall conform to Section 05500.

2.07 ADJUSTABLE LINKED RUBBER SEALS

A. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. After the seal assembly is positioned in the sleeve, tightening of the bolts shall cause the rubber sealing elements to expand and provide an absolutely watertight seal between the pipe and wall opening. The seal shall be constructed so as to provide electrical insulation between the pipe and wall, thus reducing chances of cathodic reaction between these two members. Bolting shall be Type 316 stainless steel.

B. The Contractor shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabricating or installing. The inside diameter of each wall opening shall be sized as recommended by the manufacturer to fit the pipe and seal to ensure a watertight joint.

C. Adjustable linked rubber seals shall be installed in a core-drilled wall opening for existing concrete structures, on in a stainless steel wall sleeve (with water stop collar) for cast-in-place concrete structures.

2.08 MANUFACTURERS

A. Manufacturers: Products of the type or model (if any) indicated shall be manufactured by one of the following (or equal):

1. Flange Gaskets:

a. Calpico

b. Garlock, Style 3000

c. Johns-Manville

d. Klinger 4401

e. Tripac 5000

2. Couplings, Straight Flexible:

a. APAC 301

b. Ford FC1

c. Powerseal 3501, 3538

d. Romac 501

e. Smith-Blair 411

f. Viking Johnson Maxifit

g. Dresser 38

h. Victaulic 75, 77

i. Grinnell Corp., Exeter. PA

3. Adjustable Linked Rubber Seals:

a. Link-Seal by Pipeline Seal and Insulator, Inc.

PART 3 – EXECUTION

3.01 GENERAL

A. Pipes, fittings, and appurtenances shall be installed in accordance with the manufacturer's installation instructions.

B. Threaded pipe ends and joints shall be epoxy coated in compliance with Section 09900 and 09961.

-END OF SECTION-

SECTION 15020

PIPE SUPPORTS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The Contractor shall provide pipe supports, seismic restraints, hangers, guides, and anchors, complete, in accordance with the requirements of the Drawings and Specifications.

1.02 SUBMITTALS

A. General: Submittals shall be in accordance with Section 01300 - Submittals and Section 15000 - Piping Components.

B. Shop Drawings: Shop drawings shall include the following information:

1. Pipe supports, restraints, hangers, anchors, and guides. Contractor shall design supports to determine the location and number of supports required.

2. Calculations for special supports and anchors.

PART 2 – PRODUCTS

2.01 GENERAL

A. Code Compliance: All piping systems and pipe connections to equipment shall be properly anchored and supported to prevent undue deflection, vibration, dislocation due to seismic events and line pressures, and stresses on piping, equipment, and structures. All supports and parts thereof shall conform to the requirements of ANSI/ASME B31.1 - Power Piping, except as supplemented or modified below. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code or local administration requirements.

B. Structural Members: Wherever possible, pipes shall be supported from structural members. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided at no additional cost to the RMWD. All supplementary members shall be in accordance with the requirements of the building code and the American Institute of Steel Construction and shall be acceptable to the District Representative.

C. Pipe Hangers: Pipe hangers shall be capable of supporting the pipe in all conditions of operation, allowing free expansion and contraction of the piping, and preventing excessive stress on equipment. All hangers shall have a means of vertical adjustment after erection. Hangers shall be designed to prevent becoming disengaged by any movement of the supported pipe. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves, shall include hydraulic shock suppressors. All hanger rods shall be subject to tensile

loading only.

D. Hangers Subject to Horizontal Movements: At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement. Where horizontal pipe movement is greater than 1/2-inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from the cold to the hot position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.

E. Spring-Type Hangers: Spring-type pipe hangers shall be provided for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping. All spring-type hangers shall be sized to the manufacturer's printed recommendations and the loading conditions encountered. Variable spring supports shall be provided with means to limit misalignment, buckling, eccentric loading, or to prevent overstressing of the spring, and with means to indicate at all times the compression of the spring. Supports shall be capable of accommodating at least four times the maximum travel due to thermal expansion.

F. Thermal Expansion: Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints permitting the piping to expand and contract freely in directions away from the anchored points. All components shall be structurally suitable to withstand all loads imposed.

G. Riser Supports: Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.

H. Freestanding Piping: Free-standing pipe connections to equipment such as chemical feeders and pumps shall be firmly attached to steel frames fabricated from angles, channels, or I-beams anchored to the structure. Exterior, free-standing overhead piping shall be supported on fabricated pipe stands consisting of pipe columns anchored to concrete footings, with horizontal, welded steel angles and U-bolts or clamps securing the pipes.

I. Materials of Construction:

1. General: All pipe support assemblies, including framing, hardware, and anchors, shall be steel construction, galvanized after fabrication, unless otherwise indicated.

2. Submerged Supports: All submerged piping, as well as piping, conduits, and equipment in hydraulic structures within 24-inches of the water level, shall be supported with support, assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel, unless otherwise indicated.

3. Corrosive Areas: All piping in chemical and corrosive areas shall be supported with support assemblies, including framing, hardware, and anchors, constructed of Type 316 stainless steel or FRP, unless otherwise indicated.

J. Point Loads: Any meters, valves, heavy equipment, and other point loads on PVC, FRP, and other plastic pipes, shall be supported on both sides, according to manufacturer's recommendations to avoid undue pipe stresses and failures. To avoid point loads, all supports on PVC, FRP, and other plastic piping shall be equipped with extra wide pipe saddles or galvanized steel shields.

K. Noise Reduction: To reduce transmission of noise in piping systems, all copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar, suitable material at each pipe support, bracket, clip, or hanger.

2.02 SUPPORT SPACING

A. Supports for piping shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given where components such as flanges and valves impose concentrated loads. Pipe support spacing shall not exceed the maximum spans in the tables below. For temperatures other than ambient temperatures and for other piping materials or wall thicknesses, the pipe support spacings shall be modified in accordance with the pipe manufacturer's recommendations. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of all loading effects.

1. Support Spacing for Schedule 40 and Schedule 80 Steel Pipe:

Nominal Pipe Diameter (inches)	Maximum Span (feet)
2	6
3/4 and 1	8
1-1/4 to 2	10
3	12
4	14
6	17
8 and 10	19
12 and 14	23
16 and 18	25
20 and 22	30

2. Support Spacing for Welded Fabricated Steel Pipe:

Nominal Pipe Diameter (inches)	Wall Thickness B (inches)									
	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
24	33	37	41	43	45	47				
26	34	38	41	44	46	48				
28	34	38	41	44	47	49				
30	34	38	42	45	48	49				
32	34	39	42	45	48	50				
34	35	39	42	46	48	50				
36	35	39	43	46	49	51	55			
38	35	39	43	46	49	51	55			
40	35	40	43	47	49	52	56			
42	--	40	43	47	50	52	56			
45	--	40	44	47	50	53	57			
48	--	40	44	47	50	53	58	61		
51	--	41	44	48	51	53	58	62		
54	--	41	44	48	51	54	58	62		
57	--	41	44	48	51	54	59	63		
60	--	41	45	48	52	54	59	63	67	70
63	--	41	45	49	52	55	60	64	67	71
66	--	41	45	49	52	55	60	64	68	71
72	--	41	45	49	52	55	61	65	69	72
78	--	41	45	49	53	56	61	66	69	73
84	--	41	46	50	53	56	62	66	70	74
90	--	41	46	50	53	56	62	67	71	74
96	--	42	46	50	54	57	62	67	71	75

For steel pipe sizes not presented in this table, the support spacing shall be designed so that the stress on the pipe does not exceed 5,000 psi. Maximum deflection of pipe shall be limited to 1/360th of the span and shall be calculated by using the formula:

$$L = [(7500tD)/(32t + D)]0.5$$

where: t = Thickness (inches)

D = Diameter (inches)

L = Maximum span (feet)

3. Support Spacing for Ductile-Iron Pipe:

Nominal Pipe Diameter (inches)	Maximum Span (feet)
All diameters	Two supports per pipe length or 10 feet (one of the 2 supports located at joint)

4. Support Spacing for Schedule 80 PVC Pipe:

Nominal Pipe Diameter (inches)	Maximum Span (at 100 degrees F) (feet)
1/2	4
3/4	4.5
1	5
1-1/4	5.5
1-1/2	5.75
2	6.25
3	7.5
4	8.25
6	10
8	11
10	12.25
12	13.25

2.03 MANUFACTURED SUPPORTS

A. Stock Parts: Designs shall exemplify good engineering practice and use stock or production parts. Such parts shall be locally available, new, of best commercial quality, designed and rated for the intended purpose.

B. Manufacturers, or equal:

1. Bergen-Paterson Pipe support Corp., Woburn, MA

2. Anvil International

3. Tolco

4. PHS Industries

5. Piping Technology & Products, Inc.

2.04 COATING

A. Galvanizing: Unless otherwise indicated, all fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123 - Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. Other Coatings: Other than stainless steel or non-ferrous supports, all supports shall receive protective coatings in accordance with the requirements of Section 09900 - Protective Coating.

PART 3 – EXECUTION

3.01 INSTALLATION

A. General: All pipe supports, seismic restraints, hangers, brackets, anchors, guides, and inserts shall be fabricated and installed in accordance with the manufacturer's printed instructions and ANSI/ASME B31.1 - Power Piping. All concrete inserts for pipe hangers and supports shall be coordinated with the form work.

B. Appearance: Pipe supports and hangers shall be positioned to produce an orderly, neat piping system. All hanger rods shall be vertical, without offsets. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, and without interference with other work.

3.02 FABRICATION

A. Quality Control: Pipe hangers, supports, and seismic restraints shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available. Fabricated supports shall be neat in appearance without sharp corners, burrs, and edges.

-END OF SECTION-

SECTION 15041

DISINFECTION OF PIPE AND WATER STORAGE FACILITIES

PART 1 – GENERAL

1.01 DESCRIPTION

This section describes requirements for disinfection by chlorination of potable water mains, services, pipe appurtenances and connections.

1.02 REFERENCED STANDARDS

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.

AWWA B301	Standard for Liquid Chlorine
AWWA C651	Disinfecting Water Main
AWWA C652	Tank Disinfection

1.03 RELATED WORK SPECIFIED ELSEWHERE

Section 15000	Piping Components
Section 15044	Hydrostatic Testing of Pressure Pipe
Section 15076	CML&C Steel Pipe and Specials
Section 15100	Valves
Section 15101	Resilient Seated Gate Valves

1.04 SERVICE APPLICATION

A. All water mains and appurtenances taken out of service for inspection, repairs, or other activity that might lead to contamination shall be disinfected before they are returned to service.

B. All new water mains and temporary high lines shall be disinfected prior to connection to the District's existing system.

C. All components incorporated into a connection to the District's existing system shall be disinfected prior to installation.

1.05 SUBMITTALS

A. A written disinfection and dechlorination plan signed by a certified chlorinator shall be submitted to the District for review and approval prior to starting disinfection operations.

B. A Record of Disinfection shall be provided to the District water quality staff prior to sampling. The Record of Disinfection shall include the time of injection, time length

of injection and log of disinfection. Disinfection must be completed by a licensed and certified company.

1.06 DELIVERY, STORAGE AND HANDLING

Chlorination and dechlorination shall be performed by competent individuals knowledgeable and experienced in the operation of the necessary application and safety equipment in accordance with applicable Federal, State and Local laws and regulations. The transport, storage and handling of these materials shall be performed in accordance with Code of Federal Regulations (CFR) 1910.120 Hazardous Waste Operations and Emergency Response, CFR 49.172 Hazardous Materials Regulations, and the General Industry Safety Orders of the California Code of Regulations, Title 8, Section 5194.

1.07 DISINFECTION AND HYDROSTATIC TESTING

The specified disinfection of the pipelines shall not be performed concurrently with the hydrostatic testing. Disinfection shall only be performed after lines have been flushed and have passed hydrostatic tests per Section 15044.

1.08 CONNECTION TO EXISTING MAINS

Prior to connection to existing mains, disinfection and bacteriological testing shall be performed in accordance with this specification, and hydrostatic testing shall be performed per Section 15044. District authorization for connection to the existing system shall be given only on the basis of acceptable hydrostatic, disinfection and bacteriological test results.

PART 2 – MATERIALS

2.01 LIQUID CHLORINE (GAS)

Gas chlorine shall not be used for disinfection of pipelines.

2.02 SODIUM HYPOCHLORITE (LIQUID)

Sodium hypochlorite is available in liquid form in glass or plastic containers, ranging in size from 1 qt. to 5 Gal. The solution contains approximately 10% to 15% available chlorine.

2.03 GRANULAR HYPOCHLORITE

Granular hypochlorite may be used when mixed into a solution containing approximately 10% to 15% available chlorine. When using granular hypochlorite in solution, follow the procedure for sodium hypochlorite solution in this section.

PART 3 - EXECUTION

3.01 GENERAL

A. Disinfection of pipelines shall not proceed until all appurtenances and any necessary sample ports have been installed and the District Representative provides authorization.

B. Every effort shall be made to keep the water main and its appurtenances clean and dry during the installation process.

C. All piping, valves, fittings, and appurtenances which become contaminated during installation shall be cleaned, rinsed with potable water, and then sprayed or swabbed with a 5% sodium hypochlorite disinfecting solution prior to installation.

D. Water mains under construction that become flooded by storm water, runoff, or ground water shall be cleaned by draining and flushing with metered potable water until clear water is evident. Upon completion, the entire main shall be disinfected using a method approved by the Engineer.

3.02 METHODS

A. Gas Chorine (Gas)

Gas Chlorine (Gas) shall not be used for disinfection of pipelines.

B. Sodium Hypochlorite Solution (Liquid)

1. Sodium hypochlorite solution shall be used for cleaning and swabbing piping and appurtenances immediately prior to installation and for disinfecting all components of connections to the District's existing system.

2. Sodium hypochlorite solution may be used for the initial disinfection of newly installed water mains. The solution shall be applied at a terminus of the system to be chlorinated using an injector which can adjust the amount of solution being injected into the piping system. The solution shall be injected at the appropriate concentration to achieve the specified concentration range of chlorine throughout the entire piping system. Where pumping equipment is used in conjunction with an injector, an integral backflow prevention device shall be installed and connected to the potable water supply.

3. Pumping equipment, piping, appurtenances and all other equipment in contact with potable water shall be disinfected prior to use. Water trucks shall not be used for disinfection of pipelines.

4. Sodium hypochlorite solution may also be used to increase the total chlorine residual if the concentration from the initial chlorination of the system is found to be low. The solution shall be added to the system in sufficient amounts at appropriate locations to ensure that the disinfecting solution is present at a concentration within the specified range throughout the piping system.

3.03 PROCEDURE FOR DISINFECTING WATER MAINS AND APPURTENANCES

A. The pipeline shall be filled at a rate not to exceed 300 GPM or a velocity of 1 foot per second (156 GPM in an 8-inch pipe), whichever is less.

B. Disinfection shall result in an initial total chlorine concentration of 50 ppm to 150 ppm. This concentration shall be evenly distributed throughout the system to be disinfected.

C. All valves shall be operated with the disinfection solution present in the pipeline. All appurtenances such as air-vacuum relief valves, blowoffs, hydrants, backflow prevention devices, and water service laterals shall be flushed with the treated water for a sufficient length of time to ensure a chlorine concentration within the specified range in all components of each appurtenance. (Note the limitations for discharge of chlorinated water outlined below.)

D. The Contractor will verify the presence of the disinfection solution throughout the system by sampling and testing for acceptable chlorine concentrations at the various appurtenances and/or at the test ports provided by the Contractor. Areas of the system found to be below the specified chlorine concentration level shall receive additional flushing as noted above and/or additional disinfection solution as necessary. (Note the limitations for discharge of chlorinated water outlined below.) All testing will be done in the presence of the District Representative.

E. The chlorinated water shall be retained in the system for a minimum of 24 hours. The District Representative will test the total chlorine residual. The system shall contain a total chlorine residual of not less than 80% of the initial total chlorine residual before the 24-hour soaking period began. If the total chlorine residual has decreased more than 20%, the system shall be soaked for an additional 24-hour period. If the total chlorine residual has not deceased after this additional 24-hour period, the system shall be flushed in accordance with the procedure detailed herein. If the total chlorine residual has decreased, the system shall be flushed in accordance with the procedure detailed herein and shall be re-disinfected.

F. Following a successful retention period as determined by the District Representative, the chlorinated water shall be flushed from the system at its extremities and at each appurtenance, using potable water from a source designated by the District Representative. The minimum water velocity during flushing shall be 3 feet per second or as directed by the District Representative. Flushing shall continue until the replacement water in the new system is equal in chlorine residual to the potable source of supply as verified by the District Representative. (Note the limitations for discharge of chlorinated water outlined below.)

G. The testing firm will perform bacteriological sampling and testing, in accordance with paragraph 3.05 below, and provide a certificate of compliance to the District Representative that the unit tested met the AWWA C651 requirements.

3.04 DISINFECTION OF WATER-STORAGE FACILITIES

Disinfection of water storage facilities shall be done in accordance with AWWA – C652-92

3.05 DISCHARGE OF CHLORINATED WATER

A. Indiscriminate on-site disposal or discharge to sewer systems, storm drains, drainage courses or surface waters of chlorinated water is prohibited.

B. The environment to which the chlorinated water is to be discharged shall be examined by the Developer, Certified Chlorinator, and the District Representative. Where necessary, federal, state and local regulatory agencies shall be contacted to determine special provisions for the disposal of chlorinated water. Any discharge of chlorinated water to the environment shall require the neutralizing of the chlorine residual by means of a reducing agent in accordance with AWWA C651 and the requirements of this specification.

C. A chlorine reducing agent shall be applied to the water prior to exiting the piping system. The Certified Chlorinator shall monitor the chlorine residual during the discharge operations. Total residual chlorine limits in these locations, and for the discharge of chlorinated water from the testing of pipelines to surface waters of the San Diego Region are as follows:

Total Residual Chlorine Effluent Limitations

Instantaneous Maximum - 0.02 ppm

The various methods of dechlorination available can remove residual chlorine to concentrations below standard analytical methods of detection, 0.02 ppm, which will assure compliance with the effluent limit. The Contractor will perform all necessary tests to ensure that the total residual chlorine effluent limitations listed above are met.

3.06 BACTERIOLOGICAL TESTING

A testing firm will perform bacteriological sampling and testing of all new system installations. The testing methodology employed shall be as set forth in "Standard Methods for the Examination of Water and Waste Water" (current edition). Testing requirements are as set forth in the California Domestic Water Quality and Monitoring Regulations and commensurate with current requirements for surface water testing. The District Representative will analyze the samples for the presence of coliform bacteria and heterotrophic-type bacteria (heterotrophic plate count). The evaluation criteria employed by the District for a passing test sample is as follows:

A. Coliform bacteria: no positive sample, and

B. Heterotrophic plate count (HPC): 500 colony forming units/mi or less.

3.07 REDISINFECTION

If the initial disinfection fails to produce satisfactory bacteriological test results, the pipeline system shall be re-flushed and re-sampled. If the second set of samples does not produce satisfactory results, the pipeline system shall be re-chlorinated, flushed, and re-sampled. The chlorination, flushing, and sampling procedure shall continue until satisfactory results are obtained. Re-disinfection and retesting shall be at the Contractor's expense.

3.08 DISINFECTING TIE-INS AND CONNECTIONS

Pipes, fittings, valves and all other components incorporated into connections with the District's existing system shall be spray disinfected or swabbed with a liquid chlorine solution in accordance with AWWA C651 and as specified herein. Upon connection to the main, the line shall be flushed as directed by the District Representative. Disinfection by this method is generally limited to assemblies of 20-feet or less in length. Alternate methods such as "pre-disinfection" prior to installation in accordance with AWWA C651 may be required at the discretion of the District Representative.

-END OF SECTION-

SECTION 15044

HYDROSTATIC TESTING OF PRESSURE PIPELINES

PART 1 GENERAL

1.01 DESCRIPTION

This section describes the requirements and procedures for pressure and leakage testing of all pressure mains.

1.02 REFERENCE STANDARDS

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:

AWWA C600 Installation of Ductile Iron Water Mains
AWWA M11 Steel Pipe – A Guide for Design and Installation

1.03 RELATED WORK SPECIFIED ELSEWHERE

Section 15041	Disinfection of Pipe

1.04 REQUIREMENTS PRIOR TO TESTING

A. All piping, valves, fire hydrants, services, and related appurtenances shall be installed prior to testing.

B. The pipe trench shall have trench zone backfill placed and compacted with a minimum of 2.5 feet of material over the pipe.

C. All concrete anchor blocks shall be allowed to cure a sufficient time to develop a minimum strength of 2,000 psi before testing.

D. Pressure tests on exposed and aboveground piping shall be conducted only after the entire piping system has been installed and attached to pipe supports, hangers or anchors as shown on the Approved Plans.

E. Steel pipelines shall not be tested before the mortar lining and coating on all pipe lengths within the line have been in place for a minimum of fourteen (14) days. Cement-mortar lined pipe shall not be filled with water until a minimum of eight hours has elapsed after the last joint has been mortared.

1.05 HYDROSTATIC TESTING AND DISINFECTION OF PIPELINES

Hydrostatic testing of pipelines shall be performed prior to the disinfection operations in accordance with Specification Section 15041.

1.06 CONNECTION TO EXISTING MAINS

Hydrostatic testing shall be performed prior to connections to existing mains. District authorization for connection to the existing system shall be given only on the basis of acceptable hydrostatic, disinfection and bacteriological test results.

1.07 TEST PRESSURES

Test pressures for the service piping at each site are shown in Section 3.

1.08 SUBMITTALS

A. Submit shop drawings in accordance with the requirements of Specification Section 013000.

B. Submit test bulkhead locations and design calculations, pipe attachment details, and methods to prevent excessive pipe wall stresses.

C. Submit electronic copies of the test records to the Owner's Representative upon completion of the testing.

1.09 Test Records

A. Provide records of each piping installation during the testing. These records shall include:
   a. Date and time of test.
   b. Identification of pipeline, or pipeline section tested or retested.
   c. Identification of pipeline material.
   d. Identification of pipe specification.
   e. Test fluid.
   f. Test pressure at low point in pipeline or pipeline section.
   g. Remarks: Leaks identified (type and location), types of repairs, or corrections made.
   h. Certification by Contractor that the leakage rate measured conformed to the specifications.

PART 2 MATERIALS

2.01 WATER

A. Potable water shall be used for hydrostatic testing of potable water mains when such testing is performed separately from disinfection operations.

B. Potable water shall be supplied by a District approved source. Make-up water for testing shall also be potable water.

C. Well water shall not be used for hydrostatic testing or any other purposes in new or existing pipelines.

2.02 CONNECTIONS

A. Testing water shall be supplied through a metered connection equipped with a backflow prevention device approved by the District at the point of connection to the potable water source used.

B. The Contractor shall provide any temporary piping needed to deliver potable water to the piping that is to be tested.

C. Provide temporary manual air-release valves [at test bulkheads] 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 the same as the adjacent pipe.

2.03 TEST BULKHEADS

A. 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% of yield strength of the bulkhead material at the bulkhead design pressure. Include air-release and water drainage connections.

B. Refer to Construction Drawing detail.

2.04 TESTING EQUIPMENT

Provide calibrated pressure gauges, pipes, bulkheads, pumps, compressors, chart recorder, and meters to perform the hydrostatic testing.

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall provide the Engineering Manager with a minimum of five (5) working days notice prior to the requested date and time for hydrostatic tests.

B. The Contractor shall furnish all labor, materials, tools, and equipment for testing.

C. Temporary blocking during the tests will be permitted only at temporary plugs, caps or where otherwise directed by the Engineering Manager.

D. All valves and appurtenances shall be operated during the test period. The test shall be conducted with valves in the open position.

E. At the onset of testing, all valves, air vacuum assemblies, blowoffs, and services shall be monitored for possible leakage and repairs made, if necessary, before the test proceeds. The appurtenances shall be monitored for the duration of testing.

F. For pipe with porous lining, such as cement mortar, the pipe shall be filled with water and placed under a slight pressure for a minimum of two (2) working days prior to the actual hydrostatic test.

3.02 TEST PRESSURE AND TEST FLUIDS

A. Testing and design pressures (psig) shall be as listed below:

Pipe Service	Pipe Material	Testing Fluid	Design Pressure (PSI)	Test Pressure (PSI)
West Lilac Pump Station	CMLC	Potable Water (See 2.01)	200	250
Rancho Amigos Pump Station	CMLC	Potable Water (See 2.01)	326	410
Dentro Pump Station	CMLC	Potable Water (See 2.01)	262	330

3.03 FIELD TEST PROCEDURE

A. Before applying the specified test pressure, care shall be taken to release all air within the pipe and appurtenances to be tested. Air shall be released through services, fire hydrants, air release valves, or other approved locations.

B. A five (5) hour hydrostatic pressure test shall be performed after the pipe and all appurtenances have been installed and after any trench backfill compaction with heavy-duty compaction equipment has been completed. Unless otherwise specified, the hydrostatic test pressure shall be 50 psi above the class rating of the pipe at the lowest point in the section being tested and shall be at least equal to the design class of the pipe at the highest point in the line.

C. The test pressure shall be applied and continuously maintained by pumping for a period of four (4) hours. During the pumping phase of the test, the test pressure shall be maintained within 5 psig of the specified test pressure at all times. Apply and maintain the test pressure by means of a positive displacement hydraulic force pump.

D. At the end of the fourth (4th) hour, the pressure shall meet the requirements stated above. Pumping shall then be discontinued for one (1) hour and the drop in pressure shall be recorded. Pumping shall then be resumed to restore the initial test pressure, and the quantity of water pumped into the line shall be accurately measured. This measured quantity shall not exceed that which would result from leakage at the following rates:

1. The allowable leakage for steel (flanged or welded) and ductile iron (flanged) pipe shall be zero.

2. The leakage for polyvinyl chloride (PVC) pipe and for steel or ductile-iron pipes with rubber joints shall be considered as the total amount of water pumped into the pipe system after the fifth (5th) hour of testing. Allowable leakage during the fifth (5th) hour shall be in accordance with AWWA C600-99 and calculated using the following formula:

$$L = \frac{S * D * (P)^{0.5}}{133{,}200}$$

L = testing allowance (gallons / hour)
S = length of pipe tested (feet)
D = nominal diameter of pipe (inches)
P = average test pressure during test (pounds / sq. inch (gage))

3. If leakage exceeds the allowable loss, the leak points shall be located and repaired as required by the Engineering Manager. All defective pipe, fittings, valves, and other appurtenances discovered shall be removed and replaced with reliable material. Additional disinfection shall be performed as necessary per Specification Section 15041. The hydrostatic test shall be repeated until the leakage does not exceed the rate specified above. All visible leaks shall be similarly repaired.

E. Where any section of the piping contains concrete thrust blocks or encasement, do not perform the pressure test until at least 10 days after placing the concrete. When testing mortar-lined or PVC piping, fill the pipe to be tested with water and allow it to soak for at least 48 hours to absorb water before conducting the pressure test.

F. The allowable leakage for buried piping having threaded, brazed, or welded (including solvent welded) joints shall be zero.

Repair and retest any pipes showing leakage rates greater than that allowed in the above criteria.

3.04 INITIAL PIPELINE FILLING FOR HYDROSTATIC TESTING

A. Maximum rate of filling shall not cause water velocity in pipeline to exceed 1 fps. Filling may be facilitated by removing automatic air valves and releasing air manually.

3.05 TESTING NEW PIPE WHICH CONNECTS TO EXISTING PIPE

A. Prior to testing new pipelines that are to be connected to existing pipelines, isolate the new line from the existing line by means of test bulkheads, spectacle flanges, or blind flanges.

After successfully testing the new line, remove test bulkheads or flanges and connect to the existing piping.

3.06 REPETITION OF TEST

A. If the actual leakage exceeds the allowable, locate and correct the faulty work and repeat the test. Restore the work and all damage resulting from the leak and its repair. Eliminate visible leakage.

3.07 BULKHEAD AND TEST FACILITY REMOVAL

A. After a satisfactory test, remove the testing fluid, remove test bulkheads and other test facilities, and restore the pipe coatings.

-END OF SECTION-

SECTION 15076

CEMENT-MORTAR LINED AND COATED (CML&C) STEEL PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

This section designates the requirements for steel pipe fabrication, test in shop, installation of steel pipe, fabrication of steel sheet or plate, mill-manufactured steel pipe, bends, special pipes with outlets, pass holes, flanges and all other fittings. Steel pipe shall conform to the following except as modified by this Specification:

1.02 REFERENCE STANDARDS

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:

AWWA C200	Steel Water Pipe 6-inches and larger
AWWA C205	Cement-mortar protective lining and coating
AWWA C207	Steel Pipe Flanges
AWWA C210	Coal-tar epoxy coating system for interior and exterior of steel water pipelines
AWWA C213	Fusion-Bonded epoxy coating for the interior and exterior of steel water pipelines
AWWA M11	Manual of water supply practices, steel pipe a guide for design and installation
AWS	Standard Qualification Procedure for Manual Welding Operators
ASME	Boiler and Pressure Vessel Code

1.03 RELATED WORK SPECIFIED ELSEWHERE

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.

Section 09900	Painting and Coating
Section 09961	Fusion-Bonded Epoxy Lining and Coating
Section 15041	Disinfection of Piping

1.04 SUBMITTALS

Submittals shall be made in accordance with Specification Section 01300, Contractor Submittals, and the following special provisions provided herein.

A. Submit Shop Drawings, material lists, manufacturer's literature and catalog cuts of, but not limited to, the following:

Shop Drawings	Fabrication Details
Layout Schedule	Dimensional Checks
Manufacturer's tests	Protective Coatings
Mill Reports or Plant Test Reports	Welding Rods for Field Welding

B. Shop Drawings shall be submitted and approved prior to manufacture of pipe. The layout schedule shall indicate the order of installation, the length and location of each pipe section and special, the station and elevation of the pipe invert at all changes in grade, and all data on curves and bends for both horizontal and vertical alignment.

C. Submit data used by the Contractor in manufacture and quality control.

D. Test reports showing the physical properties of the rubber used in the gaskets shall be submitted.

PART 2 - MATERIALS

2.01 PIPING

A. Steel pipe shall conform to AWWA C200. The steel for the cylinder shall be designed for a minimum of 300 psi working pressure and 36,000 psi minimum yield strength conforming to requirements for ASTM A36. Minimum pipe wall 1/4-inch thick.

B. Fittings for steel pipe shall conform to the dimensions of AWWA C208 and shall be made of segmentally welded sections of hydrostatically tested pipe (same material and thickness), with ends compatible for type of joints shown. The minimum radius of elbows shall be 2.5 times the pipe diameter and the maximum miter angle on each section of elbow shall not exceed 11.25 degrees. Fittings shall be equal in pressure design strength and shall have the same lining and coating as the abutting pipe.

C. Steel pipe joints shall be butt-strap, unless otherwise indicated. The straps shall be furnished in one or two sections, requiring two longitudinal welds in addition to the circumferential fillet welds. Provide steel flanges, welded to pipe where indicated. Flanges shall be in accordance with AWWA C207 Class F. Linings or coatings shall be continuous to the end of the pipe or back of the flange. Flange faces shall be shop cloth-inserted rubber. Bolts on buried flanges shall be Type 316 stainless steel with coal tar epoxy applied after installation.

D. Cement mortar lining for steel pipes shall conform to the following:

1. Except as otherwise provided in AWWA C205, the interior of all steel pipe, fittings and specials, shall be cleaned and lined in the shop with cement mortar lining applied centrifugally in conformance with AWWA C205. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at the construction site, the damage or unsatisfactory portions shall be replaced with lining conforming to these specifications. Cement shall be ASTM C150, Type II.

2. The pipe ends shall be left bare where field joints occur. Ends of the lining shall be left square and uniform. Feathered or uneven edges will not be permitted.

3. Defective linings as identified in AWWA C205 shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather-edged joints.

4. 5-inch minimum hand holes shall be required, unless directed otherwise by RMWD, to facilitate interior lining repairs at all joints.

E. Cement mortar coating for steel pipes shall conform to the following:

1. All buried pipe shall receive a ¾-inch thick reinforced cement mortar coating. The coating shall be reinforced with spirally wound No. 14 gauge steel wire spaced at 1½-inch centers positioned approximately at the center of the mortar coating. In lieu of a spirally wound wire, a wire mesh or wire fabric may be used. The mesh or fabric shall be fastened with welded wire clips or strips of metal so as to hold the wire approximately at the center of the mortar coating. Splices shall be lapped four inches and the free ends tied or looped to ensure continuity. Buried pipe shall be cement-mortar coated per AWWA C205. Cement shall be ASTM C150, Type II.

2. After the welding is completed, the outside annular spaces between pipe sections shall be completely filled with grout. The grout shall be poured in such a manner that all exposed portions of the metal joint shall be completely protected with cement mortar. Grout used on the outside of joints shall be non-shrink grout, sufficiently fluid to permit it to be poured down one side of the pipe and allowed to flow up the other side. The outside mortar joints shall be properly formed by the use of heavy-duty diapers or grout bands.

2.02 STEEL BAR OR WIRE REINFORCEMENT

Circumferential steel bar or wire reinforcement shall conform to ASTM A615, Grade 60, "Specifications for Billet-Steel Bars for Concrete Reinforcement". Wire fabric reinforcing for cement-mortar coatings and linings of fittings shall conform to ASTM A185, "Specifications for Welded Steel Wire Fabric," or ASTM A497, "Specifications for Welded Deformed Steel Wire Fabric." Spiral-wire reinforcement for cement-mortar coatings shall conform to ASTM A82.

2.04 JOINTS

A. Joints for aboveground, exposed, or submerged piping shall be flanged or grooved end, except where flanged joints are required to connect to valves, pumps, and other equipment.

B. Buried joints shall be butt strap welded or bell-and-spigot lap welded, except where flanged joints are required to connect to valves, meters, and other equipment.

C. Grooved-end joints for pipes 18 inches and smaller shall be flexible, square-cut grooved, per AWWA C606, Table 3. Grooved-end joints for pipes 20 inches and larger shall have AWWA C606 Type "D" collars.

2.05 OUTLETS AND NOZZLES

A. See Section 15000.

2.06 GROOVED-END COUPLINGS

A. See Section 15000.

2.07 FLANGES

A. See Section 15000.

2.08 BOLTS AND NUTS FOR FLANGES

A. See Section 15000.

2.09 LUBRICANT FOR STAINLESS STEEL BOLTS AND NUTS

A. See Section 15000.

2.10 GASKETS FOR FLANGES

A. See Section 15000.

2.11 STEEL FOR JOINT RINGS

Steel for bell rings shall conform to ASTM A575, "Specification for Merchant Quality Hot Rolled Carbon Steel Bars." Steel for spigot rings shall conform to ASTM A576, "Specification for Special Quality Hot-Rolled Carbon Steel Bars."

2.12 MANUFACTURER'S TESTS

A. Each steel cylinder with joint rings attached and cylinders for specials shall be hydrostatically tested to a circumferential stress of at least 22,000 psi, but not more than 25,000 psi. If leaks develop during testing, the cylinder shall be repaired by welding and retested until all leaks are eliminated.

B. The seams in short radius bends and special fittings shall be tested by the air-soap method using air at a pressure of 5 psi or by the dye-check method. However, if the fitting is fabricated from cylinders which have been previously hydrostatically tested, no further test will be required on seams so tested.

C. Hydrostatic testing of fittings to 150% of the design pressure may replace the tests described above. Any defects revealed by any of the alternate test methods shall be repaired by welding and the fitting retested until all defects have been eliminated.

2.13 FABRICATION DETAILS

A. Each special and each length of straight pipe shall be plainly marked at the bell end to identify the design pressure and the proper location of the pipe or special by reference to layout schedule.

B. Exposed portion of joint rings shall be protected from corrosion by the manufacturer's standard coating.

2.14 HANDLING AND SHIPMENT

Pipe and special fittings shall be handled carefully, and blocking and hold-downs used during shipment shall prevent movement or shifting. Both ends of pipe and fittings on trucks or rail cars shall be bulkheaded or covered in order to prevent excessive drying of the interior lining.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Trench Preparation: Earthwork shall be carried out in accordance with Specification Section 02223. Pipe laying shall be scheduled so that the bell end of the pipe faces in the direction of laying. Pipe installation on slopes steeper than 20% shall be laid in an uphill direction. Prior to laying the pipe, the bottom of the trench shall be graded and prepared to provide uniform bearing throughout the entire length of each joint of pipe. Suitable bell holes shall be excavated at each joint and a shallow lateral depression shall be scooped out half a pipe length from the last pipe laid to allow for easy removal of the belt pipe sling and thus avoid any movement of the pipe after it is placed on proper line and grade.

B. Butt-Strap Closure Joints: Butt-strap closure joints shall be completed in the trench after the pipe has been laid to the alignment and grade shown on the Plans. They shall be field welded by full-circumferential fillet welds or one of the edges may be shop welded and the other field welded. Welding shall be done in the same manner as specified for welded joints.

1. The interior of the joints shall be filled with stiff plastic mortar and finished off smoothly with the inside of the pipe.

2. Wire mesh, 2-inch by 4-inch by No. 13 gauge, clean, and free from rust, shall be applied to the exterior of the joints so that the wires on the 2-inch spacing run circumferentially around the pipe. The wires on the 4-inch spacing shall be crimped in such a manner that the mesh will be held 3/8-inch from the metal joint surface. The mesh shall be lapped a minimum of 8-inches and shall be securely wired in position.

3. The joint exterior shall be coated with mortar to a minimum thickness of 1½-inches. Immediately prior to applying mortar to the interior or exterior of the joints, a cement wash shall be applied to the metal to be coated. A rust inhibitor paint shall be applied per Specification Section 09900 to all metal surfaces prior to coating with mortar.

C. Welded Joints: Welded joints shall be completed after the pipe is in final position. Welded joints shall be a lap-welded slip joint as shown on the Plans. Any recess

between the bell and spigot shall be caulked with a rod to facilitate the welding. Pipe of 30-inches in diameter or more may be welded from the inside. Welders assigned to the Work shall be qualified under the AWS standard qualification procedure.

1. Joints to be welded shall be cleaned, preferably prior to placing the pipe in the trench, of all loose scale, heavy rust, paint, cement, and grease. At least a 1/2-inch recess shall be provided between adjacent mortar-covered surfaces to place the weld. In all hand welding, the metal shall be deposited in successive layers and the minimum number of passes or beads in the completed weld shall be as follows:

Steel Cylinder Thickness (Inches)	Fillet Weld Minimum Number of Passes
Smaller than 3/16 to 1/4	2
5/16	3
3/8	3

2. After the joints have been welded, the joint shall be grouted with cement mortar in the same manner as specified for rubber-ring joints.

3.02 PREVENTING FOREIGN MATTER FROM ENTERING THE PIPE

At all times when pipe laying is not in progress, the open end of the pipe shall be closed with a tight-fitting cap or plug to prevent the entrance of foreign matter into the pipe. These provisions shall apply during the noon hour as well as overnight. In no event shall the pipeline be used as a drain for removing water which has infiltrated into the trench. The Contractor shall maintain the inside of the pipe free from foreign materials and in a clean and sanitary condition until its acceptance by RMWD.

3.03 PRESSURE TEST

All pipelines shall be tested in accordance with Specification Section 15044. Zero leakage is allowed and all visible leaks must be repaired regardless of the results of the leakage allowance measurements.

3.04 DISINFECTION

Disinfection shall be in accordance with Specification Section 15041.

-END OF SECTION-

SECTION 15100

VALVES

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, testing, and installation of manually operated valves, check valves, air and vacuum valves, air-release valves, and combination air-release valves.

1.02 REFERENCE STANDARDS

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:

ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A193	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A194	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A276	Specification for Hot- and Cold-Finished Bars of Stainless and Heat-Resisting Chromium-Nickel-Manganese Steel
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
AWWA C105	Polyethylene Encasement For Ductile Iron Piping For Water And Other Liquids
AWWA C500	Gate Valves For Water And Sewerage Systems
AWWA C504	Rubber Seated Butterfly Valves
AWWA C509	Resilient Seated Gate Valves For Water And Sewerage Systems

1.03 RELATED WORK SPECIFIED ELSEWHERE

RMWD	Standard Drawings
Section 09900	Painting and Coating
Section 09961	Fusion-Bonded Epoxy Lining and Coating
Section 15041	Disinfection of Piping

1.04 SUBMITTALS

Submittals shall be made in accordance with Specification Section 01300, Contractor Submittals, and the following special provisions provided herein.

A. Submit Shop Drawings, manufacturer's catalog data and detail construction sheets showing all valve parts and describing material of construction by material and specification (such as AISI, ASTM, SAE, or CDA). Submittal shall include valve dimensions including laying lengths, dimensions and orientation of valve operators, as installed on the valves. Submittals shall also indicate valve linings and coatings with manufacturer's and paint numbers listed.

B. For valves requiring certified tests, submit certified test results.

PART 2 - MATERIALS

2.01 GENERAL

All valves shall be new and of current manufacture. Valves shall be furnished and installed by the Contractor at the location and in accordance with the type of ends as shown on the Plans and as herein specified.

The manufacturer shall have manufactured tight-closing valves of the valve type intended for use for a period of at least five (5) years.

The Contractor shall furnish and install each specific type of valve from a single manufacturer and use it throughout the Work.

All valves shall have a rated working pressure of at least 150 psi. All valves shall be certified to meet the test pressure as specified and shall have a rated working pressure that exceeds the full working pressure specified.

A. Connections: Valves shall have flanged, hub, screwed, or special connector ends as shown on the Plans. Where not indicated, the valves shall have the same type of connection as the pipeline in which valves are to be installed and conform to the Specifications.

B. Bolts, Nuts and Washers: Bolts, nuts and washers for aboveground installations shall be cadmium plated and shall conform to ASTM A307, Grade B, "Steel Machine Bolts and Nuts and Tap Holes," when a ring gasket is used and shall conform to ASTM A193, "Alloy-Steel Bolting Material for High Temperature Service", when a full-face gasket is used. Bolts and nuts shall be heavy hexagon series. Nuts shall conform to ASTM A194, "Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service" either in Grade 1, 2, or 2H. The fit shall be ANSI B1.1, "Unified Screw Threads," Class 2, except that Class 3 fit shall be used in holes tapped for studs. Threads may be made by either cutting or cold forming. Between 1/4-inch and 3/8-inch shall project through the nut when drawn tight.

1. Bolts, nuts and washers for underground installations including below ground structures shall be type 316 stainless steel. All buried bolts shall be completely coated with Bitumastic No. 50, or approved equal, which must be applied in two coats to a minimum thickness of 15 mils per coat.

2. All aboveground bolt threads shall be lubricated with graphite and oil. Flanged faces shall be wire brushed and cleaned prior to joining each flange.

C. Polyethylene Encasement: Unless otherwise specified on the Plans, all valves for underground installation shall be encased in two layers of 8 mil polyethylene wrap in accordance with AWWA C105.

D. Painting and Coating: All valves referenced in this section shall be painted and coated, interior and exterior, in accordance with Specification Section 09900.

2.02 PLUG VALVES - LUBRICATED OR NON-LUBRICATED

A. The valves shall be lubricated, tapered plug valves, and shall be manufactured in the United States. The valves shall be a top entry, bolted gland design.

B. Unless otherwise specified, valves shall have cast iron bodies and tapered plugs with bolted ductile iron, malleable iron, or steel covers depending on pressure rating of the valves. Valve castings shall be off the very highest quality obtainable. The segment gear shall have the valve stops welded prior to installation as directed by RMWD. Weld repair of cast iron castings is not permissible.

C. A ground valve plug shall be lapped to the body taper during the manufacturing process to establish an ultimate fit between these two items.

D. The valves shall be supplied with a sealant system which allows application of a sealing media to the metallic valve seats as a means of establishing drip-tight sealing. The valve shall be furnished with a single point of application sealant system, and shall incorporate a double ball check valve between the sealant application point and the sealant system to eliminate the potential for leakage of line media to atmosphere. The sealant application point of the valves shall be a combination 1/2-inch black iron sealant screw which allows use of injection equipment or sealant sticks. The combination sealant screw shall be of a piston check design which minimizes debris collection. Ball check sealant fittings shall not be furnished.

E. The valve shall be lubricated with a FDA and NSF approved lubricant suitable for potable water during installation. The lubricant shall be per the valve manufacturer's recommendation.

F. A flexible, stainless steel diaphragm shall be provided under the valve cover, and shall bear against the top of the plug to provide a primary stem seal mechanism. The valve cover shall be sealed to the body by non-asbestos containing gaskets loaded in place by cap screws.

G. A gland assembly shall be provided which shall control plug adjustment without working through compressible packing and shall not allow adjustment to be lost due to packing compression over time. Gland assembly shall have nitrile elastomer O-ring seals which bear against the plug shank and the valve cover as a provision for a secondary stem seal mechanism.

H. Enclosed worm gear operators shall be furnished. Wrench operated valves shall be available when specified on certain smaller sized valves. Gear operators shall be an integral part of the valve design and shall provide for basic isolation of the valve adjustment gland, valve stops, etc., from the general environment. When specified, gearing shall be furnished as a tightly sealed waterproof design capable of withstanding 15-feet head of water, and such design shall also serve to totally protect the gland, and gland adjusting mechanism from the environment. Gearing shall consist of a ductile iron segment keyed to the valve stem.

I. The segment shall be driven by a hardened steel worm gear. Both the segment and the worm gear shall be dry film lubricated with molybdenum disulfide. The worm gear shall be attached to an input shaft which is supported by thrust bearings. The gearing shall be lubricated by a high quality extreme pressure gear grease.

J. Valve shall conform to Valve Manufacturer's Standardization Society Specification MSS SP-78; CAST IRON PLUG VALVES, FLANGED AND THREADED ENDS. The valve shall conform to the following standards, where applicable; ANSI B16.1, ANSI B1.20.1, ASTM-A 126, class B, MSS SP-6, MSS SP-25, and AWWA C110/A21.10-87. Face to face dimensions shall conform to ANSI B16.10.

K. The valve manufacturer shall offer a five (5) year warranty against defects in materials and workmanship.

L. The valves shall be a Venturi pattern design, and range in size from 8-inch to 24-inch. The valves shall be rated for a minimum working pressure of 400 psi Cold Working Pressure (CWP) for sizes 6-inch to 12-inch, and 300 psi CWP for sizes 14-inch to 24-inch. The valves shall be hydrostatically shell pressure tested at twice the CWP rating. Each valve seat shall be tested at 150% CWP pressure in lieu of the SP-78 specified 110% CWP. The valve shall have flanged ends drilled to ANSI Class 250 Cast Iron Flange Templates.

M. Lubricated plug valves shall be selected from the Approved Materials List.

N. Non-Lubricated plug valves are acceptable.

2.03 RESILIENT WEDGE GATE VALVES

A. All valves shall be new and of current manufacture. Resilient wedge valves may be used only for nominal pipe sizes from 3-inches to 24-inches in diameter, unless specified on the plans or approved by the District Representative.

B. Valves shall be furnished and installed with the type of ends shown on the Plans and as herein specified.

C. Valves shall be manufactured to meet all applicable requirements of the latest edition of AWWA C509. Flange drilling shall be in accordance with ANSI B 16.1 standard for cast iron flanges.

D. Valves shall have non-rising stems, opening by turning counter-clockwise. Buried valves shall be provided with 2-inch square operating nut with arrow cast in metal to indicate direction of opening, and above ground valves shall be equipped with a handwheel. Valve stems shall be cast integral with stem collar and furnished of cast, forged, or rolled bronze. Stem nuts shall be independent of the wedge and shall be made of solid bronze. All body bolts shall be ANSI type 316 stainless steel.

E. Cast-iron wedge shall have sealing surfaces of the wedge permanently bonded with resilient material to meet ASTM tests for rubber to metal bond ASTM D429. Each valve shall have a smooth unobstructed waterway free from any sediment pockets. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar. Low friction torque reduction thrust bearings shall be located both above and below the stem collar.

F. Valves shall have hydrostatic shell test of 400 psi and shutoff test of 200 psi. At the 200 psi shutoff test the valve must be bubble tight - zero leakage will be allowed.

2.04 BALL VALVES - RUBBER SEATED

A. Ball valve shall be of the tight-closing, shaft-mounted type which fully complies with AWWA Standard C507 latest edition. Valve design shall eliminate metal-to-metal contact or wedging in the sealing action. The valve shall be designed to provide drip-tight shutoff against flow in both directions. Design of valve shall be such that, with the valve in the open position, the full and unobstructed circular inlet and outlet port diameter shall be as specified in Table 2 of AWWA Standard C507. With the valve in the closed position, valve shall be drip-tight at rated pressure.

B. The valve body shall have integral support legs or pads and shall consist of two body end pieces and a center body piece through-bolted and O-ring-sealed against leakage. All body pieces shall be of cast iron ASTM A126 Class B. Minimum body thickness shall be as specified in Table 3 of AWWA Standard C507. Unless otherwise specified, flanges shall be flat-faced, and flange drilling shall be in accordance with ANSI B16.1 standard for cast iron flanges.

C. The valve ball shall be constructed of cast iron ASTM A48, Class 40, and shall be taper-pinned to an upper and lower fitted shaft of 18-8 Type 316 stainless steel that is turned, ground and polished to a 32 micro-inch or smoother finish per ANSI B46.1. Valves employing chromium plated iron or steel shafts or trunnions are not acceptable.

D. The center section shall be fitted with sleeve-type bearings contained in the body hubs. Bearings shall be corrosion resistant and self lubricating, with minimum wall thickness of 1/4-inch. Material shall be teflon-lined with fiberglass backing. Bearing surfaces shall be isolated from flow by O-ring type seals. The ball assembly shall consist of a stainless steel stud and thrust collar in a grease-packed cavity.

E. All seats shall be of a synthetic rubber compound. Seats shall be retained in the valve body by mechanical means without retaining rings, segments, screws or hardware of any kind in the flow stream. Seats shall seal a full 360° without interruption and have a plurality of grooves mating with a spherical stainless steel seating surface on the ball. Valve seats shall be field adjustable around the full 360° circumference and replaceable without dismantling the operator, ball or shaft. Where line size permits, seats shall also be capable of being replaced or adjusted without removing the valve from the line. There shall be two (2) sets of ball and body seats to provide drip-tight closure in both directions. Manufacturer shall certify that the rubber seat is field adjustable and replaceable.

F. Ball valve shall be subjected to hydrostatic, shop leakage and performance tests as specified in Section 5.2 of AWWA Standard C507.

G. Valve actuator shall conform to the operating requirements of AWWA Standard C507 and shall be designed to hold the valve in any intermediate position between full open and full closed without creeping or fluttering. Unless otherwise specified on the Plans the valve shall be equipped with a manual actuator of the self-locking type with mechanical stop limiting devices to prevent over travel of the ball in the open or closed position with handwheel and position indicator for non-buried service. For buried service the valve shall be equipped with a 2inch operating nut. Manual actuator shall be Pratt MDT or approved equal. Where cylinder actuators are specified, they shall be Pratt MDT with Dura-Cyl cylinder, or approved equal.

H. The manufacturer furnishing the valve(s) shall certify that the valve(s) meet the requirements of AWWA Standard C507.

2.05 AIR RELEASE AND VACUUM RELIEF VALVES

All assemblies shall be as shown on the Standard Drawings or as detailed on the plans. Valves and fittings shall equal or exceed the pressure rating of the pipe to which they are attached. The valve shall be a combination type and shall be a minimum of 1-inch in size. Air release and vacuum relief valves shall be selected from the Approved Materials List.

A. Air and vacuum valves shall be capable of venting sufficient quantities of air as determined by the manufacturer's approved sizing methods, while pipelines are being filled and allowing air to re-enter while pipelines are being drained.

B. Air and vacuum valves shall be of the size indicated, with flanged or screwed ends to match the piping.

C. Bodies shall be of high-strength cast iron or ductile iron.

D. The float, seat, and all moving parts shall be constructed of Type 316 stainless steel.

E. Seat washers and gaskets shall be of material insuring water tightness with a minimum of maintenance.

F. Valves shall be designed for minimum 250 psi working pressure, unless otherwise indicated.

G. Combination air/vacuum assemblies shall be installed on a section of pipe no closer than 18 inches to a bell, coupling, joint or fitting.

H. Air/vacuum assemblies and valve box assemblies shall be field coated with safety yellow paint according to Specification Section 09900, unless specified on the plans or approved by RMWD.

I. All assemblies shall be installed above ground.

J. Assemblies shall be installed with a sanitary vent screen to the exhaust port of the valve, and selected from the Approved Materials List.

K. Assemblies installed will have an isolation valve to permit future maintenance. Isolation valves installed above ground will have the capability to be locked out. Isolation valves installed below ground will be required to have a debris cap with a locking device.

2.06 CORPORATION STOPS

Corporation stops shall be manufactured of bronze conforming to ASTM B62. The inlet fitting shall be a male iron pipe thread when used with a saddle and the outlet connection shall be a compression or female iron pipe thread.

2.07 HOSE BIBBS AND VALVES

Hose bibbs shall be furnished and installed in the locations shown on the Plans and shall be of the sizes required. They shall be brass hose valves, with National Standard threads, cap, and chain.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Flanges shall be cleaned by wire brushing before installing flanged valves. Flange bolts and nuts shall be cleaned by wire brushing, and threads lubricated with NSF 61 approved product. Nuts shall be tightened uniformly and progressively. If flanges leak under pressure testing, nuts and bolts shall be loosened or removed, the gasket reseated or replaced, the bolts and nuts reinstalled or retightened, and joints retested. Joints shall be watertight.

B. Threaded joints shall be cleaned by wire brushing or swabbing. Teflon joint compound or Teflon tape shall be applied to pipe threads before installing threaded valves. Joints shall be watertight.

3.02 VALVE PRESSURE TESTING

Valves shall be tested at the same time that the connecting pipelines are pressure tested and in accordance with Specification Section 15044. Any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the test pressure shall be isolated and protected.

-END OF SECTION-

SECTION 15102

DOUBLE OFFSET RUBBER SEATED BUTTERFLY VALVES

PART 1 GENERAL

1.01 SUMMARY

A. Includes manufacturing, furnishing and installing High Performance Double Offset Resilient Seated Butterfly Valves with actuators and accessories as specified herein for potable water service, meeting the ANSI/NSF Standard 61/372. Valves shall be bi-directional, tight closing, with zero allowable leakage at full rated pressure, and shall be suitable for applications involving throttling service, On/Off service and for application requiring valve actuation after long periods of inactivity. The valve shall be designed for the rated working pressure (See Specification 15044).

B. The manufacturer shall have manufactured and have a USA installed base for this style of High-Performance Double Offset Resilient Seated butterfly valve for a period of at least five years.

C. Bidder must provide for an internationally recognized third party inspection agency for valve test and material verification and must be included in the valve bid price.

D. Valves shall be marked (labeled) with the country of origin of all castings and an identifying serial number shall be stamped on a corrosion-resistant plate attached to the valve body.

E. Temporary Number Plates. Each butterfly valve shall be tagged or marked in the factory with the identifying valve number if listed in the contract drawings.

1.02 RELATED REQUIREMENTS

A. Except as modified or supplemented herein, all butterfly valves and manual actuators shall conform to the applicable requirements of ANSI/AWWA C504 and C516.

B. C-504 – Rubber-Seated Butterfly Valves

C. C550 – Protective Epoxy Interior Coatings for Valves and Hydrants

D. NSF-61/372 listed

1.03 SUBMITTALS

A. Shop Drawings and Product Data must be submitted to the Engineer for review and approval prior to fabrication and shall be submitted in accordance with the

requirements of Specification Section 01300. Shop Drawings and Product Data submittals must include at a minimum the following:

1. Project name, Supplier's name, and Manufacturer's name.

2. Manufacturer's catalog data and detailed construction sheets showing all valve parts and describing each part by material of construction, standards (such as ANSI, NSF, ASTM, SAE, or CDA) and manufacturer's part number. Identify each valve by tag number to which the catalog data and detail sheets pertain.

3. Valve dimensions including lay lengths. Show port sizes, dimensions and mounting orientation of the valve actuator to be installed on the valve.

4. Product data and shop drawings required to verify compliance with these Specifications.

5. Valve Listing from UL or NSF to NSF-61 and 372 showing valve type, place of manufacture, and valve sizes that are certified.

6. Drawings shall contain all required detailed information at reasonable scale with enough views to clearly indicate the position of the valve actuator and valve shaft, how handwheels and appurtenances will be mounted and showing the work to be done or the items to be furnished, and shall be properly checked by the Contractor prior to submittal.

7. Where multiple options or materials and/or features are available on a product or component, Contractor shall confirm and indicate which of the options and/or materials is being submitted on.

8. Proof of design certificates to AWW C504.

9. Operations and Maintenance documentation and Equipment Summary Sheets for valves and actuators and associated ancillary equipment.

10. Favorable review by the Engineer shall not relieve the Contractor of any responsibility for accuracy of dimensions and details, or for the mutual agreement of dimensions and details. It is mutually agreed that the Contractor shall be responsible for agreement and conformity of shop drawings with these Specifications.

B. Provide Coating data sheet for coatings used for shop and field coatings to be applied to valve.

C. Third party inspector(s) shall witness all material fabrication, including foundry processes, material composition verification, coating inspections, cycle test and factory leak and hydro tests. All third-party inspection reports, including instrument calibrations and final results are to be supplied to the District prior to installation.

D. Certified copies of test results as specified herein by Section 5 of ANSI/AWWA C504, with an affidavit of compliance as indicated in Section 1.7 of C504, shall be submitted to Engineer after tests are completed. Certified copies of physical and chemical test results shall be submitted for the materials of construction of valve components. Contractor shall submit certification that each valve and all appurtenances furnished is in accordance with the reference standards.

E. Submit affidavits of compliance stating that the valves and actuators furnished comply with the applicable requirements of these Specifications and the AWWA and ANSI/ASTM Standards, including appropriate standards and certified results of required hydrostatic tests.

F. Submittal shall include Manufacturer's Statement to confirm that all valves are NSF-61/372 listed. Listings shall be from UL or NSF.

1.04 **QUALITY ASSURANCE**

A. The valve manufacturer shall demonstrate and certify with shop drawing submissions at least 5 years of experience in the manufacture of high performance double offset resilient seated AWWA butterfly valves installed in the United States of America waterworks industry.

PART 2 PRODUCTS

2.01 **HIGH PERFORMANCE DOUBLE OFFSET RESILIENT SEATED BUTTERFLY VALVES**

A. Valve Design. Butterfly valves shall be of the high-performance double offset resilient seated type, tight closing design and fully comply with the latest revision of AWWA Standard C504. Valves shall be bi-directional with zero allowable leakage at full rated pressure, and shall be suitable for applications involving throttling service, On/Off service and for application requiring valve actuation after long periods of inactivity. Valves shall be available in double flange style.

B. Valve shall be listed NSF/ANSI Standard 61/372.

C. ACCEPTABLE PRODUCTS: High Performance Double Offset Resilient Seated Butterfly valves shall be DHC Valve High Performance Double Offset, or pre-approved equal.

2.02 **MATERIALS**

A. Except as modified or supplemented herein, materials used in the manufacture of butterfly valves shall conform to the requirements of ANSI/AWWA C504.

2.03 **VALVE CONSTRUCTION**

C. Valve Body. Valve bodies shall be Ductile Iron ASTM A536 65-45-12 or carbon steel A216. Flange drilling shall be in accordance with ANSI B 16.47. Body wall thickness and face to face dimensions shall be in strict accordance with AWWA C504 & AWWA C516

D. Flanges. Flanges shall be drilled and back spot faced and conform to ANSI Class 150 or ANSI Class 300 as shown on the drawings.

E. Valve Shafts. Blow-out Resistant Shaft. All shafts shall be turned, ground, polished and constructed of 304, 316 or 17-4 PH Stainless Steel. Shafts shall be keyed for actuator connection. Shaft diameters shall meet minimum requirements for their AWWA class and pressure rating.

F. Resilient Seat shall be an interference design located on the valve disc. All seats shall seal drop-tight bi-directionally. Resilient seats shall be peroxide cured EPDM. Seats shall be field adjustable and replaceable. Seats shall not touch mating seat when in the fully open position.

G. Body seat shall be hard facing NICR overlay 72% minimum nickel and 14% minimum Chromium minimum 7 mils

H. Resilient valve seat retainer ring and retaining hardware shall be made of 316 SS ASTM A351-CF8M.

I. Packing Gland Follower shall be made of 316 SS.

J. Stem Packing Shall be Vee type of PTFE or EPDM.

K. Bottom Cover Plate shall be made of Carbon steel ASTM A216-WCB or 316 SS ASTM A351-CFBM.

L. Valve Disc. Valve discs shall be constructed of A536 65-45-12 ductile iron. Disc and shaft connection shall be made with retained stainless steel pins.

M. Rotation. The direction of rotation of the handwheel to open the valve shall be to the left (counterclockwise).

N. Painting and Coatings: Interior and exterior valve surfaces excluding stainless steel shall be 12 mil minimum fusion bonded epoxy. Coatings shall be NSF 61 approved. Coatings shall be factory applied. No field coatings are acceptable.

2.04 **GEAR**

A. Operators shall conform to Spec Section 15102a, and the following;

B. Butterfly valves shall be operated by worm gear operator correctly sized for AWWA class 150B or Class 250B depending on the pressure class of the valve.

C. Worm gears for buried service shall be equipped with 2” AWWA operating nut, be 98 percent grease packed and be sealed.

D. Worm gears for above round operation shall be provided with handwheels and visual position indicators.

E. Number of turns for operating worm gears shall be indicated with a stainless steel plate attached to the worm gear.

2.05 **TESTING**

A. All factory work must be witnessed by an internationally recognized third party inspection agency regularly engaged in valve inspections. Third party inspectors shall witness material fabrication, including material composition verification, coating inspections and factory leak and hydro tests. All inspection reports, instrument calibrations and final results are to be supplied to the District. Costs for the inspection services are to be paid for by the valve supplier. The use of manufacturers factory QA personnel will not be considered compliance with this requirement.

B. District has the option to witness any factory tests with its own personnel. Cost for district inspections will be at the cost of the District

C. After the valves and actuators are assembled at the factory, the complete assemblies shall be stroked open and closed three times to ensure they are in working condition.

D. Painting and Coating Inspection shall ensure the following:

1. Painting shall be applied in accordance with the painting specification in Section 09900 and 09961.

2. The painting surface shall be free from internal holidays, bubble, blistering, peeling, foreign matter or other defects.

3. All surfaces of the valve shall be clean, dry and free from grease before applying paint or coating.

4. The final dry film thickness of painting shall be tested with dry film thickness gauge and shall be recorded.

E. Visual Inspection of Castings and Machined Surface. Surface of the castings shall be free from any defects. The machined surface shall be free from defects.

F. Valve Body Test (Shell Test)– Hydrostatic test shall be performed at 300 psi for class 150 valves and 500 psi for Class 250 valves. The disc shall be slightly open and the test pressure shall be applied to the valve to pressurize the entire body and packing to the test pressure for a period of 10 minutes. No visible leakage shall occur as verified visually and by test pressure gauge.

G. Valve Seat Leak Test– Valve seat leak test shall be performed on both sides of the disk at 200 PSI for Class 150 valves and 250 PSI for class 250 valves on one side, and atmospheric pressure on the other side. No visible leakage shall be allowed and as verified by test gauge. Test duration shall be 5 minutes for each side.

H. Closed stops (both body and actuator) shall be verified and set after successful completion of the seat leak test.

PART 3 EXECUTION

3.01 DELIVERY, INSTALATION AND OPERATION

A. An experienced, competent, and authorized representative(s) of the manufacturer(s) of the valves and actuators shall:

1. Be available for quick response to issues that may occur in the field.

2. Visit the site of the work, if requested, and inspect, check, adjust if necessary.

3. Visit the job site as often as necessary until any issues are corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

-END OF SECTION-

SECTION 15102a

VALVE OPERATORS

PART 1 – GENERAL

1.01 WORK INCLUDED

The Contractor shall provide valve operators and appurtenances, complete and operable, in accordance with the Drawings and Specifications. The Work also includes coordination of design, assembly, testing and installation. The provisions of this Section shall apply to all valves, except where otherwise indicated in the Drawings and Specifications.

1.02 SUBMITTALS

A. The Contractor shall furnish submittals in accordance with Section 01300 - Submittals and Section 15100 - Valves, General.

B. Shop Drawings: Shop drawings of all operators shall be submitted together with the valve submittals as a complete package.

1.03 SERVICES OF MANUFACTURER

A. Inspection, Startup and Field Adjustments:

1. Field representatives of manufacturers of valves or gates with electric operators shall adjust operator controls and limit switches in the field for the required function.

2. An authorized representative of the manufacturer shall visit the site for not less than 1 day to furnish the indicated services.

3. Instruction of RMWD'S Personnel: The authorized service representative shall also furnish the indicated services for instruction of RMWD's personnel for not less than 1 day.

PART 2 – PRODUCTS

2.01 GENERAL

A. Unless otherwise indicated, all shutoff and throttling valves, and externally operated valves and gates, shall be provided with manual or power operators.

B. Furnish all operators complete and operable with mounting hardware, motors, gears, controls, wiring, enclosures, solenoids, handwheels, levers, chains, extensions, and other necessary appurtenances as applicable.

C. All shut-off valves 6-inches in diameter and larger shall have operators with position indicators. All operators shall be capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering. All wires of motor-driven operators shall be identified by unique numbers.

D. Manufacturers: Where indicated, certain valves may be provided with operators

manufactured by the valve manufacturer. Where operators are furnished by different manufacturers, coordinate selection to have the fewest number of manufacturers possible.

E. Materials: All operators shall be current models of the best commercial quality materials and liberally sized for the maximum expected torque. All materials shall be suitable for the environment in which the valve or gate is to be installed.

F. Mounting: All operators shall be securely mounted by means of brackets or hardware specially designed and sized for this purpose and of ample strength. The word "open" shall be cast on each valve or operator with an arrow indicating the direction to open in the counter-clockwise direction. All gear and power operators shall be equipped with position indicators. Where possible, manual operator handwheels shall be located between 42 and 54 inches above the floor or a permanent work platform. Where chains would interfere with passageways, a chain hook shall be mounted on a permanent structure to maintain the passageway clear to a minimum height of 80 inches for the fully passage width.

G. Standard: Unless otherwise indicated and where applicable, all operators shall be in accordance with ANSI/AWWA C540.

2.02 MANUAL OPERATORS

A. General: Unless otherwise indicated, all valves and gates shall be furnished with manual operators. Valves in sizes up to and including 3.5-inches shall have direct acting lever or handwheel operators of the manufacturer's best standard design. Larger valves and gates shall have gear-assisted manual operators, with a maximum operating pull of 60 pounds on the rim of the handwheel. All buried and submerged gear-assisted valves, all gates, all gear-assisted valves for pressures higher than 250 psi, all valves 30-inches in diameter and larger, and where so indicated, shall have worm-gear operators, hermetically sealed and grease-packed, where buried or submerged. All other valves 4 to 24-inches in diameter may have traveling-nut operators, worm-gear operators, spur- or bevel-gear operators, as indicated, or if not indicated, as appropriate for each valve.

B. Buried Valves: Unless otherwise indicated, all buried valves shall have extension stems to grade, with wrench nuts located within 6 inches of the valve box cover or with floor stands, position indicators, and cast-iron or steel pipe extensions with heavy valve boxes, with stayput, hot-dip galvanized covers, and operating keys. The valve key extension shall be provided in accordance with RMWD Standard Drawing W-19 for all gate valves when the top of the gate valve nut is 25-inches or more below ground or pavement surface. Where so indicated, buried valves shall be in cast-iron, concrete, or similar valve boxes with covers of ample size to allow operation of the valve operators. Valve boxes shall be manufactured by Brooks type 3RT, Christy type G5, Empire type 7-1/2, or equal. Covers of valve boxes shall be permanently labeled as requested by the RMWD or the District Representative. Wrench-nuts shall comply with AWWA C500, and a minimum of two operating keys, or one key per 10 valves, whichever is greater, shall be furnished. Painting of the exposed surface of valve well caps shall be in accordance with RMWD Standard Drawing W-20.

C. Chain Operator: Manually activated valves with the stem located more than 78-inches above the floor or operating level shall be furnished with chain drives consisting of sprocketrim chain wheels, chain guides, and operating chains, and be provided by the valve manufacturer. Chain wheel operators shall be provided with hammer blow starting when located more than 6-feet above the floor. The wheel and guide shall be of ductile iron, cast iron, or steel, and the chain shall be hot-dip galvanized steel or stainless steel, extending to 3-feet above the operating floor level. The valve stem of chain-operated valves shall be extra strong to allow for the extra weight and chain pull. Hooks shall be provided for chain storage where chains interfere with pedestrian traffic.

D. Floor Boxes: Hot-dip galvanized cast-iron or steel floor boxes and covers to fit the slab thickness shall be provided for all operating nuts in or below concrete slabs. For operating nuts in the concrete slab, the cover shall be bronze-bushed.

E. Adjustable Shaft Valve Boxes: Adjustable shaft valve boxes shall be concrete or cast iron valve extension boxes. Box covers on water lines shall be impressed with the letter "W".

F. Manual Worm-Gear Operator: The operator shall consist of a single or double reduction gear unit contained in a weatherproof cast-iron or steel body with cover and minimum 12- inch diameter handwheel. The operator shall be capable of 90-degree rotation and shall be equipped with travel stops capable of limiting the valve opening and closing. The operator shall consist of spur or helical gears and worm-gearing. The spur or helical gears shall be of hardened alloy steel and the worm-gear shall be alloy bronze. The worm-gear shaft and the handwheel shaft shall be of 17-4 PH or similar stainless steel. All gearing shall be accurately cut with hobbing machines. Ball or roller bearings shall be used throughout. Operator output gear changes shall be mechanically possible by simply changing the exposed or helical gearset ratio without further disassembly of the operator. All gearing shall be designed for a 100% overload.

PART 3 – EXECUTION

3.01 GENERAL

Installation shall be as specified herein. Valve operators shall be located so that they are readily accessible for operation and maintenance. Valve operators shall be mounted for unobstructed access, but mounting shall not obstruct walkways. Valve operators shall not be mounted where shock or vibration will impair their operation. Support systems shall not be attached to handrails, process piping, or mechanical equipment.

3.02 INSTALLATION

All valve and gate operators and accessories shall be installed in accordance with Section 15100 - Valves, General.

-END OF SECTION-

SECTION 16010

ELECTRICAL BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Basic requirements for electrical systems.

B. Related Sections include but are not necessarily limited to:

1. Division 1 - General Requirements.
2. Section 16120 - Wire and Cable - 600 Volt and Below.
3. Section 16130 - Raceways and Boxes.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. Aluminum Association (AA).
2. American Iron and Steel Institute (AISI).
3. ASTM International (ASTM):
   a. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   b. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ETL Testing Laboratories (ETL).
5. Institute of Electrical and Electronics Engineers/American National Standards Institute (IEEE/ANSI):
   a. C2, National Electrical Safety Code (NESC).
6. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
7. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
8. Underwriters Laboratories, Inc. (UL).

B. Where Underwriters Laboratories, Inc. (UL) test procedures have been established for the product type, use UL or ETL Testing Laboratories (ETL) approved electrical equipment and provide with the UL or ETL label.

1.3 DEFINITIONS

A. For the purposes of providing materials and installing electrical work the following definitions shall be used.

1. Outdoor Area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.
2. Architecturally Finished Interior Area: Offices, laboratories, conference rooms, restrooms, corridors and other similar occupied spaces.
3. Non-Architecturally Finished Interior Area: Pump, chemical, mechanical, electrical rooms and other similar process type rooms.
4. Highly Corrosive and Corrosive Area: Areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater or chemical solutions; or chronic exposure to corrosive, caustic or acidic agents, chemicals, chemical fumes or chemical mixtures.
5. Hazardous Areas: Class I, II or III areas as defined in NFPA 70 (NEC) and NFPA 820.
6. Shop Fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.

1.4 SUBMITTALS

A. Shop Drawings:

1. See Division 1 for requirements for the mechanics and administration of submittal process.
2. See Division 1 and individual specification sections for submittal requirements for products defined as equipment.
3. General Requirements:
    a. Provide manufacturer's technical information on products to be used, including product descriptive bulletin.
    b. Include data sheets that include manufacturer's name and product model number.
        (1) Clearly identify all optional accessories.
    c. Acknowledgement that products are UL or ETL listed or are constructed utilizing UL or ETL recognized components.
    d. Manufacturer's delivery, storage, handling and installation instructions.
    e. Product installation details.
    f. See individual specification sections for any additional requirements.

B. Operation and Maintenance Manuals:

1. See Division 1 for requirements for:
    a. The mechanics and administration of the submittal process.
    b. The content process of Operation and Maintenance Manuals.

C. When a Specification Section includes products specified in another Specification Section, each Section shall have the required Shop Drawing transmittal form per Division 1 and all Sections shall be submitted simultaneously.

1.5 DELIVERY, STORAGE, AND HANDLING

A. See Division 1.

B. Protect nameplates on electrical equipment to prevent defacing.

1.6 AREA DESIGNATIONS

A. Designation of an area will determine the NEMA rating of the electrical equipment enclosures, types of conduits and installation methods to be used in that area.

1. Outdoor Areas:
    a. Wet.
    b. Also, corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications.
2. Indoor Areas:
    a. Dry.
    b. Also, wet, corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Refer to specific Division 16 sections and specific material paragraphs below.

B. Provide all components of a similar type by one (1) manufacturer.

2.2 MATERIALS

A. Electrical Equipment Support Pedestals and/or Racks:

1. Approved Manufacturers:
    a. Modular Strut:
        (1) Unistrut Building Systems.
        (2) B-Line.
        (3) OCAL.
2. Material Requirements:
    a. Modular Strut:
        (1) Stainless steel: AISI Type 316.
        (2) PVC coated galvanized steel: ASTM A123 or ASTM A153 and 20 mil PVC coating.

b. Mounting Hardware:

(1) Stainless steel.
(2) OCAL.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and wire all equipment, including pre-purchased equipment, and perform all tests necessary to assure conformance to the Drawings and Specifications and ensure that equipment is ready and safe for energization.

B. Install equipment in accordance with the requirements of:

1. NFPA 70 (NEC).
2. IEEE/ANSI C2.
3. The manufacturer's instructions.

C. In general, conduit routing is not shown on the Drawings.

1. The Contractor is responsible for routing all conduits including those shown on one-line and control block diagrams and home runs shown on floor plans.
2. Conduit routings and stub-up locations that are shown are approximate; exact routing to be as required for equipment furnished and field conditions.

D. When complete branch circuiting is not shown on the Drawings:

1. A homerun indicating panelboard name and circuit number will be shown and the circuit number will be shown adjacent to the additional devices (e.g., light fixture and receptacles) on the same circuit.
2. The Contractor is to furnish and install all conduit and conductors required for proper operation of the circuit.
3. The indicated home run conduit and conductor size shall be used for the entire branch circuit.
4. See Section 16120 for combining multiple branch circuits in a common conduit.

E. Do not use equipment that exceed dimensions or reduce clearances indicated on the Drawings or as required by the NFPA 70 (NEC).

F. Install equipment plumb, square and true with construction features and securely fastened.

G. Install electrical equipment, including pull and junction boxes, minimum of 6-inches from process, gas, air and water piping and equipment.

H. Install equipment so it is readily accessible for operation and maintenance, is not blocked or concealed and does not interfere with normal operating and maintenance requirements of other equipment.

I. Device Mounting Schedule:

1. Unless indicated otherwise on the Drawings, mounting heights are as indicated below:

a. Light switch (to center): 48 IN.

b. Receptacle in architecturally finished areas (to center): 18 IN.

c. Receptacle on exterior wall of building (to center): 18 IN.

d. Receptacle in non-architecturally finished areas (to center): 48 IN.

e. Telephone outlet in architecturally finished areas (to center): 18 IN.

f. Telephone outlet for wall-mounted phone (to center): 54 IN.

g. Safety switch (to center of operating handle): 54 IN.

h. Separately mounted motor starter (to center of operating handle): 54 IN.

i. Pushbutton or selector switch control station (to center): 48 IN.

j. Panelboard (to top): 72 IN.

J. Avoid interference of electrical equipment operation and maintenance with structural members, building features and equipment of other trades.

1. When it is necessary to adjust the intended location of electrical equipment, unless specifically dimensioned or detailed, the Contractor may make adjustments in equipment locations in accordance with the following without obtaining the Engineer's approval:

a. 1 FT at grade, floor and roof level in any direction in the horizontal plane.

b. 1 FT for equipment other than lighting at ceiling level in any direction in the horizontal plane.

c. 1 FT for lighting fixtures at ceiling level in any direction in the horizontal plane.

d. 1 FT on walls in a horizontal direction within the vertical plane.

e. Changes in equipment location exceeding those defined above require the Engineer's approval.

K. Provide electrical equipment support system per the following area designations:

1. All Areas:

a. Stainless steel system consisting of stainless steel channels and fittings, nuts and hardware.

b. PVC coated steel system consisting of PVC coated steel channels and fittings with stainless steel nuts and hardware.

L. Provide all necessary anchoring devices and supports rated for the equipment load based on dimensions and weights verified from approved submittals, or as recommended by the manufacturer.

1. Do not cut, or weld to, building structural members.

2. Do not mount safety switches or other equipment to equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.

M. Provide corrosion resistant spacers to maintain 1/4 IN separation between metallic equipment and/or metallic equipment supports and mounting surface in wet areas, on below grade walls and on walls of liquid containment or processing areas such as Basins, Clarifiers, Digesters, Reservoirs, etc.

N. Do not place equipment fabricated from aluminum in direct contact with earth or concrete.

O. Screen or seal all openings into equipment mounted outdoors to prevent the entrance of rodents and insects.

P. Do not use materials that may cause the walls or roof of a building to discolor or rust.

Q. Identify electrical equipment and components.

3.2 FIELD QUALITY CONTROL

A. Verify exact rough-in location and dimensions for connection to electrified equipment, provided by others.

1. See Division 1 for openings and penetrations in structures.

B. Replace equipment and systems found inoperative or defective and re-test.

C. Cleaning:

1. See Division 1.

D. The protective coating integrity of support structures and equipment enclosures shall be maintained.

1. Repair field damaged galvanized components utilizing a zinc rich paint.
2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the component.
4. Repair surfaces which will be inaccessible after installation prior to installation.
5. See Section 16130 for requirements for conduits and associated accessories.

E. Replace nameplates damaged during installation.

3.3 DEMONSTRATION

A. Demonstrate equipment in accordance with Division 1.

3.4 PROTECTIVE DEVICE COORDINATION

A. Provide system coordination of the protective devices furnished on this project. The

protective device on the line side closest to the fault or abnormal conditions shall isolate the problem portion of the system and minimize damage in that portion. The rest of the system shall be maintained in normal service. The coordination shall be in conformance with the recommendations of latest IEEE Standard 242.

B. Submit the analysis that shall include impedance and short circuit calculations, list of any assumptions made in the analysis, the recommended settings of the protective devices, and the system time/current characteristic curves. The submittal shall be made so as to allow time for review and resubmittal, if necessary, before the implementation of final settings and adjustments.

3.11 ARC FLASH STUDY

A. Provide a complete arc flash hazard study to help protect individuals from electrical arc flash injuries. These individuals may include any workers who inspect, maintain, or operate energized electrical equipment. Include all equipment 480 volt equipment and all panelboards.

B. Provide Arc Flash Hazard Warning Labels on all electrical panels. These labels are intended to assist maintenance personnel and others in the selection of proper Personal Protective Equipment when working around exposed and energized conductors.

C. Incident Energy Study in accordance with the IEEE 1584, "IEEE Guide for Performing Arc Flash Hazard Calculations" as referenced in NFPA 70E, "Standard for Electrical Safety in the Workplace", in order to quantify the hazard for selection of personal protective equipment (PPE). Tables that assume fault current levels and clearing time for proper PPE selection are not acceptable.

D. Installed warning labels (orange <40 cal/cm2) or danger label (red > 40 cal/cm2) in accordance with ANSI Z535.4-2002. The label must be readable in both indoor and outdoor environments for at least 3 years and contain the following information (See sample label, attached):

1. Arc hazard boundary (inches).
2. Working distance (inches).
3. Arc flash incident energy at the working distance (calories/ cm2).
4. PPE category and description including the glove rating.
5. Voltage rating of the equipment.
6. Limited approach distance (inches).
7. Restricted approach distance (inches).
8. Prohibited approach distance (inches).
9. Equipment/bus name.
10. Date prepared.
11. Arc flash hazard study preparer name and address.

E. Personnel performing the arc flash analysis shall be trained and experienced in accordance with NETA Training Specifications concerning the apparatus and systems being evaluated.
1. LABELS: (Sample)

-END OF SECTION-

SECTION 16012

SEISMIC BRACING SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. The design and installation of seismic bracing and anchorage required for electrical equipment, conduit, cable tray, and bus ducts.

1.2 RELATED SECTIONS

A. Section 01300 – Record Drawings and Submittals

B. Section 01600 – Products, Materials, Equipment and Substitutions

C. Section 05500 – Miscellaneous Metals

D. Division 1 - General Requirements.

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

A. ASTM International (ASTM):

1. A36, Standard Specification for Carbon Structural Steel.

2. A307, Standard Specification Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.

3. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

B. Building Code:

1. International Building Code (IBC) - including all State of California amendments.

2. International Conference of Building Officials (ICBO) - including all State of California amendments.

1.4 SUBMITTALS

A. Shop Drawings:

1. See Division 1 for requirements for the mechanics and administration of the submittal process.

2. Product technical data:

a. Seismic control devices.

3. Fabrication and/or layout drawings:

a. Layout and mounting detail drawings showing system and proposed brace locations for all systems including pre-engineered systems.
b. The specific detail for each type of brace or anchor must be referenced on a plan that identifies the required location.

1) Supplying a book of details without referencing the proper detail to a specific location on a plan is not acceptable.

c. Structural calculations for required lateral force level for each component.
d. All submittals, including pre-approved systems, shall be signed and sealed by a licensed engineer, licensed in the state in which the project is located.

1.5 QUALITY ASSURANCE

A. The pre-engineered suspended bracing system manufacturer shall have a minimum of five (5) year's experience in the bracing industry.

1.6 DELIVERY, STORAGE AND HANDLING

A. Transport bracing systems with proper equipment to protect systems from damage.

B. Store bracing systems off ground and on firm surfaces. Protect systems from extreme temperatures and corrosion.

1.7 SYSTEM DESCRIPTION

A. Contractor is responsible for design and installation of seismic bracing and anchorage systems.

B. Description of Systems:

1. Transverse and longitudinal bracing for seismic forces on suspended electrical systems including conduit, cable tray, bus duct, and equipment.

2. Anchorage of floor and roof mounted electrical equipment.

C. Seismic Design Requirements:

1. Seismic design criteria: Provide bracing and anchoring for equipment, conduit, cable tray, bust duct, designed, constructed, and installed to resist stresses produced by lateral forces.

2. Design and install seismic anchorage and bracing for all floor or roof mounted equipment weighing 400 LBS or more and all suspended or wall mounted equipment weighing 20 LBS or more.

3. The following components are exempt from the requirements of this Section:

   a. Electrical components in structures assigned to Seismic Design Category C provided that the importance factor (I_p) is equal to 1.0.
   b. Electrical components in Seismic Design Categories D, E, and F where I_p = 1.0 and flexible connections between the components and associated ductwork, piping, and conduit are provided and that are mounted at 4 FT (1.22 m) or less above a floor level and weigh 400 LBS (1780 N) or less.
   c. Electrical components in Seismic Design Categories D, E, and F weighing 20 LBS (95 N) or less where I_p = 1.0 and flexible connections between the components and conduit are provided, or for distribution systems, weighing 5 LBS/FT (7 N/m) or less.

4. Seismic forces shall be presumed to act through the center of mass of the equipment in a direction that will produce the largest single anchor force.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Pre-engineered suspended bracing systems:

   a. International Seismic Application Technology (ISAT) "Engineered Seismic Bracing of Suspended Utilities".
   b. Unistrut.
   c. Tolco.
   d. B-Line.

2. Custom engineered systems designed using specified criteria and common building materials.

B. Submit request for substitution in accordance with Specification Section 01640.

2.2 EQUIPMENT ANCHORS AND SUPPORTS

A. Drilled-in-place concrete anchors shall have an approved ICBO Evaluation Services Report.

B. Cast-in-place anchors shall comply with ASTM A36, ASTM A307, or ASTM F1554, 36 ksi.

C. Anchors permanently exposed to weather or corrosive environments shall be stainless steel or hot-dipped galvanized.

D. Structural Steel for Supports: ASTM A36.

E. Cold formed metal and connection material: Unistrut or equal.

F. Any details provided are based on assumed equipment and arrangement.

1. Contractor shall be responsible for design and acquiring approval for support and anchorage of equipment and arrangement which varies from equipment and arrangement assumed in detail provided.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Every run which requires bracing shall have a minimum of two (2) transverse braces and one (1) longitudinal brace.

1. A "run" is defined as suspended pipe, conduit, cable tray, bus duct or trapeze rack having a minimum 5 FT straight run length.

B. Brace spacing shall not exceed the maximum allowable brace spacing as engineered by the manufacturer or custom bracing designer.

C. Bracing may be omitted from conduit; cable tray and bus duct runs less than 5 FT in length.

D. Bracing may be omitted from conduit; cable tray and bus duct runs where rod hung supports of less than 12 IN. (305mm) in length are required.

1. All unbraced suspended utility systems having 2 IN conduit and larger or systems weighing more than 5 LBS/FT shall be installed with a minimum 6IN clearance to suspended ceiling vertical hanger wires.

2. The conduit, cable tray, or bus duct shall be installed such that the lateral motion of the members will not cause damaging impact with other systems or structural members or loss of vertical support.

E. A longitudinal brace at a 90 degree change in direction may act as a transverse brace if it is located within 2 FT of the change in direction.

F. A transverse brace may act as a longitudinal brace if it is located within 2 FT of a change in direction and if the brace arm and anchorage have been sized to meet or exceed the requirements of the longitudinal brace.

G. When bracing equipment or a utility system that is suspended from an overhead deck, brace back to the overhead deck or to the supporting structure supporting the deck.

1. Do not brace to another element of the structure which may respond differently during a seismic event.

H. Obtain approval from the Structural Engineer prior to attaching any brace elements to structural steel or wood framing.

I. When utilizing cable bracing, tension the cable to remove slack without inducing uplift of the suspended element.

1. Tension seismic bracing system prior to system start-up and adjust if necessary, after equipment start-up.

J. As a general rule, do not mix rigid bracing with cable bracing in the same run.

1. However, once bracing has transitioned a 90 degree change in run direction, the bracing may switch from rigid to cable or vice versa if required due to a significant change in overhead deck elevation or to provide an implementable bracing scheme in a congested area.

K. Install brace members at an angle of 45 degrees from horizontal within a tolerance of plus 2 1/2 degrees or minus 45 degrees provided the brace length is accounted for in design.

1. Brace angle may be increased to 60 degrees provided the brace spacing is reduced to 1/2 that required for a 45 degree brace.

L. Seismic bracing may not pass through a building separation joint.

1. Utility systems that pass through a separation joint must be seismically restrained no greater than 5 FT from the point of connection.

2. Any hardware designed to accommodate seismic movement across the span of the separation joint shall be installed per manufacturer's installation and listing instructions.

M. With approval of the Structural Engineer, utility systems that are suspended from the overhead deck may be braced to load bearing concrete or CMU (concrete masonry) walls provided that the walls and the overhead decks will respond similarly during a seismic event.

N. Each layer of a multiple layer trapeze rack shall be braced individually based on the weight of the individual layer.

O. Conduit, cable tray, or bus duct constructed of non-ductile material (plastic or fiberglass), shall have brace spacing reduced to 1/2 of the spacing allowed for ductile materials.

P. Where brace elements are through-bolted, the mounting hole in the element is to be no more than 1/16 inch in diameter larger than the bolt or threaded rod.

Q. Seismic braces shall directly brace the system and not the hanger.

3.2 SUSPENDED ELECTRICAL SYSTEMS

A. Install seismic bracing for all conduits 2-1/2 IN trade size or greater.

B. All trapeze assemblies supporting conduits, cable trays or bus ducts shall be braced considering the total weight of the elements on the trapeze.

1. For the purposes of calculating weight, all conduits are to be treated as full.

C. Brace all trapeze racks which support conduit 2-1/2 inch in trade size or larger.

1. Brace all other conduit rack, cable tray or bus duct trapezes having a minimum weight in excess of 10 LBS/LF.

2. Include a minimum 10 percent additional capacity for future additions.

D. Seismic bracing may be omitted from cable trays, conduit and bus ducts suspended by rod hung supports 12 IN or less in length from the top of the element to the bottom of the structural attachment of the hanger provided lateral motion will not cause damaging impacts to other systems or loss of system vertical support.

E. All vertical risers involving conduit 2-1/2 inch in diameter or larger shall include lateral restraint at maximum 30 FT intervals and at the top and bottom of the riser.

3.3 FLOOR OR ROOF MOUNTED EQUIPMENT

A. Provide one (1) anchor on each leg or corner.

B. Friction shall be neglected when designing anchors for shear.

C. Vertical seismic forces, when required, shall be presumed to act concurrently with horizontal seismic forces.

-END OF SECTION-

SECTION 16060

GROUNDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Material and installation requirements for grounding system(s).

B. Related Sections include but are not necessarily limited to:

1. Division 1 - General Requirements.
2. Section 16010 - Electrical: Basic Requirements.
3. Section 16080 - Acceptance Testing.
4. Section 16120 - Wire and Cable - 600 Volt and Below.
5. Section 16130 - Raceways and Boxes.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. American Association of State Highway and Transportation Officials (AASHTO):
   a. Standard Specification for Highway Bridges.
2. ASTM International (ASTM):
   a. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
3. Institute of Electrical and Electronics Engineers (IEEE):
   a. 837, Qualifying Permanent Connections Used in Substation Grounding.
4. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
5. Underwriters Laboratories, Inc. (UL):
   a. 467, Standard for Safety Electrical Grounding and Bonding Equipment.

B. Assure ground continuity is continuous throughout the entire Project.

1.3 SUBMITTALS

A. Shop Drawings:

1. Product Technical Data.

a. Provide submittal data for all products specified in PART 2 of this Specification except:
(1) Grounding clamps, terminals and connectors.
(2) Exothermic welding system.

b. See Section 16010 for additional requirements.

1.4 WORK PAYMENT

A. Payment for the Work in this section shall be included as part of the lump-sum or unit-price bid amount for which such Work is appurtenant thereto, including all Work and materials specified herein and as may be required to complete this portion of the Work.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Ground Rods and Bars and Grounding Clamps, Connectors and Terminals:
a. Burndy.
b. Harger Lightning Protection.
c. Heary Brothers.
d. Joslyn.
e. Robbins Lightning Protection.
f. Thomas & Betts (Blackburn).
g. Thompson.
h. Or equal.

2. Exothermic Weld Connections:
a. Erico Products Inc., Cadweld.
b. Harger Lightning Protection.
c. Thermoweld.
d. Or equal.

3. Prefabricated Composite Test Stations:
a. Quazite Composolite.
b. Armorcast Products Company.
c. Or equal.

2.2 COMPONENTS

A. Wire and Cable:

1. Bare Conductors: Soft drawn stranded copper meeting ASTM B8.

2. Insulated Conductors: Color coded green, per Section 16120.

B. Conduit: As specified in Section 16130.

C. Ground Bars:

1. Solid Copper:
   a. 1/4 inch thick.
   b. 2 or 4 inch wide.
   c. 24 inch long minimum in main service entrance electrical rooms, 12 inch long elsewhere.

2. Predrilled grounding lug mounting holes.

3. Stainless steel or galvanized steel mounting brackets.

4. Insulated standoffs.

D. Ground Rods:

1. 3/4 inch x 10 FT, or as indicated on the Drawings.

2. Copperclad:
   a. Heavy uniform coating of electrolytic copper molecularly bonded to a rigid steel core.
   b. Corrosion resistant bond between the copper and steel.
   c. Hard drawn for a scar-resistant surface.

E. Grounding Clamps, Connectors and Terminals:

1. Mechanical Type:
   a. Standards: UL 467.
   b. High copper alloy content.

2. Compression Type for Interior Locations:
   a. Standards: UL 467.
   b. High copper alloy content.
   c. Non-reversible.
   d. Terminals for connection to bus bars shall have two bolt holes.

3. Compression Type Suitable for Direct Burial in Earth or Concrete:
   a. Standards: UL 467, IEEE 837.
   b. High copper alloy content.
   c. Non-reversible.

F. Exothermic Weld Connections:

1. Copper oxide reduction by aluminum process.

2. Molds properly sized for each application.

G. Prefabricated Composite Material Test Stations:

1. Fiberglass reinforced polymer concrete.
2. Body and cover shall sustain a minimum vertical load test of 22,000 LBS over a 10 inch square or be H-20 rated per AASHTO.
3. Size: 12 inch round or 12 inch square.
4. Open bottom.
5. Stackable design as required for specified depth.
6. Engrave cover with the word "GROUND".

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install products in accordance with manufacturer's instructions.
2. Size grounding conductors and bonding jumpers in accordance with NFPA 70 Article 250, except where larger sizes are indicated on the Drawings.
3. Remove paint, rust, or other nonconducting material from contact surfaces before making ground connections.
4. Where ground conductors pass through floor slabs or building walls provide non-metallic sleeves.
5. Do not splice grounding conductors except at ground rods.
6. Install ground rods and grounding conductors in undisturbed, firm soil.
    a. Provide excavation required for installation of ground rods and ground conductors.
    b. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.
    c. Unless otherwise specified, connect conductors to ground rods with compressor type connectors or exothermic weld.
    d. Provide sufficient slack in grounding conductor to prevent conductor breakage during backfill or due to ground movement.
    e. Backfill excavation completely, thoroughly tamping to provide good contact between backfill materials and ground rods and conductors.

7. Do not use exothermic welding if it will damage the structure the grounding conductor is being welded to.

B. Grounding Electrode System:

1. Provide a grounding electrode system in accordance with NFPA 70 Article 250 and as indicated on the Drawings.
2. Grounding Conductor Terminations:
   a. Ground bars mounted on wall, use compression type terminal and bolt it to the ground bar with two bolts.
   b. Ground bars in electrical equipment, use compression type terminal and bolt it to the ground bar.
   c. Grounding Conductor: Bare conductor, size as indicated on the Drawings.

C. Raceway Bonding/Grounding:

1. All metallic conduit shall be installed so that it is electrically continuous.
2. All conduits to contain a grounding conductor with insulation identical to the phase conductors, unless otherwise indicated on the Drawings.
3. NFPA 70 required grounding bushings shall be of the insulating type.
4. Provide double locknuts at all panels.
5. Bond all conduit, at entrance and exit of equipment, to the equipment ground bus or lug.
6. Provide bonding jumpers if conduits are installed in concentric knockouts.
7. Make all metallic raceway fittings and grounding clamps tight to ensure equipment grounding system will operate continuously at ground potential to provide low impedance current path for proper operation of overcurrent devices during possible ground fault conditions.

D. Equipment Grounding:

1. All utilization equipment shall be grounded with an equipment ground conductor.

3.2 FIELD QUALITY CONTROL

A. Leave grounding system uncovered until observed by Owner.

B. Acceptance Testing:

1. See Section 16080.

-END OF SECTION-

SECTION 16080

ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Basic requirements for acceptance testing.

B. Related Sections include but are not necessarily limited to:

1. Division 1 - General Requirements.
2. Section 16010 - Electrical: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. International Electrical Testing Association (NETA):
   a. ATS, Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems.
2. National Institute for Certification in Engineering Technologies (NICET).
3. National Institute of Standards and Technology (NIST).
4. Nationally Recognized Testing Laboratory (NRTL).

1.3 SYSTEM DESCRIPTION

A. The purpose of field acceptance testing is to verify equipment and system integrity and operation after manufacture, shipping and installation.

1. All equipment included in Division 16 shall receive all routine factory tests required by the applicable industry standards or Nationally Recognized Testing Laboratory (NRTL) and certification of these tests shall be submitted concurrent with shipment to the job site.
2. However, factory testing will not be accepted in lieu of the field acceptance testing requirements specified in this Section.
3. Field testing shall be by a third party.

B. Test the following:

1. Test all electrical equipment on the project.
2. The following identifies the specific equipment to be tested:
   a. Step down dry type transformers.
   b. Low voltage cable:

(1) All feeders.
(2) All branch circuits:
(a) Serving VFDs and/or motors.
(b) Serving a load greater than 100 A.
(3) All digital communication cables (e.g., Ethernet, Device Net, Modbus, etc.).

c. Grounding and ground fault protection.

d. Switchboards

e. Motors and motor controls.

f. Automatic Transfer Switches

g. Adjustable Speed Drives

h. Emergency Systems

i. Functional tests.

C. Tests and inspections not specifically listed but required to insure that the equipment is safe to energize and ready for commercial operation, shall be performed.

1.4 SUBMITTALS

A. See Division 1 for requirements for the mechanics and administration of the submittal process.

B. Submit prior to energizing equipment:

1. Photocopies of field test reports for all applicable pre-energization tests including over-potential, insulation resistance, contact resistance, ratio and excitation, protective device and continuity tests.

C. Submit within two (2) weeks of the completion of acceptance testing:

1. Final test report signed by the engineering technician including the following information:

a. Summary of Project.

b. Description of equipment/components tested.
(1) Identify equipment by tag numbers and circuit numbers shown on the Drawings.
(2) Individual units of switchgear and switchboards shall be identified by manufacturer's section number as shown on Shop Drawings.

c. Date and time of each test.

d. Visual inspection report.

e. Description of tests.

f. Test results recorded legibly or typewritten on appropriate test forms.
(1) Include acceptance criteria, acceptable range of values or other basis for pass/fail decision.

(2) Include "as found" and "as left" results and identify all adjustments or corrections made during testing.

g. Conclusions and recommendations.

PART 2 - PRODUCTS - (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Scope:

1. Complete visual inspection, mechanical and electrical operational tests and electrical acceptance tests shall be performed in accordance with NETA ATS.
2. The following paragraphs identify the scope of testing for each item to be tested.
   a. All required tests per NETA shall be performed.
   b. Tests identified by NETA ATS as optional shall be performed when listed below.
   c. Additional tests not required by NETA ATS are also listed when required.
3. Perform and report all tests recommended or required by the equipment manufacturer's installation, operation and maintenance instructions, even if not included in NETA ATS or listed below.
4. Repairs shall be made when test values do not meet known acceptable values.
   a. Test report shall clearly indicate "as found" and "as left" values, the cause of the unacceptable values, and the details of the corrective action taken to obtain acceptable results.

B. Sequencing and Scheduling:

1. Testing shall be performed only after completion of installation of systems and equipment unless the nature of the test requires an exception.
   a. Do not test partial systems unless specified.
2. Schedule all tests intended to determine fitness for energizing to occur immediately prior to first energizing of equipment.
3. Equipment and systems shall not be energized or placed into service until testing is complete and all unacceptable results have been resolved.
   a. Except tests that, by their nature, require the equipment in an energized or operational state, such as synchronism-check.

C. Testing personnel shall have the following system and equipment reference data on site during all testing:

1. Approved Shop Drawings for the Project to include at a minimum:
   a. Single line diagrams.

b. Three-line diagrams.

c. Cable schedules.

2. Manufacturers approved Shop Drawings for motor control centers and other major equipment items.

3. Manufacturer's instruction manuals for all equipment.

4. A copy of this Specification Section.

5. Manufacturer's instruction manuals for all test instruments.

6. NETA ATS.

3.2 ACCEPTANCE TESTING

A. Low Voltage Molded Case Circuit Breakers:

1. Perform inspections and tests per NETA ATS 7.6.1.1.

2. Components:

a. Test all components per applicable paragraphs of this Specification and NETA ATS.

b. Thermal magnetic breakers: Visual and mechanical inspection per NETA ATS only.

c. Solid-state trip type: Visual and mechanical inspection and electrical tests per NETA ATS.

3. Record as-left settings.

B. Grounding:

1. Perform inspections and tests per NETA ATS 7.13.

2. Components: Test all components per applicable paragraphs of this Specification and NETA ATS.

C. Motors:

1. Perform inspections and tests per NETA ATS 7.15.1.

2. Components: Test all components per applicable paragraphs of this Specification and NETA ATS.

D. Motor Controllers:

1. Perform inspections and tests per NETA ATS 7.16.

2. Components: Test all components per applicable paragraphs of this Specification and NETA ATS.

E. Control System Functional Test:

1. Perform test upon completion of equipment acceptance tests.

2. The test is to prove the correct interaction of all sensing, processing and action devices.

3. Develop a test plan and parameters for the purpose of evaluating the performance of the system.
4. Perform the following tests:
    a. Verify the correct operation of all interlock safety devices for fail-safe functions in addition to design function.
    b. Verify the correct operation of all sensing devices, alarms and indicating devices.
5. Systems to be tested: PLC's and local control system panels.

-END OF SECTION-

SECTION 16120

WIRE AND CABLE – 600 VOLT AND BELOW

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Material and installation requirements for:
    a. Building wire.
    b. Power cable.
    c. Control cable.
    d. Instrumentation cable.
    e. Wire connectors.
    f. Insulating tape.
    g. Pulling lubricant.

B. Related Sections include but are not necessarily limited to:

1. Division 1 - General Requirements.
2. Section 16010 - Electrical: Basic Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. Canadian Standards Association (CSA):
    a. Test Methods for Electrical Wires and Cables (FT-4 Vertical Cable Tray Test).
2. National Electrical Manufacturers Association (NEMA):
    a. ICS 4, Industrial Control and Systems: Terminal Blocks.
3. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA):
    a. WC 57/S-73-532, Standard for Control Cables.
4. National Fire Protection Association (NFPA):
    a. 70, National Electrical Code (NEC).
5. Underwriters Laboratories, Inc. (UL):
    a. 44, Standard for Safety Thermoset-Insulated Wires and Cables.
    b. 83, Standard for Safety Thermoplastic-Insulated Wires and Cables.
    c. 467, Standard for Safety Grounding and Bonding Equipment.
    d. 486A, Standard for Safety Wire Connectors and Soldering Lugs for use

with Copper Conductors.

e. 486C, Standard for Safety Splicing Wire Connections.

f. 510, Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.

g. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords.

h. 2250, Standard for Safety Instrumentation Tray Cable.

1.3 DEFINITIONS

A. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.

B. Instrumentation Cable:

1. Multiple conductor, insulated, twisted or untwisted, with outer sheath.

2. The following are specific types of instrumentation cables:

a. Analog signal cable:

(1) Used for the transmission of low current (e.g., 4-20mA DC) or low voltage (e.g., 0-10 Vdc) signals, using No. 16 AWG and smaller conductors.

(2) Commonly used types are defined in the following:
(a) TSP: Twisted shielded pair. #18 AWG minimum size.
(b) TST: Twisted shielded triad. #18 AWG minimum size.

b. Digital signal cable: Used for the transmission of digital signals between computers, PLC's, RTU's, etc.

C. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, No. 8 AWG and larger.

D. Control Cable: Multi-conductor, insulated, with outer sheath containing building wires, No. 14, No. 12 or No. 10 AWG.

E. Building Wire: Single conductor, insulated, with or without outer jacket depending upon type.

1.4 SUBMITTALS

A. Shop Drawings:

1. Product technical data:

a. Provide submittal data for all products specified in Part 2 of this specification except:

(1) Wire connectors.

(2) Insulating tape.

(3) Cable lubricant.

b. See Section 16010 for additional requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. See Section 16010.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Building wire, power and control cable and multiplex cable:
    a. American Insulated Wire Corporation.
    b. General Cable.
    c. Southwire Company.
2. Instrumentation cable:
    a. Analog cable:
        (1) Alpha Wire Corporation.
        (2) American Insulated Wire Corporation.
        (3) Belden CDT Inc.
3. Wire connectors:
    a. Burndy Corporation.
    b. Buchanan.
    c. Thomas and Betts.
4. Insulating and color coding tape:
    a. 3M Co.
    b. Plymouth Bishop Tapes.
    c. Red Seal Electric Co.

B. Submit request for substitution in accordance with Division 1.

2.2 MANUFACTURED UNITS

A. Building Wire:

1. Conductor shall be copper with 600 V rated insulation.
2. Conductors shall be stranded, except for conductors used in lighting and receptacle circuits which may be stranded or solid.
3. Surface mark with manufacturers name or trademark, conductor size, insulation type and UL label.
4. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 for type THHN/THWN and THHN/THWN-2 insulation.
5. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 for type XHHW-2 insulation.

B. Power Cable:

1. Conductor shall be copper with 600 V rated insulation.
2. Surface mark with manufacturers name or trademark, conductor size, insulation type and UL label.
3. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 and UL 1277 for type THHN/THWN insulation with an overall PVC jacket.
4. Number of conductors as required, including a bare ground conductor.
5. Individual conductor color coding:
   a. ICEA Method 4.
   b. See Part 3 of this specification for additional requirements.
6. Conform to NFPA 70 Type TC {and IEEE/ANSI 1202 or CSA FT-4}.

C. Control Cable:

1. Conductor shall be copper with 600 V rated insulation.
2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
3. Conform to NEMA/ICEA WC 57/S-73-532 and UL 83 and UL 1277 for type THHN/THWN insulation with an overall PVC jacket.
4. Number of conductors as required, provided with or without bare ground conductor of the same AWG size.
   a. When a bare ground conductor is not provided, an additional insulated conductor shall be provided and used as the ground conductor (e.g., 6/c No. 14 w/g and 7/c No. 14 are equal).
5. Individual conductor color coding:
   a. NEMA/ICEA Method 1, Table E-2.
   b. See Part 3 of this Specification for additional requirements.
6. Conform to NFPA 70 Type TC.

D. Electrical Equipment Control Wire:

1. Conductor shall be copper with 600 V rated insulation.
2. Conductors shall be stranded.
3. Surface mark with manufacturers name or trademark, conductor size, insulation type and UL label.
4. Conform to UL 44 for Type SIS insulation.
5. Conform to UL 83 for Type MTW insulation.

E. Instrumentation Cable:

1. Surface mark with manufacturers name or trademark, conductor size, insulation type and UL label.
2. Analog cable:

a. Tinned copper conductors, #18 AWG minimum.
b. 300 V or 600 V PVC insulation with PVC jacket.
c. Twisted with 100 percent foil shield coverage with drain wire.
d. Six (6) twists per foot minimum.
e. Individual conductor color coding: ICEA Method 1, Table K-2.
f. Conform to UL 2250, UL 1581 and NFPA 70 Type ITC.

3. Digital cable:
   a. As recommended by equipment (e.g., PLC, RTU) manufacturer.
   b. Conform to UL 910 and NFPA 70 Type ITC.

F. Wire Connectors:

1. Twist/screw on type:
   a. Insulated pressure or spring type solderless connector.
   b. 600 V rated.
   c. Ground conductors: Conform to UL 486C and/or UL 467 when required by local codes.
   d. Phase and neutral conductors: Conform to UL 486C.
2. Compression and mechanical screw type:
   a. 600 V rated.
   b. Ground conductors: Conform to UL 467.
   c. Phase and neutral conductors: Conform to UL 486A.
3. Terminal block type:
   a. High density, screw-post barrier-type with white center marker strip.
   b. 600 V and ampere rating as required, for power circuits.
   c. 600 V, 20 ampere rated for control circuits.
   d. 300 V, 15 ampere rated for instrumentation circuits.
   e. Conform to NEMA ICS 4 and UL 486A.

G. Insulating and Color Coding Tape:

1. Pressure sensitive vinyl.
2. Premium grade.
3. Heat, cold, moisture, and sunlight resistant.
4. Thickness, depending on use conditions: 7, 8.5, or 10 mil.
5. For cold weather or outdoor location, tape must also be all-weather.
6. Color:
   a. Insulating tape: Black.
   b. Color coding tape: Fade-resistant color as specified herein.

7. Comply with UL 510.

H. Pulling Lubricant: Cable manufacturer's standard containing no petroleum or other products which will deteriorate insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Permitted Usage of Insulation Types:

1. Type XHHW-2:

a. Building wire and power and control cable in architectural and non-architectural finished areas.

b. Building wire and power and control cable in conduit below grade.

2. Type THHN/THWN and THHN/THWN-2:

a. Building wire and power and control cable No. 8 AWG and smaller in architectural and non-architectural finished areas.

3. Type SIS and MTW:

a. For the wiring of control equipment within control panels and field wiring of control equipment within switchgear, switchboards, motor control centers.

B. Conductor Size Limitations:

1. Feeder and branch power conductors shall not be smaller than No. 12 AWG unless otherwise indicated on the Drawings.

2. Control conductors shall not be smaller than No. 14 AWG unless otherwise indicated on the Drawings.

3. Instrumentation conductors shall not be smaller than No. 18 AWG unless otherwise indicated on the Drawings.

C. Color Code All Wiring as Follows:

1. Building wire:

	240 V, 208 V, 240/120 V, 208/120 V	**480 V, 480/277 V**
Phase 1	Black	Brown
Phase 2	Red*	Orange
Phase 3	Blue	Yellow
Neutral	White	White
Ground	Green	Green
* *Orange when it is a high leg of a 120/240 V Delta system.*		

a. Conductors No. 6 AWG and smaller: Insulated phase, neutral and ground

conductors shall be identified by a continuous colored outer finish along its entire length.

b. Conductors larger than No. 6 AWG:

(1) Insulated phase and neutral conductors shall be identified by one (1) of the following methods:
(a) Continuous colored outer finish along its entire length.
(b) 3 IN of colored tape applied at the termination.

(2) Insulated grounding conductor shall be identified by one (1) of the following methods:
(a) Continuous green outer finish along its entire length.
(b) Stripping the insulation from the entire exposed length.
(c) Using green tape to cover the entire exposed length.

(3) The color coding shall be applied at all accessible locations, including but not limited to: Junction and pull boxes, wireways, manholes and handholes.

2. Power cables ICEA Method 4 with:

a. Phase and neutral conductors identified with 3 IN of colored tape, per the Table herein, applied at the terminations.

b. Ground conductor: Bare.

3. Control cables NEMA/ICEA Method 1, Table E-2:

a. When bare ground is not provided, one (1) of the colored insulated conductors shall be re-identified by stripping the insulation from the entire exposed length or using green tape to cover the entire exposed length.

b. When used in power applications the colored insulated conductors used as phase and neutral conductors may have to be re-identified with 3 IN of colored tape, per the Table herein, applied at the terminations.

D. Install all wiring in raceway unless otherwise indicated on the Drawings.

E. Feeder, branch, control and instrumentation circuits shall not be combined in a raceway, cable tray, junction or pull box, except as permitted in the following:

1. Where specifically indicated on the Drawings.

2. Where field conditions dictate, and written permission is obtained from the Engineer.

3. Control circuits shall be isolated from feeder and branch power and instrumentation circuits but combining of control circuits is permitted.

a. The combinations shall comply with the following:

(1) 12 Vdc, 24 Vdc and 48 Vdc may be combined.

(2) 125 Vdc shall be isolated from all other AC and DC circuits.

(3) AC control circuits shall be isolated from all DC circuits.

4. Instrumentation circuits shall be isolated from feeder and branch power and control circuits but combining of instrumentation circuits is permitted.

a. The combinations shall comply with the following:

(1) Analog signal circuits may be combined.

(2) Digital signal circuits may be combined but isolated from analog signal circuits.

5. Multiple branch circuits for lighting, receptacle and other 120 Vac circuits are allowed to be combined into a common raceway.

a. Contractor is responsible for making the required adjustments in conductor and raceway size, in accordance with all requirements of the NEC, including but not limited to:

(1) Up sizing conductor size for required ampacity de-ratings for the number of current carrying conductors in the raceway.

(2) The neutral conductor may be shared on sequential circuits (e.g., circuit numbers 1, 3, 5).

(3) Up sizing raceway size for the size and quantity of conductors.

F. Ground the drain wire of shielded instrumentation cables at one (1) end only.

1. The preferred grounding location is at the load (e.g., control panel), not at the source (e.g., field mounted instrument).

G. Splices and terminations for the following circuit types shall be made in the indicated enclosure type using the indicated method.

1. Feeder and branch power circuits:

a. Device outlet boxes:

(1) Twist/screw on type connectors.

b. Junction and pull boxes and wireways:

(1) Twist/screw on type connectors for use on No. 8 and smaller wire.

(2) Compression, mechanical screw or terminal block or terminal strip type connectors for use on No. 6 AWG and larger wire.

c. Motor terminal boxes:

(1) Compression lugs taped first with 3M Cambric tape, or equal, followed by rubber splicing tape, followed by vinyl electric tape, or by means approved by the motor manufacturer.

d. Manholes or handholes:

(1) Twist/screw on type connectors pre-filled with epoxy for use on No. 8 AWG and smaller wire.

(2) Watertight compression or mechanical screw type connectors for use on No. 6 AWG and larger wire. All splices shall be submersible.

2. Control Circuits:

a. Junction and pull boxes: Terminal block type connector.

b. Manholes or handholes: Twist/screw on type connectors pre-filled with epoxy.

c. Control panels and motor control centers: Terminal block or strips provided within the equipment or field installed within the equipment by the Contractor.

3. Instrumentation circuits can be spliced where field conditions dictate, and written permission is obtained from the Engineer.
   a. Maintain electrical continuity of the shield when splicing twisted shielded conductors.
   b. Junction and pull boxes: Terminal block type connector.
   c. Control panels and motor control centers: Terminal block or strip provided within the equipment or field installed within the equipment by the Contractor.
4. Non-insulated compression and mechanical screw type connectors shall be insulated with tape or hot or cold shrink type insulation to the insulation level of the conductors.

H. Insulating Tape Usage:
1. For insulating connections of No. 8 AWG wire and smaller: 7 mil vinyl tape.
2. For insulating splices and taps of No. 6 AWG wire or larger: 10 mil vinyl tape.
3. For insulating connections made in cold weather or in outdoor locations: 8.5 mil, all weather vinyl tape.

I. Color Coding Tape Usage: For color coding of conductors.

3.2 FIELD QUALITY CONTROL

A. Acceptance Testing:
1. See Section 16080.

-END OF SECTION-

SECTION 16130

RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Material and installation requirements for:
    a. Conduits.
    b. Conduit fittings.
    c. Conduit supports.
    d. Wireways.
    e. Outlet boxes.
    f. Pull and junction boxes.

B. Related Sections include but are not necessarily limited to:

1. Division 1 - General Requirements.
2. Section 16010 - Basic Electrical Requirements.
3. Section 16135 - Electrical: Exterior Underground.
4. Section 16140 - Wiring Devices.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. American Iron and Steel Institute (AISI).
2. ASTM International (ASTM):
    a. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    b. D2564, Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
3. National Electrical Manufacturers Association (NEMA):
    a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    b. RN 1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
    c. TC 2, Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
    d. TC 3, PVC Fittings for Use with Rigid PVC Conduit and Tubing.
4. National Fire Protection Association (NFPA):
    a. 70, National Electrical Code (NEC).

5. Underwriters Laboratories, Inc. (UL):
    a. 1, Standard for Safety Flexible Metal Conduit.
    b. 6, Standard for Safety Rigid Metal Conduit.
    c. 50, Standard for Safety Enclosures for Electrical Equipment.
    d. 360, Standard for Safety Liquid-Tight Flexible Steel Conduit.
    e. 467, Standard for Safety Grounding and Bonding Equipment.
    f. 514A, Standard for Safety Metallic Outlet Boxes.
    g. 514B, Standard for Safety Fittings for Cable and Conduit.
    h. 651, Standard for Safety Schedule 40 and 80 Rigid PVC Conduit.
    i. 870, Standard for Safety Wireways, Auxiliary Gutters, and Associated Fittings.
    j. 886, Standard for Safety Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.

1.3 SUBMITTALS

A. Shop Drawings:
1. Product technical data:
    a. Provide submittal data for all products specified in PART 2 of this Specification except:
        (1) Conduit fittings.
        (2) Support systems.
    b. See Section 16010 for additional requirements.
2. Fabrication and/or layout drawings:
    a. Identify dimensional size of pull and junction boxes to be used.

1.4 DELIVERY, STORAGE, AND HANDLING

A. See Section 16010.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. PVC coated rigid metallic conduits and repair kits:
    a. Occidental Coating Company.
    b. Rob-Roy Ind.

2. Rigid non-metallic conduit:
    a. Carlon.
    b. Cantex.
3. Flexible conduit:
    a. AFC Cable Systems.
    b. Anamet, Inc.
    c. Electri-Flex.
4. Wireway:
    a. Hoffman Engineering Company.
5. Conduit fittings and accessories:
    a. OCAL.
6. Support systems:
    a. Unistrut Building Systems (stainless steel).
    b. OCAL.
7. Outlet, pull and junction boxes:
    a. OCAL.

2.2 RIGID METALLIC CONDUITS

A. PVC-Coated Rigid Steel Conduit (PVC-RGS):
1. Nominal 40 mil Polyvinyl Chloride Exterior Coating:
    a. Coating: Bonded to hot-dipped galvanized rigid steel conduit conforming to NEMA/ANSI C80.1.
    b. The bond between the PVC coating and the conduit surface: Greater than the tensile strength of the coating.
2. Nominal 2 mil, minimum, urethane interior coating.
3. Urethane coating on threads.
4. Conduit: Epoxy prime coated prior to application of PVC and urethane coatings.
5. Female Ends:
    a. Have a plastic sleeve extending a minimum of 1 pipe diameter or 2 IN, whichever is less beyond the opening.
    b. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used with it.
6. Standards: NEMA/ANSI C80.1, UL 6, NEMA RN 1.

2.3 RIGID NON-METALLIC CONDUIT

A. Schedules 80 (PVC-80):

1. Polyvinyl-chloride (PVC) plastic compound which includes inert modifiers to improve weatherability and heat distribution.
2. Rated for direct sunlight exposure.
3. Fire retardant and low smoke emission.
4. Shall be suitable for use with 90 DegC wire and shall be marked "maximum 90 Deg C".
5. Standards: NEMA TC 2, UL 651.

2.4 FLEXIBLE CONDUIT

A. PVC-Coated Flexible Galvanized Steel (liquid-tight) Conduit (FLEX-LT):

1. Core formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked. ¾-inch minimum size.
2. Extruded PVC outer jacket positively locked to the steel core.
3. Liquid and vapor tight.
4. Standard: UL 360.

2.5 WIREWAY

A. Watertight (NEMA 4X rated) Wireway:

1. 14 GA Type 304 or 316 stainless steel bodies and covers without knockouts and 10 GA stainless steel flanges.
2. Cover: Fully gasketed and held in place with captive clamp type latches.
3. Flanges: Fully gasketed and bolted.

2.6 CONDUIT FITTINGS AND ACCESSORIES

A. Fittings for Use with PVC-RGS:

1. General:
   a. In hazardous locations listed for use in Class I, Division 2, Groups C and D locations.
2. Hubs: Threaded, insulated and gasketed metallic for raintight connection. Stainless steel or PVC coated.
3. Unions: Threaded PVC coated, galvanized steel or zinc plated malleable iron.
4. Conduit bodies (ells and tees):
   a. Body: PVC coated with threaded hubs.
   b. Standard and mogul size.
   c. Cover:
      (1) PVC coated, clip-on type with stainless steel screws.

5. Conduit bodies (round):
    a. Body: PVC coated with threaded hubs.
    b. Cover: Threaded screw on type, PVC coated.
6. Sealing fittings:
    a. Body: PVC coated.
    b. Standard and mogul size.
    c. With or without drain and breather.
    d. Fiber and sealing compound: UL listed for use with the sealing fitting.

B. Fittings for Use with FLEX-LT:
1. Connector:
    a. Straight or angle type.
    b. PVC coated, insulated and gasketed.
    c. Composed of locknut, grounding ferrule and gland compression nut.
    d. Liquid tight.
2. Standards: UL 467, UL 514B.

C. Fittings for Use with Rigid Non-Metallic PVC Conduit:
1. Coupling, adapters and conduit bodies:
    a. Same material, thickness, and construction as the conduits with which they are used.
    b. Homogeneous plastic free from visible cracks, holes or foreign inclusions.
    c. Bore smooth and free of blisters, nicks or other imperfections which could damage the conductor.
2. Solvent cement for welding fittings shall be supplied by the same manufacturer as the conduit and fittings.
3. Standards: ASTM D2564, NEMA TC 3, UL 651, UL 514B.

D. Weather and Corrosion Protection Tape:
1. PVC based tape, 10 mils thick.
2. Protection against moisture, acids, alkalis, salts and sewage and suitable for direct bury.
3. Used with appropriate pipe primer.

2.7 ALL RACEWAY AND FITTINGS

A. Mark Products:
1. Identify the nominal trade size on the product.
2. Stamp with the name or trademark of the manufacturer.

2.8 OUTLET BOXES

A. Cast Outlet Boxes:

1. Threaded hubs and grounding screw.
2. Styles:
    a. "FS" or "FD".
    b. "Bell".
    c. Single or multiple gang and tandem.
    d. "EDS" or "EFS" for hazardous locations.
3. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.
4. Standards: UL 514A, UL 886.

B. See Section 16140 for wiring devices, wall plates and cover plates.

2.9 PULL AND JUNCTION BOXES

A. NEMA 4X Rated (metallic):

1. Body and cover: 14 GA Type 304 or 316 stainless steel.
2. Seams continuously welded and ground smooth.
3. No knockouts.
4. External mounting flanges.
5. Hinged door and stainless steel screws and clamps.
6. Door with oil-resistant gasket.

B. NEMA 7 and 9 Rated:

1. Cast gray iron alloy or copper-free aluminum with manufacturers standard finish.
2. Drilled and tapped openings or tapered threaded hub.
3. Cover bolted-down with stainless steel bolts or threaded cover with neoprene gasket.
4. External mounting flanges.
5. Grounding lug.
6. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.

C. Miscellaneous Accessories:

1. Rigid handles for covers larger than 9 SF or heavier than 25 LBS.
2. Split covers when heavier than 25 LBS.
3. Weldnuts for mounting optional panels and terminal kits.
4. Terminal blocks: Screw-post barrier-type, rated 600 volt and 20 ampere minimum.

D. Standards: NEMA 250, UL 50.

2.10 SUPPORT SYSTEMS

A. Multi-conduit Surface or Trapeze Type Support and Pull or Junction Box Supports:

1. Material requirements.

a. Stainless steel: AISI Type 316.

b. PVC coated galvanized steel: ASTM A123 or ASTM A153 and 20 mil PVC coating.

B. Single Conduit and Outlet Box Support Fasteners:

1. Material requirements:

a. Stainless steel.

b. PVC coat malleable iron or steel: 20 mil PVC coating.

PART 3 - EXECUTION

3.1 RACEWAY INSTALLATION - GENERAL

A. Shall be in accordance with the requirements of:

1. NFPA 70.

2. Manufacturer instructions.

B. Size of Raceways:

1. Raceway sizes are shown on the Drawings, if not shown on the Drawings, then size in accordance with NFPA 70.

2. Unless specifically indicated otherwise, the minimum raceway size shall be:

a. Conduit: 3/4 IN (exposed) and 1 IN (buried).

b. Wireway: 2-1/2 IN x 2-1/2 IN.

C. Field Bending and Cutting of Conduits:

1. Utilize tools and equipment recommended by the manufacturer of the conduit, designed for the purpose and the conduit material to make all field bends and cuts.

2. Do not reduce the internal diameter of the conduit when making conduit bends.

3. Prepare tools and equipment to prevent damage to the PVC coating.

4. Degrease threads after threading and apply a zinc rich paint.

5. Debur interior and exterior after cutting.

D. Male threads of conduit systems shall be coated with an electrically conductive anti-seize compound.

E. The protective coating integrity of conduits, fittings, outlet, pull and junction boxes and accessories shall be maintained.

1. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.

2. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the conduit; or a self-adhesive, highly conformable, cross-linked silicone composition strip, followed by a protective coating of vinyl tape.

   a. Total nominal thickness: 40 mil.

3. Repair surfaces which will be inaccessible after installation prior to installation.

F. Remove moisture and debris from conduit before wire is pulled into place.

1. Pull mandrel with diameter nominally 1/4 IN smaller than the interior of the conduit, to remove obstructions.
2. Swab conduit by pulling a clean, tight-fitting rag through the conduit.
3. Tightly plug ends of conduit with tapered wood plugs or plastic inserts until wire is pulled.

G. Only nylon or polyethylene rope shall be used to pull wire and cable in conduit systems.

H. Where portions of a raceway are subject to different temperatures and where condensation is known to be a problem, as in cold storage areas of buildings or where passing from the interior to the exterior of a building, the raceway shall be sealed to prevent circulation of warm air to colder section of the raceway.

I. Fill openings in walls, floors, and ceilings and finish flush with surface.

1. See Division 1.

3.2 RACEWAY ROUTING

A. Raceways shall be routed in the field unless otherwise indicated.

1. Conduit and fittings shall be installed, as required, for a complete system that has a neat appearance and is in compliance with all applicable codes.
2. Run in straight lines parallel to or at right angles to building lines.
3. Do not route conduits:

   a. Through areas of high ambient temperature or radiant heat.

   b. In suspended concrete slabs.

4. Conduit shall not interfere with, or prevent access to, piping, valves, ductwork, or other equipment for operation, maintenance and repair.
5. Provide pull boxes or conduit bodies as needed so that there is a maximum of 360 degrees of bends in the conduit run or in long straight runs to limit pulling tensions.

B. Maintain minimum spacing between parallel conduit and piping runs in accordance with the following when the runs are greater than 30 FT:

1. Between instrumentation and telecommunication: 1 IN.
2. Between instrumentation and 125 V, 48 V and 24 Vdc, 2 IN.
3. Between instrumentation and 600 V and less AC power or control: 6 IN.
4. Between instrumentation and greater than 600 Vac power: 12 IN.
5. Between telecommunication and 125 V, 48 V and 24 Vdc, 2 IN.
6. Between telecommunication and 600 V and less AC power or control: 6 IN.
7. Between telecommunication and greater than 600 Vac power: 12 IN.
8. Between 125 V, 48 V and 24 Vdc and 600 V and less AC power or control: 2 IN.
9. Between 125 V, 48 V and 24 Vdc and greater than 600 Vac power: 2 IN.
10. Between 600 V and less AC and greater than 600 Vac: 2 IN.
11. Between process, gas, air and water pipes: 6 IN.

C. Conduits shall be installed to eliminate moisture pockets.

1. Where water cannot drain to openings, provide drain fittings in the low spots of the conduit run.

D. Provide all required openings in walls, floors, and ceilings for conduit penetration.

1. See Division 1.

3.3 RACEWAY APPLICATIONS

A. Permitted Raceway Types per Wire or Cable Types:

1. Power wire or cables: All raceway types.
2. Control wire or cables: All raceway types.
3. Instrumentation cables: Metallic raceway except non-metallic may be used underground.
4. Motor leads from a VFD: RGS, RAC or shielded VFD cables in all other raceways.
5. Telecommunication cables: All raceway types.

B. Permitted Raceway Types Per Area Designations:

1. All exposed areas:
    a. PVC-RGS.

C. Permitted Raceway Types Per Routing Locations:

1. Direct buried conduits and ductbanks:
    a. PVC-80.
    b. 90 degree elbows for transitions to above grade:
        (1) RGS wrapped with factory applied weather and corrosion protection tape.
        (2) PVC-RGS.

c. Long sweeping bends greater than 15 degrees:
(1) RGS wrapped with factory applied weather and corrosion protection tape.
(2) PVC-RGS.

2. Red concrete encased ductbanks:
a. PVC-80.
b. 90 degree elbows for transitions to above grade:
(1) RGS wrapped with factory applied weather and corrosion protection tape.
(2) PVC-RGS.
c. Long sweeping bends greater than 15 degrees:
(1) RGS for sizes 2 IN and larger.

D. FLEX-LT conduits shall be install as the final conduit connection to light fixtures, dry type transformers, motors, electrically operated valves, instrumentation primary elements, and other electrical equipment that is liable to vibrate.
1. The maximum length shall not exceed:
a. 3 FT to motors.
b. 3 FT to all other equipment.

3.4 CONDUIT FITTINGS AND ACCESSORIES

A. Conduit Seals:
1. Installed in conduit systems located in hazardous areas as required by the NFPA 70.

B. Rigid non-metallic conduit and fittings shall be joined utilizing solvent cement.
1. Immediately after installation of conduit and fitting, the fitting or conduit shall be rotated 1/4 turn to provide uniform contact.

C. Install Expansion Fittings:
1. Where conduits are exposed to the sun and conduit run is greater than 200 FT.
2. Elsewhere as identified on the Drawings.

D. Install Expansion/Deflection Fittings:
1. Where conduits enter a structure.
a. Except electrical manholes and handholes.
b. Except where the ductbank is tied to the structure with rebar.
2. Where conduits span structural expansions joints.
3. Elsewhere as identified on the Drawings.

E. Threaded connections shall be made wrench-tight.

F. Conduit joints shall be watertight:

1. Where subjected to possible submersion.
2. In areas classified as wet.
3. Underground.

G. Terminate Conduits:

1. In NEMA 4 and 4X rated enclosures:
   a. Watertight, insulated and gasketed hub and locknut.
2. In NEMA 7 and 9 rated enclosures:
   a. Into an integral threaded hub.
3. When stubbed up through the floor into floor mount equipment:
   a. With an insulated grounding bushing on metallic conduits.
   b. With end bells on non-metallic conduits.

H. Threadless couplings shall only be used to join new conduit to existing conduit when the existing conduit end is not threaded, and it is not practical or possible to cut threads on the existing conduit with a pipe threader.

3.5 CONDUIT SUPPORT

A. Permitted multi-conduit surface or trapeze type support system per area designations and conduit types:

1. All areas:
   a. Stainless steel system consisting of: Stainless steel channels and fittings, nuts and hardware and conduit clamps.
   b. PVC coated steel system consisting of: PVC coated galvanized steel channels and fittings and conduit clamps with stainless steel nuts and hardware.

B. Permitted single conduit support fasteners per area designations and conduit types:

1. All areas:
   a. Material: Stainless steel and PVC coat malleable iron or steel.
   b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.

C. Conduit Support General Requirements:

1. Maximum spacing between conduit supports per NFPA 70.
2. Support conduit from the building structure.
3. Do not support conduit from process, gas, air or water piping; or from other conduits.
4. Provide hangers and brackets to limit the maximum uniform load on a single support to 25 LBS or to the maximum uniform load recommended by the

manufacturer if the support is rated less than 25 LBS.

a. Do not exceed maximum concentrated load recommended by the manufacturer on any support.

b. Conduit hangers: Continuous threaded rods combined with struts or conduit clamps: Do not use perforated strap hangers and iron bailing wire.

5. Conduit support system fasteners:

a. Use sleeve-type expansion anchors as fasteners in masonry wall construction.

b. Do not use concrete nails and powder-driven fasteners.

3.6 OUTLET, PULL AND JUNCTION BOX INSTALLATION

A. General:

1. Install products in accordance with manufacturer's instructions.
2. See Section 16010 and the Drawings for area classifications.
3. Size boxes to accommodate quantity of conductors enclosed and quantity of conduits connected to the box.

B. Outlet Boxes:

1. Permitted uses of cast outlet boxes:

a. Housing of wiring devices surface mounted in non-architecturally finished dry, wet corrosive, highly corrosive and hazardous areas.

b. Pull and junction box surface mounted in non-architecturally finished dry, wet corrosive and highly corrosive areas.

2. Mount device outlet boxes where indicated on the Drawings and at heights as scheduled in Section 16010.
3. Set device outlet boxes plumb and vertical to the floor.
4. When an outlet box is connected to a PVC coated conduit, the box shall also be PVC coated.

C. Pull and Junction Boxes:

1. Install pull or junction boxes in conduit runs where indicated or required to facilitate pulling of wires or making connections.

a. Make covers of boxes accessible.

2. Permitted uses of NEMA 4X metallic enclosure:

a. Pull or junction box surface mounted in areas designated as wet and/or corrosive.

3. Permitted uses of NEMA 7 enclosure:

    a. Pull or junction box surface mounted in areas designated as Class I hazardous.

        (1) Provide PVC coating in corrosive and highly corrosive areas when PVC coated conduit is used.

-END OF SECTION-

SECTION 16135

ELECTRICAL: EXTERIOR UNDERGROUND

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Material and installation requirements for:
   a. Handhole.
   b. Underground conduits and duct banks.

B. Related Sections include but are not necessarily limited to:

1. Division 1 - General Requirements.
2. Section 16060 - Grounding.
3. Section 16130 - Raceways and Boxes.

1.2 QUALITY ASSURANCE

A. Referenced Standards:

1. American Association of State Highway and Transportation Officials (AASHTO):
   a. Standard Specifications for Highway Bridges.
2. ASTM International (ASTM):
   a. A536, Standard Specification for Ductile Iron Castings.
3. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
4. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
5. Society of Cable Telecommunications Engineers (SCTE):
   a. 77, Specification for Underground Enclosure Integrity.

1.3 DEFINITIONS

A. Direct-buried conduit(s):

1. Individual (single) underground conduit.
2. Multiple underground conduits, arranged in one or more planes, in a common trench.

B. Concrete encased ductbank: An individual (single) or multiple conduit(s), arranged in one or more planes, encased in a common concrete envelope.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Division 1 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data:
      a. Provide submittal data for all products specified in PART 2 of this Specification.
   3. Fabrication and/or layout drawings:
      a. Provide dimensional drawings of each manhole indicating all specified accessories and conduit entry locations.

1.5 WORK PAYMENT

A. Payment for the Work in this section shall be included as part of the lump-sum or unit-price bid amount for which such Work is appurtenant thereto, including all Work and materials specified herein and as may be required to complete this portion of the Work.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Precast handholes:
      a. Utility Vault Co.
      b. Oldcastle Precast, Inc.
      c. Or equal.

2.2 HANDHOLES

A. Precast Handholes:
   1. Fiberglass reinforced polymer concrete or steel reinforced cement concrete structures:
   2. Shall have an AASHTO live load rating of H-20 for full deliberate vehicle traffic.
   3. Mating edges shall be tongue and groove type.
   4. Solid bottom with a 12 inch x 12 inch or 12 inch diameter French drain in the bottom of each manhole.
   5. Gasketed removable top slab with lifting eyes and cast in frame for cover. Cover extension rings as required.

2.3 UNDERGROUND CONDUIT AND ACCESSORIES

A. Concrete: Comply with Division 3.

B. Conduit: See Section 16130.

C. Duct Spacers/Supports:

1. High density polyethylene or high impact polystyrene.
2. Interlocking.
3. Provide 3 inch minimum spacing between conduits.
4. Accessories, as required:
   a. Hold down bars.
   b. Ductbank strapping.

PART 3 - EXECUTION

3.1 GENERAL

A. Drawings indicate the intended location of handholes and routing of ductbanks and direct buried conduit.

1. Field conditions may affect actual routing.

B. Handhole Locations:

1. Approximately where shown on the Drawings.
2. As required for pulling distances.
3. As required to keep pulling tensions under allowable cable tensions.
4. As required for number of bends in ductbank routing.
5. Shall not be installed in a swale or ditch.
6. Determine the exact locations after careful consideration has been given to the location of other utilities, grading, and paving.
7. Locations are to be approved by the Engineer prior to excavation and placement or construction of manholes and handholes.

C. Install products in accordance with manufacturer's instructions.

D. Install handholes in conduit runs where indicated or as required to facilitate pulling of wires or making connections.

E. Comply with Division 2 for trenching, backfilling and compacting.

3.2 HANDHOLES

A. Precast Handholes:

1. For use in vehicular and non-vehicular traffic areas.
2. Construction:
   a. Grout or seal all joints, per manufacturer's instructions.
3. Place manhole or handhole on a foundation of compacted 1/4 to 1/2 inch crushed rock or gravel a minimum of 8 inch thick and 6 inch larger than

manholes or handholes footprint on all sides.

4. Install so that the top of cover is 1 inch above finished grade.
   a. Where existing grades are higher than finished grades, install sufficient number of courses of curved segmented concrete block between top of handhole frame to temporarily elevate manhole cover to existing grade level.
5. After installation is complete, backfill and compact soil around handholes.
6. Handhole size:
   a. As indicated on the Drawings or as required for the number and size of conduits entering or as indicated on the Drawings.

3.3 UNDERGROUND CONDUITS

A. General Installation Requirements:

1. Ductbank types per location:
   a. Concrete encased ductbank:
      (1) Under all traffic areas.
      (2) Conduits containing medium voltage cables.
   b. Direct-buried conduit(s):§
      (1) All other locations.
2. Do not place concrete or soil until conduits have been observed by the Owners Representative.
3. Ductbanks shall be sloped a minimum of 4 inch per 100-foot or as detailed on the Drawings.
   a. Low points shall be at handholes.
4. During construction and after conduit installation is complete, plug the ends of all conduits.
5. Provide conduit supports and spacers.
   a. Place supports and spacers for rigid nonmetallic conduit on maximum centers as indicated for the following trade sizes:
      (1) 1 inch and less: 3 FT.
      (2) 1-1/4 to 3 IN: 5 FT.
      (3) 3-1/2 to 6 IN: 7 FT.
   b. Place supports and spacers for rigid steel conduit on maximum centers as indicated for the following trade sizes:
      (1) 1 inch and less: 10 FT.
      (2) 1-1/4 to 2-1/2 IN: 14 FT.
      (3) 3 inch and larger: 20 FT.
   c. Securely anchor conduits to supports and spacers to prevent movement during placement of concrete or soil.
6. Stagger conduit joints at intervals of 6 inch vertically.
7. Make conduit joints watertight and in accordance with manufacturer's recommendations.
8. Accomplish changes in direction of runs exceeding a total of 15 degrees by long sweep bends having a minimum radius of 25 FT.

a. Sweep bends may be made up of one or more curved or straight sections or combinations thereof.

9. Furnish manufactured bends at end of runs.
   a. Minimum radius of 18 inch for conduits less than 3 inch trade size and 36 inch for conduits 3 inch trade size and larger.

10. Field cuts requiring tapers shall be made with the proper tools and shall match factory tapers.

11. After the conduit run has been completed, pull a standard flexible mandrel having a length of not less than 12 inch and a diameter approximately 1/4 inch less than the inside diameter of the conduit through each conduit.
    a. Then pull a brush with stiff bristles through each conduit to remove any foreign material left in conduit.

12. Pneumatic rodding may be used to draw in lead wire.
    a. Install a heavy nylon cord free of kinks and splices in all unused new ducts.
    b. Extend cord 3-foot beyond ends of conduit.

13. Transition from rigid non-metallic conduit to rigid metallic conduit, per Section 16130, prior to entering a structure or going above ground.
    a. Except rigid non-metallic conduit may be extended directly to manholes, handholes, pad mounted transformer boxes and other exterior pad mounted electrical equipment where the conduit is concealed within the enclosure.
    b. Terminate rigid PVC conduits with end bells.
    c. Terminate steel conduits with insulated bushings.

14. Place warning tape in trench directly over ductbanks, direct-buried conduit, and direct-buried wire and cable.

15. Placement of conduits stubbing into handholes shall be located to allow for proper bending radiuses of the cables.

B. Concrete Encased Ductbank:

1. Ductbank system consists of conduits completely encased in minimum 2 inch of red concrete and with separations between different cabling types as required in Section 16130 or as detailed on the Drawings.

2. Install so that top of concrete encased duct, at any point:
   a. Is not less than 24 inch below grade.
   b. Is below pavement sub-grading.

3. Where identified and for a distance 10-foot either side of the area, the concrete shall be reinforced.
   a. The reinforcement shall consist of #4 bars and #4 ties placed 12 inch on center, in accordance with Division 3 or as detailed on the Drawings.

4. Conduit supports shall provide a uniform minimum clearance of 2 inch between the bottom of the trench and the bottom row of conduit.

5. Conduit separators shall provide a uniform minimum clearance of 2 inch between conduits or as required in Section 16130 for different cabling types.

C. Direct-Buried Conduit(s):

1. Install so that the top of the uppermost conduit, at any point:
   a. Is not less than 30 inch below grade.
   b. Is below pavement sub-grading.

2. Provide a uniform minimum clearance of 2 inch between conduits or as required in Section 16130 for different cabling types.
   a. Maintain the separation of multiple planes of conduits by one of the following methods:
      (1) Install multilevel conduits with the use of conduit supports and separators to maintain the required separations and backfill with flowable fill (100 PSI) or concrete per Division 2.
      (2) Install the multilevel conduits one level at a time.
         (a) Each level is backfilled with the appropriate amount of soil and compaction, per Division 2, to maintain the required separations.

D. Conduits embedded in concrete structure (e.g., sidewalks, bridge decks) where shown on the Contract Drawings:

1. Shall not be considered to replace structurally the displaced concrete except as indicated in the following:

2. Shall not be larger in outside diameter than one-third the thickness of concrete.

3. Shall have a minimum spacing of 3 diameter OC.

4. In reinforced concrete construction:
   a. Place conduit after reinforcing steel has been laid.
   b. The reinforcement steel shall not be displaced by the conduit.
   c. Provide a minimum of 1-1/2 inch of cover over conduit.

-END OF SECTION-

SECTION 16195

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nameplates and labels.

B. Wire and cable markers.

C. Conduit markers

1.2 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

A. Submit under provisions of the General Requirements.

B. Product Data: Provide catalog data for nameplates, labels, and markers.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 NAMEPLATES AND LABELS

A. Nameplates: Engraved three-layer laminated plastic, black letters on white background. Provide 316 stainless steel screws for mounting (adhesives not allowed). Seton Identifications Products or approved equal.

B. Locations:

1. Each electrical distribution and control equipment enclosure.

C. Letter Size:

1. Use 1/8 inch letters for identifying individual equipment and loads.
2. Use 1/4 inch letters for identifying grouped equipment and loads.

D. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background. Use only for identification of individual wall switches and receptacles, and control device stations.

2.2 WIRE MARKERS

A. Description: Slip-on PVC sleeve type as manufactured by Brady or approved equal.

B. Locations: Each conductor at terminal boards and at each termination.

C. Wire Labeling Standard: The intent of this standard is to provide for a wire marking system that clearly identifies the termination point at either end of any given conductor. Implementing this system would facilitate quicker troubleshooting due to the immediate recognition of a wires origination and destination without the need of contract drawings.

1. Method: The most powerful controller would take precedence as the first termination point called out on the label. The second half of the label would be the termination point at the other end. The wire label would remain the same at both ends of the wire. For example:

   a. If a wire ran from the RTU, Terminal Block number 4, Point 25 to the Motor Control Center, Pump 1 bucket, Field Terminal Block, Point 3, the tag would read; RTU-TB4-25/MCC-P1-FTB-3.

   b. A wire that runs from the Motor Control Center, Pump 1 bucket, Field Terminal Block, Point 22 to the common of High Pressure Switch PSH-101, would read; MCC-P1-FTB-22/PSH-101-C.

   c. An analog signal conductor from the positive connection of Pressure Transmitter PIT-111 to the RTU, Terminal Block number 6, Point 6, would read; RTU-TB6-6/PIT-111-+.

   d. A circuit conductor originating from panel “LP” circuit breaker number 5 and feeding exhaust fan EF1 would read, LP-5/EF1.

   e. Any conductor going to a relay would include the actual relay base pin number. For example, a conductor from the RTU Terminal Block 2 point 12 to relay CR1 pin 7 would read, RTU-TB2-12/CR1-7.

   f. Motor feeders are not required to be marked with anything other than phase colors.

2.3 CONDUIT TAGS

A. Conduit tags shall be provided for exposed conduits stub ups and shall be stainless steel and labeled per the Drawing conduit schedule. Provide Seaton or equal.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.2 APPLICATION

A. Install nameplate and label parallel to equipment lines.

B. Secure nameplate to equipment surface using 316 stainless steel machine screws. Sheet metal screws shall not be used. Adhesives are not allowed.

C. Wire numbers shall be precisely located on each conductor, 3/8" from end of insulation. Where solderless type terminals are used, the number shall be applied to the wire not the terminal insulator.

-END OF SECTION-

SECTION 16400

SWITCHBOARDS

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install, where indicated, a free-standing, front-access only, 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 16010 – Basic Electrical Requirements.

B. Section 16443 – Surge Suppression Device

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:

B. NEMA PB-2

C. UL Standard 891

.

1.04 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Engineer:

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. Product data sheets.

B. Where applicable, the following additional information shall be submitted to the Engineer:

14. Connection details between close-coupled assemblies

15. Composite floor plan of close-coupled assemblies

1.05 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in paragraph 1.04.

2. Wiring diagrams

3. Certified production test reports

4. Installation information

5. Seismic certification and equipment anchorage details.

B. The final (as-built) drawings shall include the same drawings as the original construction drawings and shall incorporate all changes made during the manufacturing process.

1.06 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the circuit protective devices within the assembly.

For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified. 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. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the California

Building Code (CBC) through zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, CBC: a peak of 2.15g's and a ZPA of 0.86g's applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.

2. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.

3. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.07 REGULATORY REQUIREMENTS

A. The low-voltage switchboard shall be UL labeled.

1.08 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
.

1.09 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Cutler-Hammer

B. General Electric

C. Square D

D. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Owner ten (10) days prior to bid date.

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.

B. Voltage and ampere rating to be as indicated on the drawings.

2.03 CONSTRUCTION

A. Outdoor NEMA 3R 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. Provide thermostatic controlled space heaters and receptacle with switched lighting in the vestibule. 120 vac power source will be external to the switchboard.

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 utilize the components herein specified and as shown on the drawings.

E. The service meter switchboard shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.

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 standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).

B. A copper ground bus (minimum 1/4 x 2 inches), shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard.

C. 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 terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

2.06 MOLDED CASE CIRCUIT BREAKERS

A. Protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics.

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. Circuit breakers 250 ampere frame and below shall be thermal-magnetic trip units and inverse time-current characteristics.

E. Circuit breakers 400 ampere and larger frame shall have microprocessor-based RMS sensing trip units. Provide ALSIG feature, where indicated. Provide arc flash maintenance switches to reduce arc flash for downstream equipment when selected.

F. Ground fault protection shall be provided where indicated.

G. Where indicated, provide UL listed circuit breakers, where indicated, for applications at 100% of their continuous ampere rating in their intended enclosure.

H. Circuit breakers shall be padlockable in the open position.

2.07 TRIP UNIT

A. Each molded case circuit breaker microprocessor-based tripping system shall consist of three (3) current sensors, a trip unit and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the adjustable time-current protection functions. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors, and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time-delay settings are reached.

B. An adjustable trip setting dial mounted on the front of the trip unit, or interchangeable ratings plugs shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be fixed or adjustable as indicated. Rating plugs shall be interlocked so they are not interchangeable between frames, and interlocked such that a breaker cannot be closed and latched with the rating plug removed.

C. System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:

1. Adjustable long-time setting (set by adjusting the trip setting dial or rating plug)

2. Adjustable short-time setting and delay with selective curve shaping

3. Adjustable instantaneous setting

4. Arc Flash feature

D. The microprocessor-based trip unit shall have both powered and unpowered thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.

E. When the adjustable instantaneous setting is omitted, the trip unit shall be provided with an instantaneous override.

F. Breakers shall have built-in test points for testing the long-time delay, instantaneous, and ground fault functions of the breaker by means of a test set.

2.08 UTILITY METERING

A. Where indicated on the drawings, furnish a separate barriered utility metering compartment complete with hinged sealable door. Bus work shall include provisions for mounting utility company current transformers and potential transformers or potential taps as required by the utility company.

B. Provide service entrance label and provide necessary applicable service entrance features per NEC and local code requirements. The switchboard shall meet the requirements of San Diego Gas and Electric (SDG&E) and be approved by SDG&E.

2.09 ENCLOSURES

A. Outdoor NEMA 3R Enclosure.

1. Section lineup and configuration shall be as indicated on the drawings.

2. Finish: Manufacturer's standard gray enamel.

2.10 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.

C. Provide a warning sign near the breakers warning emergency generator operation per NEC article 702.7(A).

2.11 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.

2.12 SURGE SUPPRESSION DEVICE

A. Provide a surge suppression in service entrance switchboard as specified in Section 16443.

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.

B. The manufacturer shall provide three (3) certified copies of factory test reports.

3.02 MANUFACTURER'S CERTIFICATION

A. A certified test report of all standard production tests shall be available to the engineer upon request.

3.03 TRAINING

A. The Contractor shall provide a training session for up to six (6) owner's representatives for one normal workday at a jobsite location determined by the Owner.

B. The training session shall be conducted by a manufacturer's qualified representative, not the Contractor. The training program shall consist of instruction on operation of the assembly, circuit breakers, fused switches, and major components within the assembly.

3.04 INSTALLATION

A. The contractors shall install all equipment per the manufacturer's instructions, contract drawings 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.

3.05 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.

-END OF SECTION-

SECTION 16421

UTILITY SERVICE ENTRANCE

PART 1 GENERAL

1.1 SUMMARY

A. Arrangement with Utility Company for permanent electric service.

B. Underground service entrance.

C. Metering equipment.

1.2 RELATED SECTIONS

A. Section 01300 – Record Drawings and Submittals

B. Section 01600 – Materials and Equipment

C. Section 16130 – Raceways and Boxes

D. Section 16170 – Grounding and Bonding

E. Section 16400 – Switchboards

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

A. ANSI/NFPA 70 - National Electrical Code.

B. SDG&E Guide.

1.4 SYSTEM DESCRIPTION

A. System Characteristics: 480/277, three phase, four-wire, 60 Hertz.

1.5 SUBMITTALS

A. Submit under provisions of the General Requirements.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with Utility Company written requirements.

B. Maintain one copy of each document on site.

1.7 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.8 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Utility Company drawings.

PART 2 PRODUCTS

2.1 UTILITY METERS

A. Meters will be furnished by Utility Company.

2.2 UTILITY METER BASE

A. Description: Meter base shall meet SDG&E service guide requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that service equipment is ready to be connected and energized.

3.2 PREPARATION

A. Make arrangements with Utility Company to obtain permanent electric service to the Project.

B. Coordinate location of Utility Company's facilities to ensure proper access is available.

C. Obtain the Utility Company’s approval of the Service Distribution Switchboard submittal prior to fabrication.

3.3 INSTALLATION

A. Install service entrance conduits from Utility Company's indicated point of connection to building service entrance equipment per utility company drawings. Connect service lateral conductors to service entrance conductors.

B. Provide concrete pad for Utility Company transformer as indicated in Utility Company drawings.

****END OF SECTION****

SECTION 16431

SHORT CIRCUIT, COORDINATION, AND ARC FLASH HAZARD STUDY

PART 1 GENERAL

1.1 REQUIREMENT

A. The Contractor shall prepare a short circuit and protective device coordination study for the electrical power system in accordance with the requirements of these Specifications and as shown.

B. The study shall include all portions of the 480V electrical distribution system for normal and standby power sources.

C. The work to be provided by the Contractor shall include protection studies for motors supplied with solid state overload and overcurrent protection devices.

D. It is the responsibility of the Contractor to obtain from the serving utility and vendors the information required for the work.

E. Provide a complete arc flash hazard study to help protect individuals from electrical arc flash injuries. These individuals may include any workers who inspect, maintain, or operate energized electrical equipment. Include all equipment 480 volts and 240 panelboards.

F. Provide Arc Flash Hazard Warning Labels. These labels are intended to assist operators and others in the selection of proper Personal Protective Equipment when working around exposed and energized conductors.

1.2 ORGANIZATION'S QUALIFICATIONS

A. Short circuit studies, protective device evaluation studies, and protective device coordination studies shall be performed by a third-party testing agency who has been regularly engaged in short circuit and protective device coordination services for a period of at least 15 years. The study shall utilize proven computer programs for making three-phase fault duty calculations. The studies shall be signed by the professional electrical Engineer, registered in the State of California, responsible for the studies.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Short Circuit Study in accordance with ANSI standard C37 and IEEE standard 141 (Red Book).

B. Coordination Study in accordance with IEEE 242 "Buff" to determine the proper overcurrent device settings that will balance system reliability through selective coordination while minimizing the magnitude of an electrical arc flash hazard incident.

C. Incident Energy Study in accordance with the IEEE 1584, "IEEE Guide for Performing Arc Flash Hazard Calculations" as referenced in NFPA 70, "Standard for

Electrical Safety in the Workplace", in order to quantify the hazard for selection of personal protective equipment (PPE). Tables that assume fault current levels and clearing time for proper PPE selection are not acceptable.

1.4 CONTRACTOR SUBMITTALS

A. The short circuit protective device coordination report shall conform to the requirements of this Section.

B. Studies related to distribution system protection, and coordination shall be submitted to the Engineer 30 days prior to receiving final approval of the distribution equipment shop drawings and release of equipment for manufacture. Approval from the Engineer shall be obtained for a preliminary submittal of sufficient detail to ensure that device selection will be adequate. Preliminary submittal shall indicate the computer program for use in performing the WORK of this Section.

C. Protective device and coordination evaluation studies shall be approved by the Engineer prior to releasing all distribution equipment for manufacturer, and project acceptance.

D. The Contractor shall indicate in the submittal changes to the protection scheme or equipment selection that will result in improved system reliability, and safety.

E. The submittal shall provide information concerning the program used for the work of this Section, and it shall include a general discussion of the procedure, items, and data considered in preparing the WORK.

PART 2 PRODUCTS

2.1 GENERAL

A. The study organization shall include a single-line, and an impedance diagram of the power system. This diagram shall identify all components considered in the study and the ratings of all power devices. This includes, but is not limited to transformers, circuit breakers, relays, fuses, busses, and cables. The resistances and reactance’s of all cables shall be identified in the impedance diagram. The study shall contain, from the serving utility company, all written data regarding maximum available short circuit current, voltage, and X/R ratio of the utilities' power system.

2.2 SHORT CIRCUIT STUDY

A. The short circuit study shall be performed with the aid of a digital computer program and shall be in accordance with ANSI/IEEE C 37.010, ANSI/IEEE C 37.13, ANSI/IEEE Standard 242, and ANSI/IEEE Standard 141.

2.3 PROTECTIVE DEVICE EVALUATION STUDY

A. A protective device evaluation study shall be performed to determine the adequacy of circuit breakers, molded case switches, automatic transfer switches, and fuses.

Any problem areas or inadequacies in the equipment due to prospective short-circuit currents shall be promptly brought to the Engineer's attention.

2.4 PROTECTIVE DEVICE COORDINATION STUDY

A. A protective device coordination study shall be performed to provide the necessary calculations required to select or check the 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.

2.5 TIME/CURRENT COORDINATION CURVES

A. As a minimum, the time/current coordination curves for the power distribution system shall include the following on log-log graph paper:

1. Time/current curves for each protective relay, circuit breaker, or fuse showing graphically that the settings will provide protection and selectivity within industry standards. Each curve shall be identified and tap, and time dial settings shall be specified. Provide individual curves for each feeder unless identical to others shown.

2. Time/current curves for each device shall be positioned to provide the maximum selectivity to minimize system disturbances during fault clearing. Where selectivity cannot be achieved, the Engineer shall be notified as to the cause. Recommendations shall be included for alternate designs that would improve selectivity.

3. Time/current curves and points for cable and equipment damage.

4. Circuit interrupting device operating and interrupting times.

5. Indicate maximum fault values on the graph.

6. Sketch of bus and breaker arrangement.

7. Magnetizing inrush points of transformers.

8. All restrictions of the ANSI and National Electrical Code shall be adhered shall be maintained.

9. Thermal limits of motors 250 hp and above.

10. Thermal limits of dry type and liquid insulated transformers. (ANSI damage curve).

2.6 LABELS

A. Installed warning labels (orange <40 cal/cm2) or danger label (red > 40 cal/cm2) in accordance with ANSI Z535.4-2002. The label must be readable in both indoor and outdoor environments for at least 3 years and contain the following information (See sample label, attached):

1. Arc hazard boundary (inches)
2. Working distance (inches)
3. Arc flash incident energy at the working distance (calories/ cm2)
4. PPE category and description including the glove rating
5. Voltage rating of the equipment
6. Limited approach distance (inches)
7. Restricted approach distance (inches)
8. Prohibited approach distance (inches)
9. Equipment/bus name
10. Date prepared
11. Arc flash hazard study preparer name and address
12. Protective device and rating

PART 3 EXECUTION

3.1 PROTECTIVE DEVICE TESTING, CALIBRATION, AND ADJUSTMENT

A. The Contractor shall provide the services of a qualified field Engineer and necessary tools and equipment to test, calibrate, and adjust the protective relays and circuit breaker trip devices as recommended in the power system coordination study.

B. The motor control center manufacturer shall provide the services of a qualified field Engineer to calibrate all MCPs as recommended in the power system study.

3.2 STUDY REPORTS

A. The results of the power system study shall be summarized in a final report. Eight bound copies of the final report shall be submitted. The report shall include the following:

1. Single-line diagram
2. Impedance diagram
3. Tabulation of all protective devices, which shall be identified on the single line diagram
4. Time/current coordination curves
5. Computerized fault current calculations

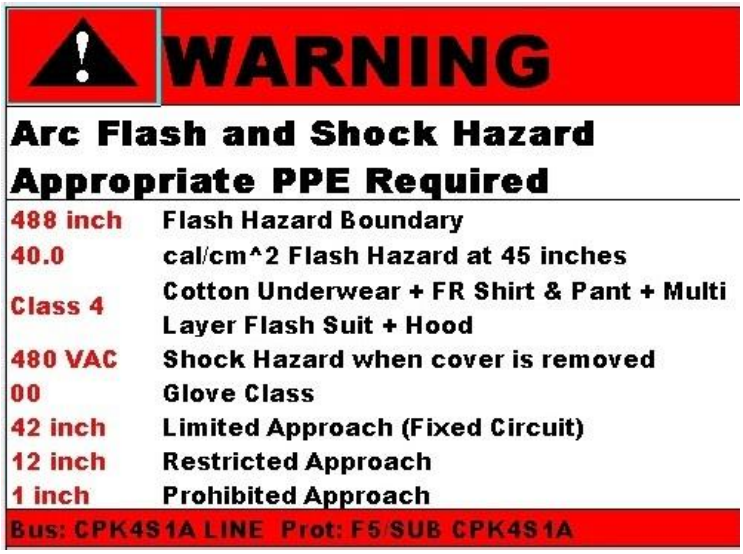
6. Specific recommendations, if any

7. Test instrumentation, condition, and connections, as applicable, for each study.

3.3 ARC FLASH ANALYSIS

A. Personnel performing the arc flash analysis shall be trained and experienced in accordance with NETA Training Specifications concerning the apparatus and systems being evaluated.

B. LABELS: (Sample)



****END OF SECTION****

SECTION 16443

SURGE SUPPRESSION DEVICE (SPD)

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall furnish and install the Surge Suppression Device (SPD) equipment having the electrical characteristics, ratings and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability, the AC surge protection shall be integrated into the main switchboard as indicated.

1.02 REFERENCES

A. SPD units and all components shall be designed, manufactured and tested in accordance with the latest applicable UL Listed standards (UL 1449, 3rd Edition), UL 1283 and CSA certified per CSA 22.2

1.03 SUBMITTALS

A. The following information shall be submitted to the Engineer:

1. Provide verification that the SPD device complies with the required UL 1449 3rd Edition and CSA approvals.

2. For retrofit mounting applications, electrical and mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.

B. The following additional information shall be submitted to the engineer:

1. Descriptive bulletins.

2. Product sheets.

1.04 QUALIFICATIONS

A. For the specified herein, the manufacturer shall be ISO 9000 certified.

B. The manufacturer must have a 24-hour response capability with nationwide field engineering personnel. The field service organization must have fully accredited, Power System Engineers located across North America who are capable of performing complete grounding, Power Quality analysis, and coordination studies. Factory trained SPD sales personnel do not qualify as Power System Engineers.

C. The manufacturer of the transient voltage surge suppression equipment shall be the same manufacturer as the manufacturer of the low voltage distribution equipment in which the SPD units are installed.

D. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

1. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.

2. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.05 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

1.06 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

PART 2 MATERIALS

2.01 MANUFACTURERS

A. Eaton/Cutler-Hammer: Visor Series, or equal.

2.02 VOLTAGE SURGE SUPPRESSION - GENERAL

A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.

2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall be greater than 115% of the nominal system operating voltage.

3. The suppression system shall incorporate a hybrid designed Metal-Oxide Varistors (MOV) surge suppressor for the service entrance and other distribution level. The system shall not utilize silicon avalanche diodes, selenium cell, air gaps or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.

4. Protection Modes – For a wye configured system, the device must have directly connected suppression elements between line-neutral (L-N), line-ground (L-G), and neutral-ground (N-G). For a delta-configured system, the device must have suppression elements between line to line (L-L) and line to ground (L-G).

5. UL 1449 3rd Edition Suppressed Voltage Rating (SVR) – The maximum UL 1449 2nd Edition SVR for the device must not exceed the following:

   a. Modes 208Y/120 480Y/277 600Y/347

b. L-N; L-G; N-G 400V 800V 1200V

c. L-L 800V 1800V 1800V

6. ANSI/IEEE Cat. C3 Let Through Voltage – The let through voltage based on IEEE C62.41 and C62.45 recommended procedures for Category C3 surges (20 kV, 10 kA) shall be less than:

a. Modes 208Y/120 480Y/277 600Y/347

b. L-N 560V 960V 1840V

7. ANSI/IEEE Cat. B3 Let Through Voltage – Let through voltage based on IEEE C62.41 and C62.45 recommended procedures for the ANSI/IEEE Cat. B3 ring wave (6 kV, 500 amps) shall be less than:

a. Modes 208Y/120 480Y/277 600Y/347

b. L-N 160V 165V 168V

B. SPD Design

1. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating SPD modules shall not be acceptable.

2. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be 50 dB at 100 kHz using the MIL-STD-220A insertion loss test method. Products not able to demonstrate noise attenuation of 50 dB @ 100 kHz shall be rejected.

3. Extended Range Filter –The Surge Protective Device shall have a High Frequency Extended Range Tracking Filter in each Line to Neutral mode with compliance to UL 1283 and NEMA LS1. The filter shall have published high frequency attenuation rating in the attenuation frequencies.

a. Attenuation Frequency 50kHz 100kHz 500kHz 1MHz 10MHz 100MHz

b. Insertion Loss (ratio) 40 316 89 200 79

c. Insertion Loss (dB) 32 50 39 46 38

4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be hardwired with connections utilizing low impedance conductors and compression fittings.

5. Standard Monitoring Diagnostics – Each SPD shall provide integral monitoring options:

a. Each unit shall provide a green / red solid state indicator light shall be provided on each phase. The absence of a green light and the presence of a red light shall indicate which phase(s) have been damaged.

b. Remote Status Monitor – The SPD device must include form C dry contacts (one NO and one NC) for remote annunciation of unit status. The remote alarm shall change state if any of the three phases detect a fault condition.

c. Event Counter – The SPD shall be equipped with an LCD display system designed to indicate to the user how many surges, sags, swells and outages have occurred at the location. The event counter triggers each time under each respective category after significant event occurs. A reset pushbutton shall also be standard allowing all counters to be zeroed.

d. Push to Test – The SPD shall be equipped with push-to-test feature, designed to provide users with real time testing of the suppressor's monitoring and diagnostic system. By depressing the test button, the diagnostic system initiates a self-test procedure. If the system is fully operational, the self-test will activate all indicator lights.

6. Optional Monitoring Diagnostics:

   Non Volatile Memory – The SPD shall at least be able to save the last 1000 events.

7. Overcurrent Protection Fusing: In order to isolate the SPD under any fault condition, the manufacturer shall provide:

   a. Individual Fusing: MOV's shall be individually fused via Copper Fuse Trace. The Copper Fuse shall allow protection during high surge (kA) events.

   b. Thermal Protection: MOV's shall be equipped with Thermal Fuse Spring (TFS) technology which allows disconnection of the suppression component at the overheated stage common during temporary over voltage condition. For small fault currents between 100mA to 30Amp, or if the occurrence is over a longer period of time, the TFS will disconnect first. Manufacturers that utilize fuse trace only shall not be approved since there is no fault current protection between 100mA to 30A.

   c. All overcurrent protection components shall be tested in compliance with UL 1449-Limited Current Test and AIC rating test.

C. Minimum Repetitive Surge Current Capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 – 1992. The suppression filter system shall be repetitive surge tested in every mode utilizing a 1.2 x 50µsec, 20kV open circuit voltage. 8 x 20µsec, 10kA short circuit current Category C3 bi-wave at one minute intervals without suffering either performance degradation or more than 10% deviation of clamping voltage at a specified surge current. The minimum repetitive surge current capability as per ANSI/IEEE C62.41 and ANSI/IEEE C62.45 – 1992 shall 12000 impulse per mode

2.03 SYSTEM APPLICATION

A. The SPD applications covered under this section include distribution and branch panel locations, bus plugs, motor control centers (MCC), switchgear, and switchboard assemblies. The branch panel located SPD shall be tested and demonstrate to be suitable for ANSI/IEEE C62.41 Category C1 environments.

B. Surge Current Capacity -- The minimum total surge current 8 x 20 microsecond waveform that the device is capable of withstanding shall be as follows:

1. Minimum total Surge Current and Withstand Capability with compliance to ANSI/IEEE C62.41 AND NEMA LS1, Application Per Phase, Per Mode Surge Withstand Capabilities ANSI/IEEE C3 Wave (10kA).

2. Service Entrance Locations (Switchboards): 250kA, 125kA, 12000 hits.

C. Switchboard Requirements

1. The SPD application covered under this section is for switchboard locations. Service entrance located SPD shall be tested and suitable for ANSI/IEEE C62.41 Category C3 environments.

2. The SPD shall be of the same manufacturer as the switchboard where possible.

3. Locate suppressor on load side of main disconnect device, as close as possible to the phase conductors and ground/neutral bar.

4. Provide a 30-amp disconnect. The disconnect shall be directly integrated to the suppressor and assembly bus using bolted bus bar connections.

5. All monitoring diagnostics features shall be visible from the front of the equipment.

PART 3 EXECUTION

3.01 FACTORY TESTING

A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.02 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.

3.03 WARRANTY

A. The manufacturer shall provide a full ten (10) year warranty from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local code.

-END OF SECTION-

SECTION 17000

INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section provides specifications for all instrumentation and control equipment, control panel, and necessary appurtenances for an integrated control system. These specifications and drawings include descriptions of functional operation and performance, as well as standards, but do not necessarily enumerate detailed specifications for all components and devices which are necessary. However, all components and devices shall be furnished and installed as required to provide complete and operable systems capable of providing the functions and meeting the performance set forth hereinafter.

B. PLC, OIT and SCADA programming will be provided by the District's preferred supplier - Freedom Automation. The Contractor shall utilize the preferred supplier, whose quote is provided in appendices.

C. Wherever submittals are required hereunder, all such submittals by the CONTRACTOR shall be submitted to the ENGINEER.

D. In these Contract Documents all systems, meters, instruments, and other elements are represented schematically, and are designated by numbers, as derived from criteria in Instrument Society of America Standard ANSI/ISA S5.1. The CONTRACTOR shall assign nomenclature and instrument tags on their submittal drawings. ANSI nomenclature and numbers shall be employed exclusively throughout shop drawings, data sheets, computer programming and similar materials. Any other symbols, designations, and nomenclature unique to the manufacturer's standard methods shall not replace those prescribed above.

E. Should an error be found in a shop drawing during installation or testing of equipment, the correction, including any field changes found necessary, shall be noted on the drawing and submitted finally "as-built" prior to acceptance of the project.

F. The submittal shall be submitted complete at one time within 60 working days after date of Notice to Proceed. Any incomplete submittal will be rejected and returned without comments.

1.2 RESPONSIBILITIES

A. The CONTRACTOR, through the use of a System Integrator shall be responsible to the OWNER for the implementation of the Control System, with other required electrical, instrumentation, and control devices.

B. Due to the complexities associated with the interfacing of numerous control system devices, it is the intent of these specifications that the System Integrator be responsible to the CONTRACTOR for the integration of the SCADA system with existing devices and devices provided under other sections with the objective of

providing a completely integrated control system free of signal incompatibilities.

C. Provide all engineering, documentation, labor, and materials required to resolve signal, power, or functional incompatibilities between the control and instrumentation system and interfacing devices. This includes all interfaces to existing instruments and equipment.

D. As a minimum, the Contractor, System Integrator, and EFI shall perform the following work (System Integrator and EFI's scopes of work are provided in Appendices, the Contractor shall provide all other work):

1. Prepare a field instrument test plan submittal

2. Verify calibration of field instruments after installation

3. Oversee and certify installation of instruments.

4. Oversee, document, and certify loop testing

5. Oversee, document, and certify system commissioning

6. Conduct the performance test

7. Coordinate with the District for PLC I/O software functional testing

8. Prepare Owner's Manuals

9. Prepare record drawings

E. Integration of the SCADA system with instrumentation and control devices being provided under other sections:

1. Resolve signal, power, or functional incompatibilities between the SCADA system and interfacing devices.

F. Any System Integrator responsibilities in addition to the list above are at the discretion of the CONTRACTOR and the System Integrator. Additional requirements in this Section and throughout Division 17 that are stated to be the CONTRACTOR'S responsibility may be performed by a qualified System Integrator if the CONTRACTOR and System Integrator so agree.

1.3 SYSTEM INTEGRATOR

A. The Contractor shall select one of the following as the Instrumentation System Integrator for electrical and control hardware:

1. Freedom Automation, Phone No. 760-639-4100.

1.4 RELATED WORK SPECIFIED ELSEWHERE

A. Electrical work specified hereunder shall conform to the requirements of this section and the applicable requirements of section entitled "Electrical General Provisions".

(See Section 16000).

1.5 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. The installation and fabrication of all items within the scope of this section of the specifications shall be accomplished according to the requirements of the regulatory agencies as specified in Electrical Section 16000 and the referenced standards listed including UL, IEEE, ICEA, and NEMA.

The primary reference standards for this section of the specifications shall be ISA-Instrument Society of America.

Without limiting the generality of other requirements of these specifications, all work specified herein shall conform to or exceed the applicable requirements of the referenced documents to the extent that the requirements therein are not in conflict with the provisions of this section; provided, that where such documents have been adopted as a code or public ordinance by the public agency having jurisdiction, such code or ordinance shall take precedence.

1.6 CONTRACTOR SUBMITTALS

A. General Submittal Requirements:

1. Submittals shall be provided per Section 01300.

B. Shop Drawings

1. The term "Shop Drawings" as used herein shall be understood to include detail design calculations, shop drawings, fabrication, and installation drawings, erection drawings, list, graphs, catalog sheets, data sheets, and similar items. Whenever the CONTRACTOR is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the project is to be built, unless otherwise directed.

2. Fabrication of an item shall be commenced only after the ENGINEER has reviewed the pertinent submittals and declared to the CONTRACTOR either "NO EXCEPTIONS TAKEN" 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 for changes to the contract requirements.

3. All CONTRACTOR shop drawings submittals shall be carefully reviewed by an authorized representative of the CONTRACTOR, prior to submission to the ENGINEER. The Engineer’s review of Contractor shop drawings 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.

C. RTU Submittal

1. This submittal to include field instrumentation and RTU modifications in a singular, all-inclusive submittal which shall include but not be limited to.

a. A complete index appearing in the front of each bound submittal volume. Labeled tags shall separate system groups.

b. Installation, mounting, and anchoring details for all components and assemblies, including access requirements and conduit connection or entry details.

c. Drawings showing schematic diagrams for control circuits. Complete details on the circuit interrelationship of all devices within and outside each Control Panel shall be submitted using schematic control diagrams. The diagrams shall show numbered terminals on components together with the unique number of the wire to be connected to each terminal. The diagrams shall also show terminal assignments from all primary measurement devices, such as flowmeters, and to all final control devices. The CONTRACTOR shall furnish all necessary equipment suppliers' shop drawings to facilitate inclusion of this information by the System Integrator.

d. Complete and detailed bills of materials: A bill of material list, including quantity, description, manufacturer, and part number, shall be submitted for cabinet assemblies and subassemblies. Bills of material shall include all items within an enclosure.

e. Data sheets for each component, together with a technical product brochure or bulletin: The data sheets shall show:

1. Component functional description used herein and on the Drawings;

2. Manufacturer's model number or other product designation;

3. Project tag number used herein and on the Drawings;

4. Project system or loop of which the component is a part;

5. Project location or assembly at which the component is to be installed;

6. Input and output characteristics;

7. Scale range and units (if any) and multiplier (if any);

8. Requirements for electric supply (if any);

9. Materials of construction and of component parts to be in contact with or otherwise exposed to, process media;

10. Special requirements or features, such as specifications for ambient operating conditions.

11. Features and options which are furnished.

f. A separate technical brochure or bulletin shall be included with each instrument data sheet. The data sheets shall be indexed in the submittal by systems or loops, as a separate group for each system or loop. If within a single system or loop, a single instrument is employed more than once, one data sheet with one brochure or bulletin may cover all identical uses of that instrument in that system. Each brochure or bulletin shall include a list of tag numbers for which it applies. Special options and features, which are furnished, shall be identified.

g. Calibration, adjustment and test details for all components and systems.

D. Submittals - Test Procedures

1. Submit the procedures proposed to be followed during each test. Procedures shall include test descriptions, forms, and checklists to be used to control and document the required tests.

2. Upon completion of each required test, document the test by submitting a copy of the signed off test procedures. Testing documentation shall consist of the following:

a. The summary check-off index shall be an index of all PLC and telemetry systems in the project and shall include the following as a minimum for each system:

1. System description

2. Physical installation check-off box

3. Functional check-off box for each point

4. Satisfactory completion check-off box for each point

5. Comments box

6. Sign-off area for the SI, the Engineer, and the Agency

b. The individual instrument sign-off sheet(s):

1. The instrument tag number

2. The manufacturer and part number

3. Description of instrument

4. Power requirements
5. Calibration procedure including calibration ideal vs. actual chart for 0%, 25%, 50%, 75%, and 100% of full scale value
6. Calibration range
7. Calibration data (setpoint, deadband, etc.)
8. Switch settings
9. PLC I/O address(es)
10. Additional comments as required
11. Signoff space for the SI, the Engineer, and the Agency

c. The System Integrator shall submit the Test Plan and receive a satisfactory review approval by the Engineer before any witnessed testing can occur.

E. Submittals - Operations and Maintenance Manuals

1. The CONTRACTOR shall submit technical operation and maintenance information for each item of mechanical, electrical and instrumentation equipment in an organized manner in the OWNER'S MANUAL. Contractor shall integrate information provided by EFI into the OWNER'S MAUNUAL, which shall be written so that it can be used and understood by the DISTRICT's operation and maintenance staff.

2. All drawings developed for the RTU shall be generated utilizing a commercial CAD system and shall be delivered on CD-ROM in a DWG format, as completely compatible with/readable by the latest AutoCAD software package.

3. The OWNER'S MANUAL shall be in both hard copy and electronic as stated in Section 01630 in latest version of MSWord and Adobe Acrobat PDF formats on CD-ROM, subdivided first by specification section number; second, by equipment item; and last, by "Part." "Parts" shall conform to the following (as applicable):

a. Part 1 — Equipment Summary:

1. Procedures: Manufacturer-recommended procedures on the following shall be included in Part 2:

2. Form: The ENGINEER will supply an Equipment Summary Form for each item of mechanical, electrical and instrumentation equipment in the WORK. The CONTRACTOR shall fill in the relevant information on the form and include it in Part 1.

b. Part 2 — Operational Procedures:

1. Summary: A summary table shall indicate the equipment name, equipment number, and process area in which the equipment is installed.
Installation
Adjustment
Location of controls, special tools, equipment required, or related instrumentation needed for operation
Operation procedures
Load changes
Calibration
Shutdown
Troubleshooting
Disassembly
Reassembly
Realignment
Testing to determine performance efficiency
Tabulation of proper settings for all pressure relief valves, low and high-pressure switches, and other protection devices
List of all electrical relay settings including alarm and contact settings

c. Part 3 — Preventive Maintenance Procedures:

1. Procedures: Preventive maintenance procedures shall include all manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by leaving the equipment in place.

2. Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade, type, and temperature ranges, shall be covered.

d. Part 4 - Parts List:

1. Parts List: A complete parts list shall be furnished, including a generic description and manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included.

2. Drawings: Cross-sectional or exploded view drawings shall accompany the parts list.

e. Part 5 - Wiring Diagrams:

1. Diagrams: Part 5 shall include complete internal and connection wiring diagrams for electrical equipment items.

f. Part 6 - Shop Drawings:

1. Drawings: This part shall include approved shop or fabrication drawings.

g. Part 7 - Safety:

1. Procedures: This part describes the safety precautions to be taken when operating and maintaining the equipment or working near it.

h. Part 8 - Documentation:

1. All equipment warranties, affidavits, and certifications required by the Technical Specifications shall be placed in this part.

4. OWNER'S MANUALS shall be submitted in final form to the ENGINEER not later than the 75 percent of construction completion date. The CONTRACTOR shall correct all discrepancies found by the ENGINEER in the TECHNICAL MANUALS within 30 days from the date of written notification by the ENGINEER.

5. Incomplete or unacceptable OWNER'S MANUALS at the 75 percent construction completion point shall constitute sufficient justification to withhold adequate amount, proportional in value, from any monies due the CONTRACTOR.

1.7 SPARE PARTS

A. The CONTRACTOR shall include in the Owner's Manual a list of spare parts as per the specification's requirements.

1.8 QUALITY ASSURANCE

A. Unless otherwise specified, each individual instrument shall have a minimum accuracy of +0.5 percent of full scale and a minimum repeatability of +0.25 percent of full scale.

1.9 GUARANTEE

A. The CONTRACTOR shall guarantee the performance and the hardware of all the CONTROL PANEL equipment as specified herein, for a period of one year following the date of completion and formal acceptance of the WORK as specified under the General Conditions of these Specifications. Services shall begin within 24 hours for critical items and within 3 days for non-critical items after notification by the DISTRICT.

B. Equipment, software, and materials which do not achieve design requirements after installation shall be replaced or modified by the System Integrator to attain compliance, at no additional cost to the DISTRICT. Following replacement or

modification, the CONTRACTOR shall retest the system and perform any additional procedures needed to place the complete system in satisfactory operation and attain design compliance approval from the ENGINEER.

C. All parts, material (excluding consumables), labor, travel, subsistence, or other expenses incurred in providing all the services and service visits during the one-year warrantee period shall be borne by the CONTRACTOR under the guarantee.

D. The warrantee period shall start when the work has been completed and accepted by the DISTRICT and the ENGINEER.

PART 2 - PRODUCTS

2.1 MATERIALS AND STANDARD SPECIFICATIONS

A. Provide instruments, equipment and materials suitable for service conditions and meeting standard specifications such as ANSI, ASTM, ISA, and SAMA. The intent of this Specification is to ensure instruments and equipment are of a uniform quality and manufacture throughout the plant. All instruments in the plant of the same type shall be made by the same manufacturer.

2.2 NAME TAGS

A. All instrumentation and equipment items or systems shall be identified by name tags. Field equipment shall be tagged with the assigned instrumentation tag number listed in the Instrument Schedule.

B. Name tags shall be stainless steel with engraved or stamped black characters of 3/16 inch minimum height. Tags shall be attached to equipment with a tag holder and stainless steel band with a worm screw clamping device. Use 20-gauge stainless steel wire where banding is impractical. For field panels or large equipment cases use stainless steel screws; however, such permanent attachment shall not be on an ordinarily replaceable part.

2.3 FIELD-MOUNTED EQUIPMENT

A. All instrument and control equipment mounted outside of protective structures shall be equipped with suitable surge arresting devices to protect the equipment from damage due to electrical transients induced in the interconnecting lines from lightning discharges or nearby electrical devices. Protective devices used on 120 Vac inputs to field mounted equipment shall be secondary valve surge protectors conforming to the requirements of ANSI C62.1.

2.4 EQUIPMENT OPERATING CONDITIONS

A. All equipment shall be rated for normal operating performance with varying operating conditions over the following minimum ranges.

1. Operation and Maintenance (O&M) Manuals shall be prepared respective to the Work of this Instrumentation Section. Preliminary and final O&M Manuals shall be submitted for Engineer approval.

2. Field Instruments:
   a. Outdoor Areas:
      Ambient Temperature: +15°F to +120°F
      Ambient Relative Humidity: 5% to 100%
      Weather: Rain, and ice
   b. Indoor Unheated Areas:
      Ambient Temperature: +30°F to +110°F
      Ambient Relative Humidity: 10% to 95%, non-condensing
   c. Indoor Environmentally Controlled Areas:
      Ambient Temperature: +60°F to +104°F
      Ambient Relative Humidity: 10% to 90%, non-condensing

2.5 EQUIPMENT LOCATIONS

A. Provide equipment and materials suitable for the types of locations in which they are located as defined under Division 16. All equipment specified for field mounting shall be weatherproof and splash proof as a minimum.

2.6 CURRENT TECHNOLOGY

A. All meters, instruments, and other components shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise required to match existing equipment.

2.7 LOOP ACCURACY

A. The accuracy of each instrumentation system or loop shall be determined as a probable maximum error; this shall be the square-root of the sum of the squares of certified “accuracies” of the designated components in each system, expressed as a percentage of the actual span or value of the measured variable. Each individual instrument shall have a minimum accuracy of plus and minus 0.5 percent of full scale and a minimum repeatability of plus and minus 0.25 percent of full scale unless otherwise indicated. Instruments which do not conform to or improve upon these criteria are not acceptable.

2.8 ANALOG SIGNAL INDICATED UNITS

A. For all instruments with local or remote indicators, provide indicators scaled in actual engineering units, i.e., gallons per minute, feet, psi, etc., rather than 0 to 100%, unless noted otherwise on the Drawings or Instrument Schedule.

2.9 SIGNAL TRANSMISSION

A. Analog:

1. Signal transmission between electric or electronic instruments shall be 4-20 mA and shall operate at 24 Vdc. Signal output from all transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating.

2. Nonstandard transmission systems such as impulse duration, pulse rate, and voltage regulated will not be permitted except where specifically noted in the Instrument Schedule or shown on the Drawings. When transmitters with nonstandard outputs do occur, their output shall be converted to 4-20 mA prior to transmission.

B. Discrete: All alarm and status signals shall be 24 VDC unless specified otherwise on the Instrument Schedule.

2.10 FASTENERS

A. Fasteners for securing equipment to walls, floors and the like shall be 316 stainless steel. When fastening to existing walls, floors, and the like, provide capsule anchors, not expansion shields. Size capsule anchors to meet load requirements. Minimum size capsule anchor bolt is 3/8 inch.

2.11 ELECTRONIC MEDIA

A. As-built drawings shall be provided in AutoCAD (DWG) format on CD – ROMs. The CD shall be organized to simplify user browsing.

PART 3 – EXECUTION

3.1 GENERAL

A. Elements such as transmitters, and the like, shall be tested and exercised to demonstrate correct operation, first individually and then collectively as functional analog networks. Each analog system shall be tested to verify proper performance. Individual component uncertainty requirements shall be as specified by the manufacturer.

3.2 MOUNTINGS

A. Mount and install equipment as indicated. Mount field instruments on pipe mounts or other similar means in accordance with suppliers' recommendation. Where mounted in control panels, mount according to requirements of that section.

B. Equipment specified for field mounting shall be suitable for direct pipe mounting or surface mounting, surface-mounted indicators and equipment with calibration adjustments or requiring periodic inspection shall be mounted not lower than 3 feet 6 inches nor higher than 6 feet above walkways, platforms, catwalks, and the like.

C. All devices shall be accessible to operators for servicing, operating, reading, etc. Provide permanent platforms to assure devices are continuously accessible.

3.3 FIELD WIRING

A. Ring out signal wiring prior to termination and perform surge withstand tests where required. Verify all terminations are tight and shields are uniformly grounded at one location.

3.4 CALIBRATION

A. General: All devices provided under Division 17 shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements.

B. Calibration Points: Each instrument shall be calibrated at 0, 25, 50, 75, and 100% of span using test instruments to simulate inputs. The test instruments shall have accuracies traceable to National Institute of Testing Standards.

C. Bench Calibration: Instruments which have been bench-calibrated shall be examined in the field to determine whether any of the calibrations are in need of adjustment. Such adjustments, if required, shall be made only after consultation with the ENGINEER.

D. Field Calibration: Instruments which were not bench-calibrated shall be calibrated in the field to insure proper operation in accordance with specification data sheets.

E. Analyzer Calibration: Each analyzer system shall be calibrated and tested as a workable system after installation. Testing procedures shall be directed by the manufacturers' technical representatives. All samples and sample gases shall be furnished by the manufacturers.

F. Calibration Sheets: Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit.

1. Project name
2. Loop number
3. Tag number
4. Manufacturer
5. Model number
6. Serial number
7. Calibration range
8. Calibration data: Input, output, and error at 0, 25, 50, 75, and 100% of span
9. Switch setting, contact action, and deadband for discrete elements
10. Space for comments
11. Space for sign-off by System Integrator and date
12. Test equipment used and associated serial numbers

G. Calibration Tags: A calibration and testing tag shall be attached to each piece of

equipment or system at a location determined by the ENGINEER. The CONTRACTOR shall have the System Integrator sign the tag when calibration is complete.

3.5 LOOP TESTING

A. Control Valve Tests: All control valves, cylinders, drives and connecting linkages shall be stroked from the operator interface units as well as local control devices and adjusted to verify proper control action, hand switch action, limit switch settings, torque settings, remote control actions, and remote feedback of valve status and position. Control valve actions and positioner settings shall be checked with the valves in place to ensure that no changes have occurred since the bench calibration.

B. Interlocks: All hardware and software interlocks between the instrumentation and the motor control circuits, control circuits of soft starters and packaged equipment controls shall be checked to the maximum extent possible.

C. Instrument and Instrument Component Validation: Each instrument shall be field tested, inspected, and adjusted to its indicated performance requirement in accordance to its Manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirement, or, in the absence of a Contract requirement, any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced.

D. Loop Validation: Controllers and electronic function modules shall be field tested and exercised to demonstrate correct operation. All control loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements, final control elements, and the graphic displays associated with the PLC. Actual signals shall be used whenever available. Following any necessary corrections, the loops shall be retested. Specified accuracy tolerances for each analog network are defined as the root-mean-square-summation of individual component accuracy requirements. Individual component accuracy requirements shall be as indicated by Contract requirements or by published manufacturer accuracy specifications, whenever Contract accuracy requirements are not indicated. Each analog network shall be tested by applying simulated analog or discrete inputs to the first element of an analog network. For networks which incorporate analog elements, simulated sensor inputs corresponding to 0, 25, 50, 75, and 100% of span shall be applied, and the resulting element outputs monitored to verify compliance to calculated root-mean-square-summation accuracy tolerance requirements. Continuously variable analog inputs shall be applied to verify the proper operation and setting of discrete devices. Provisional settings shall be made on controllers and alarms during analog loop test. All analog loop test data shall be recorded on test forms which include calculated root-mean-square-summation system accuracy tolerance requirements for each output.

E. Loop Validation Sheets: The CONTRACTOR shall prepare loop confirmation sheets for each loop covering each active instrumentation and control device except simple hand switches and lights. Loop confirmation sheets shall form the basis for operational tests and documentation. Each loop confirmation sheet shall cite the following information and shall provide spaces for sign-off on individual items and on

the complete loop by the System Integrator:

1. Project name
2. Loop number
3. Tag number, description, manufacturer and model number for each element
4. Installation bulletin number
5. Specification sheet number
6. Loop description number
7. Adjustment check
8. Space for comments
9. Space for loop sign-off by System Integrator and date
10. Space for sign-off by System Integrator and date
11. Space for sign-off by Engineer or District and date

F. Loop Certification: When installation tests have been successfully completed for all individual instruments and all separate analog control networks, a certified copy of all test forms shall be retained by the CONTRACTOR.

3.6 FIELD FUNCTIONAL TESTING

A. General: Field functional testing shall commence after acceptance of all wire test, calibration tests and loop tests, and all inspections have demonstrated that the instrumentation and control system complies with all Contract requirements. Field functional testing shall demonstrate proper operation of all systems with process equipment operating over full operation ranges under conditions as closely resembling actual operation conditions as possible.

B. Field functional Test Procedures and Documentation: All field functional testing activities shall follow detailed test procedures and check lists accepted by the ENGINEER. All test data shall be acquired using equipment as required and shall be recorded on test forms accepted by the ENGINEER, which include calculated tolerance limits for each step. Completion of all system field functional testing activities shall be documented by a certified report, including all test forms with test data entered and retained by the CONTRACTOR.

C. Operational Validation: Where feasible, system field functional testing activities shall include the use of water to establish service conditions that simulate, to the greatest extent possible, normal final control element operation conditions in terms of applied process loads, operation ranges, and environmental conditions. Final control elements, control panels, and ancillary equipment shall be tested under start-up and steady-state operation conditions to verify that proper and stable control is

achieved using motor control center and local field mounted control circuits. All hardwired and software control circuit interlocks and alarms shall be operational. The control of final control element and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits. The stable steady-state operation of final control elements running under the control of field mounted controllers as required eliminating oscillatory final control element operation. The transient stability of final control elements operation under the control of field mounted, and software based automatic analog controllers shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations (if any) and making necessary controller adjustments as required to eliminate excessive oscillatory amplitudes and decay rates.

D. Field Functional Test Validation Sheets: Field functional testing shall be documented on one of two types of test forms as follows:

1. For functions which can be demonstrated on a loop-by-loop basis, the form shall include:

    a. Project name

    b. Loop number

    c. Loop description

    d. Tag number, description, manufacturer and data sheet number for each component

    e. Space for sign-off and date by both the System Integrator and ENGINEER

2. For functions which cannot be demonstrated on a loop-by-loop basis, the test form will be a listing of the specific tests to be conducted. With each test description the following information shall be included:

    a. Specification page and paragraph of function demonstrated

    b. Description of function

    c. Space for sign-off and date by both the System Integrator and ENGINEER

E. Field Functional Test Certification: The CONTRACTOR shall submit an instrumentation and control system field functional test completion report which shall state that all Contract requirements have been met and shall include a listing of all instrumentation and control system maintenance and repair activities conducted during the field functional testing. Acceptance of the instrumentation and control system field functional testing must be provided in writing by the ENGINEER before the acceptance testing may begin. Final acceptance of the control system shall be based upon plant completion as stated in the General Conditions:

3.7 ACCEPTANCE TEST

A. General: Subsequent to Field Functional Test and instrument calibration, verifying substantial completion of field installation and start-up, the system will be given a final 14-day acceptance test. The 14-day test must be successfully completed, including resolution of punch-list items generated during the test period, prior to the date of substantial completion of the entire project. The system must run continuously for 14 consecutive days. During this period, all system functions shall be exercised, and any system interruption and accompanying component, subsystem, or hardware failure shall be logged for cause of failure, as well as time of occurrence and duration of each failure. The CONTRACTOR shall provide a competently trained technician on call during all normal working days and hours from the start of the acceptance test until final acceptance of the system.

B. Testing: The systems to be tested on-line will include general operations as well as the Report Generator and Operation as specified herein. Each system function, e.g., status report-backs, logs, and displays shall be exercised several times at a minimum, and in a manner, which approximates "normal" system operation. Failure of the system during the above program testing shall be considered as indicating that the programs and operating system do not meet the requirements of the specifications and corrective action shall be required before restarting the acceptance test. Only those components, subsystems, and systems covered in this specification shall be considered for this acceptance test. Problems and failures of other systems shall not be considered as part of this test (except as they display the capabilities of this system to detect failures).

C. Failures: Failures shall be classified as either major or minor. A minor failure would be a small and non-critical component failure, which can be corrected by the OWNER operators. This occurrence shall be logged but shall not be reason enough for stopping the test and shall not be grounds for non-acceptance. However, should the same or similar component failure occur repeatedly, this may be considered as grounds for non-acceptance. A major failure shall be considered to have occurred when a component, subsystem, or program fault causes a halt in operation of the system and/or when a technician's work is required to make a repair or to re-initiate operation of the system. A major failure shall cause termination of the acceptance test. When the causes of a major failure have been corrected, a new acceptance test with a new 14-day duration shall be started.

D. Technician Report: Each time a technician is required to respond to a system malfunction, he or she must complete a report which shall include details concerning the nature of the complaint or malfunction and the resulting repair action required and taken. If a malfunction occurs which clears itself or which the operator on duty is able to correct, no report shall be required (logged as specified above). If a technician has performed work but no report is written, then a major failure shall be considered to have occurred. Each report shall be as specified above). Each report shall be submitted within 24 hours to the ENGINEER or its representative, and the OWNER.

-END OF SECTION-

Section 17100

CONTROL PANELS AND APPURTENANCES

PART 1 - GENERAL

1.1 SCOPE

A. The Panels and Appurtenances section covers the furnishing of panels and appurtenances as listed below:

WEST LILAC PUMP STATION SCADA TELEMETRY PANEL
RANCHO AMIGOS PUMP STATION SCADA TELEMETRY PANEL
DENTRO PUMP STATION SCADA TELEMETRY PANEL

1.2 GENERAL

A. Equipment furnished and installed under this section shall be fabricated and assembled in full conformity with the Drawings, specifications, equipment schedules, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

B. General Equipment Stipulations

1. The General Equipment Stipulations shall apply to all equipment and materials provided under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1.3 SUBMITTALS

A. Submittals shall be made as specified in the Instrumentation and Control System section.

1.4 DELIVERY, STORAGE, AND SHIPPING

A. Delivery, storage and shipping shall be as per The Instrumentation and Control System section.

PART 2 - PRODUCTS

2.1 PANEL DESIGN AND FABRICATION FEATURES

All panels furnished shall conform to the stipulations of NEMA ICS-6-1993. Unless indicated otherwise on the Drawings, the following paragraphs describe general fabrication specifications for the PLC cabinets, instrument panels, consoles, enclosures, and subpanels.

A. Piping

1. Pneumatic tubing shall be 1/4-inch [6 mm] OD, soft annealed copper with compression fittings. Tubing and fittings shall be as specified in the Miscellaneous Piping section.
   a. Fittings. Compression type bulkhead fittings shall be provided near the bottom or the top of the panel for all field connections. Compression nuts and sleeves shall be provided for the field connections. Indicators, recorders, controllers, and other pneumatic devices shall be provided with plugged test connections and shutoff valves for isolation.

   b. Valves. All devices shall have separate air supply shutoff valves. Valves and compression fittings shall be as manufactured by, Parker Hannifin, Swagelock or Tylok

B. Power Entrance

1. The power entrance to each panel shall be provided with a surge protection device. Surge arresters shall be Transtector "ACP-100-HW Series", Power Integrity Corporation “ZTA Series”, Phoenix Contact “Mains PlugTrab”, or MCG Surge Protection “400 Series”.

C. Power Wiring

1. Power distribution wiring on the line side of panel fuses shall be minimum 12 AWG. Secondary power distribution wiring shall be minimum 14 AWG. Wiring for ac power distribution, dc power distribution, intrinsically safe, and control circuits shall have different colors and shall agree with the color-coding legend on System Supplier's panel wiring diagrams. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, insulated for not less than 600 volts, with a moisture resistant and flame retardant covering rated for not less than 90°C.

D. Instrument and Control Wiring

1. All internal panel wiring shall be type MTW stranded copper wiring rated not less than 600 volts. Electronic analog circuits shall be twisted, and shielded pairs rated not less than 300 volts. Analog circuits shall be separated from ac power circuits. Intrinsically safe circuits shall be physically separated from other circuits in accordance with applicable codes. Wires within the panel shall conform to the minimum size as shown in the table below.

Type	Min. Wire Size	Color
AC Control	16 AWG	Red
DC Control (+24vdc)	16 AWG	Brown
DC Control (-24vdc)	16 AWG	Orange
Analog Circuits	18 AWG Twisted Pair	Insert colors

2. All wiring shall be grouped or cabled and firmly supported inside the panel. Each individual wire in power, control, and instrumentation circuits shall be provided with identification markers at each point of termination. The wire markers shall be positioned to be readily visible for inspection and the identification numbers shall match the identification on the supplier's panel wiring drawings. Wiring shall be bundled in groups and bound with nylon cable ties or routed in Panduit or similar nonmetallic slotted ducts. Ducts shall be readily accessible within the panel, with removable covers, and with space equal to at least 40 percent of the depth of the duct remaining available for future use after completion of installation and field wiring. Sufficient space shall be provided between cable groups or ducts and terminal blocks for easy installation or removal of cables.

E. Terminal Blocks

1. Terminal blocks for external connections shall be suitable for 12 AWG wire and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with marking strip, covers, and pressure connectors. Terminals shall be labeled to agree with identification shown on the supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits, plus one ground for each shielded cable. Not less than inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space. Not less than 25 percent spare terminals shall be provided. Each control loop or system shall be individually fused, and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance.

F. Backup Power

1. The control panel be provided with an interior-mounted UPS to provide backup power to critical loads upon loss of power supply to the panel. UPS-backed power shall be provided to the programmable logic controller CPU, instrument loops, I/O modules (operating and wetting voltages), all network communications devices, future 2 amp radio, and any other load essential to preventing loss of control system function. Backup power for panel interior lights, heaters, and convenience receptacles is not required. UPSs for free-standing vertical panels and wall cabinets shall meet the requirements specified below.

2. <u>UPS for PLC Control Panel</u>. Each UPS shall accept incoming 120 volts ac, 60Hz, single-phase utility power, apply surge protection, and supply power to the connected loads. The UPS shall be a double-conversion (“on-line”) type to provide a breakless transfer to backup power. In the event of incoming power failure, the UPS shall provide 120 volts ac, 60 Hz, single-phase power to its connected loads by inverting power stored within integral storage batteries. The UPS shall be contained inside the enclosure and supported by a dedicated shelf attached to the backplane or sidewall. The shelf shall be between 12 and 18 inches from the bottom of the enclosure and shall not be directly above any electronic or

electromechanical devices.

The UPS shall have at least two integral NEMA 5-15R receptacles for connection of battery-backed loads. Upon restoration of incoming power, the UPS shall recharge the batteries and return its connected loads to the incoming power source. The factory-installed line cord and plug shall not be altered. The UPS output shall be connected by plug and line cord to terminal blocks as necessary to distribute power to loads not having a power cord and plug; all other loads shall be connected directly to the UPS's integral receptacles or to permanently installed receptacles fed from the UPS output.

The UPS shall maintain a temperature-compensated, float charge voltage on the batteries when utility power is available. Overcurrent protection when utility power is available shall be from a circuit breaker internal to the UPS. The UPS shall be intrinsically current-limiting when the unit is on battery.

The UPS shall meet the following requirements.

Capacity, minimum	1000 VA
Filtering and surge Protection (on utility power	Meets IEEE/ANSI C62.41 Category B (IEEE 587)
Voltage, output (on battery)	120 volts ±3 percent
Voltage, output (on-line)	Nominal ±3 percent
Frequency and waveform,	60 ± 0.3 Hz, true sine-wave output (on battery)
Efficiency, minimum (on-line)	90 percent
Operating environment	0 to 40ºC; 0 to 95 percent relative humidity, non-condensing
Backup time, minimum at half of rated load	10 minutes
Recharge time, maximum to 90 Percent of full charge	12 hours

The UPS shall have spare capacity of at least 30 percent based on actual connected loads. The System Supplier shall advise the Engineer if the UPS capacity needs to be higher than specified above to meet this requirement.

The UPS shall have a visual status indicator for low (or faulty) battery and incoming ac power failure. The UPS shall emit an audible signal when the UPS is operating on battery power. A relay shall be installed within the panel and its coil connected across the UPS input power as a means of providing a contact for remote indication of a power failure condition.

Batteries shall be sealed maintenance-free, gelled electrolyte lead-acid, or valve-regulated, maintenance-free, lead-acid. Flooded-electrolyte type batteries will not be acceptable.

The UPS shall be APC “Smart-UPS”, Emerson/Liebert “GXT1000MT”, “Eaton Powerware” or equal.

Provide a UPS maintenance bypass switch to allow UPS replacement without interruption of power. Switch shall have a selector switch and be Liebert Micropod MP2 or approved equal.

G. Device Tag Numbering System

1. All devices shall be provided with permanent identification tags. The tag numbers shall agree with the Contract Drawings and with the supplier's equipment drawings. All field-mounted transmitters and devices shall have stamped stainless steel identification tags. Panel, subpanel, and rack-mounted devices shall have laminated phenolic identification tags securely fastened to the device. Hand-lettered labels or tape labels will not be permitted.

H. Nameplates

1. Nameplates shall be provided on the face of the panel or on the individual device. Panel nameplates shall have legends and approximate dimensions as indicated on the Drawings and shall be made of laminated phenolic material having engraved letters approximately 3/16 inch [5 mm] high extending through the black face into the white layer. Nameplates shall be secured firmly to the panel. Panel face nameplates do not replace the requirement for device identification tags as specified under the Device Tag Numbering System paragraph.

I. Indicating Light Color Designations

1. Indicating lights shall be colored as shown in the following table unless indicated otherwise on the Drawings, in other specification sections, or in the instrument device schedule.

Color	Meaning
Red	Associated equipment or device is “running, “ “open,” or is in an “unsafe” state or position
Green	Associated equipment or device is “stopped,” “closed,” or is in a “safe” state or position

Yellow or Amber	Associated equipment or device has “failed” or a process alarm condition is present or imminent.
White	All other conditions not defined above.

J. Painting

Not used.

K. Panel-Mounted Instruments

1. Instruments, power supplies, pilot devices, and appurtenances shall be provided as required for proper, efficient use of the control panel.

L. Factory Test

1. Panels shall be factory tested electrically and pneumatically by the panel fabricator before shipment.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Installation requirements are specified in the Instrumentation and Control System section. In addition, equipment furnished under this section shall conform to the following manufacturing stipulations.

1. Piping

a. All tubing shall be run in horizontal and vertical planes and shall be rigidly supported to withstand handling and shipment. Flexible polyethylene tubing shall be used to connect devices mounted on hinged doors.

2. Wiring

a. All wiring shall be grouped or cabled and firmly supported inside the panel. Wiring shall be bundled in groups and routed in Panduit or similar nonmetallic slotted ducts. Ducts shall be readily accessible within the panel with removable covers and shall have a space of at least 40 percent of the depth of the duct available for future use after installation is complete and all field wiring installed. Sufficient space shall be provided between cable groups or ducts and terminal blocks for easy installation or removal of cables.

-END OF SECTION-

Section 17150

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 – GENERAL

1.1 SCOPE

A. This section covers Programmable Logic Controllers (PLCs), and Operator Interface Terminals (OIT), including associated input/output hardware to control process equipment and serve as the interface to field devices.

02 GENERAL

A. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

B. General Equipment Stipulations.

1. The General Equipment Stipulations shall apply to all equipment and materials furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

PART 2 - PRODUCTS

2.1 GENERAL

A. Equipment: As shown in the drawings.

B. General: Each PLC shall be of solid-state design. All central processor (CPU) operating logic shall be contained on plug-in modules for quick replacement. Chassis-wired logic is not acceptable. The controller shall be capable of operating in a hostile industrial environment and designed to provide high reliability specifically in this process application. The internal wiring of the controller is to be fixed; with the logic functions it must perform in a given application to be programmed into its memory. The controller shall be supplied with the CPU, input/output scanner, inputs, outputs, memory, power supply, and all power and interface cables necessary to function as a complete and operable PLC system.

C. Design: Each PLC shall have all of the facilities required to implement the control schemes and database indicated. Instrumentation and control system shall have the following functions and features:

1. Modular, field-expandable design allowing the system to be tailored to this process control application. The capability shall exist to allow for expansion of the system by the addition of hardware and/or user

software.

2. The processor plus input and output circuitry shall be of a modular design with interchangeability provided for all similar modules. Modules are defined herein as devices that plug together to form an interlocking modular chassis. The design must prohibit upside-down insertion of the modules.

3. The PLC shall have downward compatibility whereby all new module designs can be interchanged with all similar modules in an effort to reduce obsolescence.

4. All hardware shall operate at an ambient temperature of 0 to 60 degrees C (32 to 140 degrees F), with an ambient temperature rating for storage of - 40 to + 85 degrees C (- 40 to + 185 degrees F), and shall function continuously in the relative humidity range of 5 percent to 95 percent with no condensation. The PLC system shall be designed and tested to operate in the high electrical noise environment of an industrial plant.

5. The PLC shall provide a means for mounting the chassis in a standard cabinet.

D. Central Processors: The CPU shall contain all the relays, timers, counters, number storage registers, shift registers, sequencer, arithmetic capability, and comparators necessary to perform the indicated control functions. It shall be capable of interfacing sufficient discrete inputs, analog inputs, discrete outputs, and analog outputs as shown on the drawings. The Processor shall be an Allen Bradley CompactLogix 5370 Controller, as shown on the Drawing, no exceptions. The CPU shall be supplied with a 64 MB CompactFlash card Allen-Bradley 1784-CF- 64, or equal. The instrumentation and control system shall have the following features and capabilities:

1. Modular, field-expandable design allowing the system to be tailored to this process control application. The capability shall exist to allow for expansion of the system by the addition of hardware and/or user software.

2. The CPU shall be a self-contained unit and shall provide control program execution and support remote or local programming. This device shall also supply I/O scanning and inter-processor and peripheral communication functions.

3. The operating system shall be contained in removable programmable devices which allow for easy field replacement.

4. The CPU within the system shall perform internal diagnostic checking and give visual indication to the user by illuminating a "green" indicator when no fault is detected and a "red" indicator when a fault is detected.

5. Non-volatile memory shall store the operating system information to protect against loss in the case of power loss or system shut-down. Only

at the time of a hardware change shall this configuration status be altered or re-entered.

6. Storage (Memory).

   a. The program storage medium shall be of a static RAM type.

   b. The PLC system shall be capable of addressing up to 768 kilobytes, where each word is comprised of 8 data bits.

   c. Memory capacity shall be configurable to allow for the most economical match to the intended application. It shall be possible to upgrade to a processor with a larger memory size simply by saving a program, replacing the processor, and downloading the program to the new system without having to make any program changes.

   d. Memory shall contain battery back-up capable of retaining all stored program data through a continuous power outage for 4 months under worst case conditions. The capability shall exist to remove all batteries from the system without removing system power. A low battery condition must be detectable in ladder logic but shall not automatically generate a major fault.

   e. The operator shall be able to backup volatile memory, including data and program logic, onto external hard disk, at their option.

   f. All user memory in the processor not used for program storage shall be allocatable from main memory for the purpose of data storage. The PLC system shall be capable of storing the following data types:

      i. External Output Status

      ii. External Input Status

      iii. Timer Values

      iv. Counter Values

      v. Signed Integer Numbers (16-bit)

      vi. Floating Point Numbers

      vii. Decimal Numbers

      viii. Binary Numbers

      ix. BCD Numbers

      x. Direct and Indexed Addressing

xi. Internal Processor Status Information

xii. ASCII Character Data

xiii. ASCII String Data

xiv. Block Transfer Control Structures

xv. Floating Point PID Control Structures

xvi. File Instruction Control Structures

xvii. Message Control Structures

7. Control logic programs shall have immediate access to the sub-elements of control structures by address and sub-element mnemonic, such as timer accumulator value, timer done bit, or PID Process Variable value.

8. Each unit shall be supplied with memory to implement the indicated control functions. The memory shall be programmed in a multi-mode configuration with multiple series or parallel contacts, counters, timers, and arithmetic functions.

E. Ethernet Interface and Network.

1. The PLC system shall offer industry standard Ethernet TCP/IP communication capabilities. The controller shall be able to connect to industry standard 10baseT media types by implementing a standard RJ-45 transceiver port that can connect to different transceivers. The PLC shall have a selectable option of using 802.32 as the interface to the network as well as DIX Ethernet II. There shall be a software protocol layer that uses TCP/IP as the transport mechanism to deliver packets of data to other instrumentation and control system devices that use the same protocol. This protocol handles the addressing and transfer of all the specific data file types in the PLC to allow for peer-to-peer messaging.

a. Token passing system

b. Peer-to-peer communication

c. Message error checking

d. Retries of unacknowledged messages

e. Diagnostic checks on other stations

f. Interface to more than one network

g. A user-oriented command language for manipulation of data

structures of variable size and organization, such as setting or resetting bits, word and file transfers in a peer processor

h. The ability to perform PLC memory uploads and downloads

i. The ability to communicate with all other models of PLC manufactured by said manufacturer

j. The ability to monitor the status of any processor remotely via the network

k. The ability to automatically broadcast data to (and receive data from) all compatible stations on the link. Once configured, this operation shall be continuous without operator intervention

l. A gateway interface to the Ethernet TCP/IP network for connectivity to host computers as well as other instrumentation and control system devices that have direct Ethernet connectivity

2. The PLC system shall allow industry standard repeaters, bridges, routers, and gateways on the network in order to access other instrumentation and control system devices and host computers. The controller shall be able to name a specific gateway/router IP address in order to direct data to other networks.

3. On-line programming and upload/downloads of control programs shall be able to occur over the Ethernet network.

F. PLC Power Supply

1. The PLC shall operate in compliance with an electrical service of 120 VAC. The power supply shall be mounted in the PLC housing and be sized to power all modules mounted in that housing and an "average module load" for any empty housing slots plus 25 percent above that total. Power supply shall be by the same manufacturer as the PLC and shall be of the same product line. A single main power supply shall have the capability of supplying power to the CPU and local input/output modules. Auxiliary power supplies shall provide power to remotely located racks.

2. The power supply shall be Allen-Bradley 1769-PA2.

G. PLC Input/Output (I/O) Modules

1. I/O Modules General: All I/O housings and modules shall be suitable for hostile industrial environments. The I/O’s shall be 4-20 mA DC for all analog inputs and outputs and shall be 24VDC for discrete inputs and dry relay contacts for safe discrete outputs. Each PLC I/O location shall contain the I/O module quantity and type as shown on the Drawings.

2. Discrete Input Modules: Defined as contact closure inputs from devices

external to the programmable controller module. Input modules shall be Allen-Bradley 1769-IA16.

3. Discrete Output Modules: Defined as contact closure outputs for ON/OFF operation of devices external to the programmable controller module. Discrete output contacts shall be provided with interposing relays in the control panel. Output modules shall be Allen-Bradley 1769-OW16.

4. Analog Input Modules: Defined as 4 to 20 mA DC signals, where an analog to digital conversion is performed with 14-bit precision and the digital result is entered into the processor. The analog to digital conversion shall be updated with each scan of the processor. Input modules shall be source or sink to handle 2-wire or 4-wire transmitters, respectively. Input modules shall be Allen-Bradley 1769-IF8.

5. Analog Output Module: Defined as 4 to 20 mA DC signals, where an analog to digital conversion is performed with 14-bit precision and the digital result is entered into the processor. Output modules shall be Allen-Bradley 1769-OF8.

2.4 RADIO TOWER

A. The radio tower shall be free standing aluminum, height as specified on the drawings. Provide Universal Towers model 9-30. Install per manufacturer's recommendation. Bond tower to ground grid.

2.5 PROGRAMMING SOFTWARE

A. System Supplier shall furnish one licensed copy of PLC programming software for the District.

B. The software shall be suitable for running on a laptop computer running Windows XP operating system software. A full legal set of programming software documentation shall accompany each copy of the software. Each copy of the programming software shall include all necessary device drivers and add-on software packages.

C. The PLC programming software shall be RSLogix 5000 Professional by Rockwell Automation.

2.6 SYSTEM ENCLOSURES

A. Programmable logic controllers and input/output hardware shall be housed in shop-assembled panels as described in the Panels section.

2.7 OPERATOR INTERFACE TERMINALS

A. Operator interface terminals (OIT) shall be microprocessor-based flat panel type. The unit shall have data entry capabilities and shall include a password security function. The unit shall be connected to the PLC and shall display status, alarm, and diagnostic information. The unit shall provide a nominal diagonal display

area dimension of 5. The operator interface unit shall be provided with an Ethernet port for communications, and one serial RS-232 or RS-485 port for programming. The OIT shall be rated NEMA 4X, suitable for panel face.

B. Terminals shall be powered from 120 Vac, 60 Hz, single phase. Terminals shall be suitable for ambient temperatures of +32 to +130°F and a relative humidity of 5 to 95 percent.

C. One licensed copy of the OIT software used to create the screens shall be turned over to the District upon successful startup and commissioning of the system.

D. The operator interface unit shall be a Direct Automation EA9-T15CL-R-15", with touch screen capability. Provide power supplies, protective overlay cover, USB flash pen drive, and SD card.

E. The OIT shall provide graphic screens that shall be used by the operators to access all functions and set points necessary for comprehensive control. The supplier shall be responsible for developing and configuring the custom graphic displays. Each piece of major process equipment that is monitored and controlled by the control system shall be displayed on the graphic screens. Graphic screens shall be representations of the equipment and piping. The screens must accurately show all devices and equipment that is part of the control loops. The supplier shall use the software configuration standards and conventions to be established by direct coordination with the District that shall describe and define such items as proposed graphic display process line colors/representations; color standards for "on", "off", "opened", "closed", and "alarm" conditions; alarm handling conventions; how items will be selected for control; methods for navigation between displays; address usage/naming conventions; and security setup. Displays will be designed and programmed by the District's System Integrator. The System Integrator will load the displays into the OIT and test them at Factory Test and during startup with Contractor's support.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. The PLC and OIT shall be installed in the SCCADA TELEMETRY PANEL (RTU) as shown on drawings.

B. Field check, testing, and training shall be as specified in the Instrumentation and Control System section.

3.2 SOFTWARE CONFIGURATION

A. PLC Programming and Configuration (by District)

1. The PLC software program will be fully configured and tested by the District's Programmer with full support of the Contractor. This work by Programmer shall be performed under a separate contract with Developer.

B. Communications Configuration

1. The communications shall be fully configured and installed by District Programmer. Communication requirements, such as IP addressing shall be coordinated with the District. This work by Programmer shall be performed under a separate contract with Developer.

C. District SCADA HMI

1. The District's Programmer will modify the District's SCADA software at Central to add the new pump station PLC and will test the changes with Contractor's support. This work by Programmer shall be performed under a separate contract with Developer.

-END OF SECTION-