Dublin San Ramon Services District
Water, wastewater, recycled water

Reservoir 20B

(CIP 14-W008)

Volume 2 of 5

Technical Specifications

CONTRACT DOCUMENTS

May 2026

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WOOD RODGERS

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Dublin San Ramon Services District

RESERVOIR 20B (CIP 14-W008)

VOLUME 1 OF 5

TABLE OF CONTENTS

DIVISION 0	BIDDING AND CONTRACT REQUIREMENTS	PAGE NUMBER
00010	Notice Inviting Bids	00010-1
00100	Instructions to Bidders	00100-1
00200	Information Available to Bidders	00200-1
00300	Bid Form	00300-1
00310	Bid Schedule	00310-1
00410	Bidder's Bond	00410-1
00412	Iran Contracting Act Certification	00412-1
00430	Designation of Subcontractors	00430-1
00440	Site Visit Affidavit	00440-1
00450	Schedule of Major Equipment and Material Suppliers	00450-1
00458	Certification of Drug-Free Workplace Requirements	00458-1
00460	Certification of Bidder's Experience and Qualifications	00460-1
00461	Certification of Electrical Subcontractor's Experience and Qualifications	00461-1
00462	Certification of Reservoir Subcontractor's Experience and Qualifications	00462-1
00470	Acknowledgement of Insurance Requirements	00470-1
00471	Acknowledgement of Insurance Requirements for Designated Subcontractors	00471-1
00480	Non-collusion Affidavit	00480-1
00490	Affidavit of Safety Compliance	00490-1
00500	Agreement	00500-1
00610	Bond of Faithful Performance	00610-1
00620	Payment Bond	00620-1
00630	Escrow Agreement for Security Deposits in Lieu of Retention	00630-1
00650	General Liability Endorsement	00650-1

00651	**Auto Liability Endorsement**	**00651-1**
00700	**General Conditions**	**00700-1**
1.0	**General**	**00700-1**
1.1	Contract Agreement	00700-1
1.2	Written Notice and Service Thereof	00700-2
1.3	Rights of Action	00700-2
1.4	Plans and Specifications	00700-2
1.5	Applicability of all Paragraphs of Specifications	00700-3
1.6	Contract Interpretation by the Construction Manager	00700-3
1.7	Order of Precedence	00700-4
1.8	Bonds	00700-4
1.9	Penalty for Collusion	00700-5
1.10	Rights and Remedies	00700-5
2.0	**Contract Administration**	**00700-5**
2.1	Administration of the Contract	00700-5
2.2	Owner's Representative	00700-6
2.3	Construction Manager	00700-6
2.4	Design Consultant	00700-8
3.0	**Owner**	**00700-8**
3.1	General	00700-8
3.2	Attention to Work	00700-8
3.3	Observation and Inspection	00700-9
3.4	Owner's Right to Use or Occupy	00700-9
3.5	Owner's Right to Carry out the Work	00700-9
3.6	Owner's Right to Perform Work and to Award Separate Contacts	00700-10
3.7	Responsibility of the Owner	00700-10
4.0	**Contractor**	**00700-10**
4.1	Status of Contractor and Subcontractors	00700-10
4.2	Contractor's Representative	00700-11
4.3	Use and Protection of Owner's Site and Adjacent Property	00700-12
4.4	Fees and Permits	00700-13
4.5	Compliance with Laws	00700-13
4.6	Compliance with Environmental Laws	00700-17
4.7	Safety	00700-17
4.8	Provisions for Handling Emergencies	00700-22
4.9	Nonstandard Working Hours	00700-23
4.10	Cooperation with Other Contractors	00700-23
5.0	**Control of Work and Material**	**00700-23**
5.1	Means, Methods and Appliances	00700-23
5.2	Character of Workers	00700-24
5.3	Supply of Sufficient Workers	00700-24
5.4	Materials and Workmanship	00700-24
5.5	Existing Utilities	00700-25
6.0	**Progress of the Work**	**00700-27**
6.1	Commencement of Work	00700-27

6.2	Contract Time	00700-27
6.3	Delays	00700-27
6.4	Time Extensions	00700-29
6.5	Liquidated Damages	00700-31
6.6	Suspension of Work	00700-31
6.7	Right to Terminate Contract	00700-32
7.0	**Changes in the Work**	**00700-33**
7.1	Change Orders	00700-33
7.2	Differing Site Conditions	00700-34
7.3	Resolution of Disputes	00700-35
8.0	**Payment**	**00700-38**
8.1	Basis of Payment	00700-38
8.2	Partial Payments	00700-39
8.3	Right to Withhold Amounts	00700-42
8.4	Security Substitution for Withholds	00700-43
8.5	Warranty of Title	00700-44
8.6	Substantial Completion	00700-44
8.7	Final Inspection and Payment	00700-45
00800	**Supplementary General Conditions**	**00800-1**
1.0	**Modifications to the General Conditions**	**00800-1**
1.1	Time Allowed for Completion	00800-1
1.2	Damages for Delays	00800-2
1.3	Weather Days	00800-2
1.4	Contract Administration	00800-2
1.5	Alternative Dispute Resolution of Claims	00800-3
2.0	**Liability and Insurance**	**00800-5**
2.1	General Requirements	00800-5
2.2	Subcontractors	00800-6
2.3	Coverage Requirements	00800-6
2.4	Deductibles and Self-Insured Retentions	00800-8
2.5	Additional Insureds	00800-8
2.6	Primary Coverage	00800-8
2.7	Claims Made Policies	00800-8
2.8	Waiver of Subrogation	00800-9
2.9	Verification of Coverage	00800-9
2.10	Insurance During Guarantee Period	00800-9
3.0	**Indemnification**	**00800-9**
4.0	**Injury or Illness Reports**	**00800-10**
5.0	**State Revolving Fund Loan Program – Not Used**	
6.0	**Wage Rate Requirements**	**00800-11**
6.1	Prevailing Wages	00800-11
6.2	Traveling Subsistence	00800-11
6.3	Penalty	00800-11

7.0	**Partnering – Not Used**	
8.0	**Record Drawings and Additional Information**	**00800-11**
9.0	**Substantial Completion**	**00800-12**
9.1	Retention Release – Not Used	
10.0	**Project Liaison – Not Used**	
00823	**Escrow Bid Documents**	**00823-1**
1.0	**Scope**	**00823-1**
2.0	**Ownership**	**00823-1**
3.0	**Program**	**00823-1**
4.0	**Format and Contents**	**00823-2**
5.0	**Submittal**	**00823-2**
6.0	**Storage**	**00823-3**
7.0	**Examination after Award of Contract**	**00823-3**
8.0	**Final Disposition**	**00823-4**

DIVISION 1 – GENERAL REQUIREMENTS

01010	**Summary of Work**	**01010-1**
1.0	**Work Covered by Contract Documents**	**01010-1**
2.0	**Work Sequence and Constraints**	**01010-1**
3.0	**Early Occupancy of Portions of Work – Not Used**	
4.0	**Owner Furnished Materials – Not Used**	
5.0	**Trench Excavation – Not Used**	
6.0	**Work Under Other Contracts**	**01010-4**
7.0	**Work Percentages**	**01010-5**
8.0	**Underground Facilities**	**01010-5**
9.0	**Project Sign – Not Used**	
10.0	**Access for Operational Personnel**	**01010-6**
01025	**Measurement and Payment**	**01025-1**
1.0	**Measurement and Payment**	**01025-1**
2.0	**Bid Items**	**01025-2**
3.0	**Contractor's Cost Breakdown**	**01025-3**
4.0	**Payment Schedule for Pipeline Projects – Not Used**	
01026	**Allowances – Not Used**	
01035	**Modification Procedures**	**01035-1**
1.0	**Changes in Contract Price**	**01035-1**
2.0	**Negotiated Change Orders**	**01035-1**
3.0	**Force Account Payment**	**01035-2**
4.0	**Direct Cost Categories**	**01035-2**
5.0	**Markup Allowances**	**01035-4**
6.0	**Increased or Decreased Quantities**	**01035-5**
7.0	**Cost Pricing Data and Access to Records**	**01035-7**
8.0	**Time Extensions for Change Orders**	**01035-7**
9.0	**Cost-Reduction Incentive**	**01035-7**

01050	**Field Engineering**	**01050-1**
1.0	**Datum**	**01050-1**
2.0	**Quality Assurance**	**01050-1**
3.0	**Project Survey Requirements**	**01050-2**
4.0	**Record Documents**	**01050-2**
01060	**Regulatory Requirements and Permits**	**01060-1**
1.0	**Applicable Codes**	**01060-1**
2.0	**Fees and Permits**	**01060-1**
3.0	**Storm Water and Non-Storm Water Quality Controls Within Treatment Plant Drainage Boundaries – Not Used**	
4.0	**Storm Water and Non-Storm Water Quality Controls Outside Treatment Plant Drainage Boundaries**	**01060-2**
01090	**References**	**01090-1**
1.0	**Codes and Standards**	**01090-1**
2.0	**Definitions of Words and Terms**	**01090-1**
3.0	**Abbreviations**	**01090-6**
01200	**Project Meetings**	**01200-1**
1.0	**Pre-Construction Conference**	**01200-1**
2.0	**Progress Meetings**	**01200-1**
3.0	**Partnering Meetings – Not Used**	
4.0	**Submittal Meetings**	**01200-1**
5.0	**Quality Assurance Meetings**	**01200-1**
6.0	**Pre-Installation Meetings**	**01200-2**
7.0	**Special Meetings**	**01200-2**
8.0	**Post Construction Guaranty Period Meeting**	**01200-2**
01308	**Project Plan**	**01308-1**
1.0	**General**	**01308-1**
2.0	**Project Plan Requirements**	**01308-1**
3.0	**Submittals**	**01308-1**
01310	**Progress Schedules and Reports**	**01310-1**
1.0	**General**	**01310-1**
2.0	**Responsible Scheduling Person**	**01310-1**
3.0	**Construction Schedule**	**01310-2**
4.0	**Weather Conditions and Weather Day Allowance**	**01310-8**
5.0	**Schedule Updates**	**01310-8**
6.0	**Time Impact Analysis**	**01310-10**
7.0	**Weekly Schedule**	**01310-12**
8.0	**Final Schedule Submittal**	**01310-12**
01322	**Web Based Document Control**	**01322-1**
1.0	**Web Database**	**01322-1**
2.0	**Equipment**	**01322-2**
3.0	**Execution**	**01322-3**
01340	**Shop Drawings, Product Data and Samples**	**01340-1**
1.0	**Submittals**	**01340-1**

2.0	Material and Equipment Substitutions	01340-3
3.0	Submittal and Material List	01340-6
4.0	Transmittal Procedures	01340-6
5.0	Review Procedure	01340-8
6.0	Effect of Review of Contractor's Submittals	01340-8
7.0	Seismic Design and Anchorage of Equipment and Other Appurtenant Facilities	01340-9
01345	Requests for Information and Clarifications	01345-1
1.0	General	01345-1
2.0	RFI Procedures	01345-1
01400	Quality Control	01400-1
1.0	Contractor's Quality Control	01400-1
2.0	Inspection and Testing	01400-2
3.0	Test Water	01400-6
01510	Temporary Utilities	01510-1
1.0	Electrical Services	01510-1
2.0	Water	01510-1
3.0	Temporary Lighting	01510-1
4.0	Heating and Ventilation	01510-1
5.0	Sanitary Conveniences	01510-1
01560	Temporary Controls	01560-1
1.0	Temporary Facilities	01560-1
2.0	Staging and Falsework	01560-1
3.0	Protection of Work, Property and Persons	01560-1
4.0	Fences	01560-2
5.0	Temporary Enclosures	01560-2
6.0	Above Grade Protection	01560-2
7.0	Working Hours	01560-2
8.0	Dust Control	01560-3
9.0	Fire Extinguisher	01560-4
10.0	Use of Explosives	01560-4
11.0	Removed Materials	01560-4
12.0	Construction Cleaning	01560-4
13.0	Noise Abatement	01560-4
14.0	Drainage Control	01560-4
15.0	Erosion Control	01560-5
16.0	Warning Devices and Barricades	01560-5
17.0	Traffic Regulations	01560-5
18.0	Roads and Fences	01560-7
19.0	Parking and Staging Areas	01560-7
20.0	Trees and Shrubs	01560-7
21.0	Office of Contractor at Site	01560-7
22.0	Contractor's Work and Storage Area	01560-7
23.0	Construction Manager's Field Office	01560-8
24.0	Public Access at Treatment Plant – Not Used	

25.0	**Firearms and Dogs**	**01560-10**
26.0	**Wildfire Prevention**	**01560-11**
27.0	**Biological Controls**	
01600	**Material and Equipment**	**01600-1**
1.0	**Salvaging and Storage of Equipment and Materials**	**01600-1**
2.0	**Hazardous Materials**	**01600-1**
3.0	**Disposal of Excavated Material**	**01600-1**
01612	**Seismic Design Criteria**	**01612-1**
1.0	**Summary**	**01612-1**
2.0	**References**	**01612-1**
3.0	**System Description**	**01612-1**
4.0	**Submittals**	**01612-2**
01614	**Wind Design Criteria**	**01614-1**
1.0	**Summary**	**01614-1**
2.0	**References**	**01614-1**
3.0	**System Description**	**01614-1**
4.0	**Submittals**	**01614-1**
01660	**Testing and Training**	**01660-1**
1.0	**Testing**	**01660-1**
2.0	**Training of Equipment**	**01660-7**
3.0	**Training of Owner Personnel**	**01660-12**
01710	**Final Clean-Up**	**01710-1**
1.0	**Final Site Clean-Up**	**01710-1**
2.0	**Final Building Clean-Up**	**01710-1**
01720	**Project Record Documents**	**01720-1**
1.0	**Record Documents**	**01720-1**
01730	**Operation and Maintenance Data**	**01730-1**
1.0	**Operation and Maintenance Manuals**	**01730-1**
01740	**Warranties and Bonds**	**01740-1**
1.0	**Guarantee of Work**	**01740-1**
01750	**Spare Parts and Maintenance Materials**	**01750-1**
1.0	**Responsibility for Spare Parts and Tools**	**01750-1**

VOLUME 2 OF 5

TECHNICAL SPECIFICATIONS

Division 2 - Site Work

02050	Demolition and Removal	1 – 2
02100	Clearing, Grubbing, and Site Preparation	1 – 4
02202	Slope Protection and Erosion Control	1 – 4
02223	Trenching, Excavation, Backfill and Compaction	1 – 10

02225 Utility Crossings ..... 1 – 2
02444 Chain Link Fencing and Gates ..... 1 – 7

Division 3 - Concrete
03000 Cast-in-Place Concrete ..... 1 – 8
03100 Concrete Formwork ..... 1 – 7
03251 Expansion and Construction Joints ..... 1 – 2
03255 Tank Wall Base Joint ..... 1 – 2
03314 Strand-Wound, Prestressed Concrete Tank ..... 1 – 15
03350 Concrete Finishes ..... 1 – 2
03462 Precast Concrete Vaults ..... 1 – 2

Division 4 – Masonry (Not Used)

Division 5 – Metals
05220 Concrete Bolts ..... 1 – 3
05500 Miscellaneous Metals ..... 1 – 8

Division 6 – Wood and Plastic (Not Used)

Division 7 – Thermal & Moisture Protection
07100 Waterproofing ..... 1 – 4
07900 Caulking and Sealants ..... 1 – 3
07920 Joint Sealants ..... 1 – 6

Division 8 – Doors and Windows (Not Used)

Division 9 – Finishes
09810 Polyethylene Tape Pipe Coating (Tape Wrapped) ..... 1 – 13
09910 Field Painting and Coating ..... 1 – 7

Division 10 – Specialties (Not Used)

Division 11 – Equipment
11268 Hydrodynamic Mixing System ..... 1 – 5

Division 12 – Furnishings (Not Used)

Division 13 - Special Construction
13000 Instrument and Control System ..... 1 – 16
13110 Cathodic Protection and Joint Bonding ..... 1 – 6
13470 SCADA PLC System ..... 1 – 4
13490 Fiber Optic System ..... 1 – 8

Division 14 – Conveying Systems (Not Used)

Division 15 – Mechanical
15000 General Piping Systems and Appurtenances ..... 1 – 8

15035 PVC Gravity Pipe ..... 1 – 3
15045 PVC Schedule 80 Plastic Pipe ..... 1 – 5
15056 Ductile Iron Pipe ..... 1 – 4
15061 Cement-Mortar Lined and Tape Coated Steel Pipe and Specials ..... 1 – 16
15100 Valves, Gauges, and Appurtenances ..... 1 – 4
15120 Altitude Control Valve ..... 1 – 6

Division 16 – Electrical
16000 Requirements for Electrical Work ..... 1 – 16
16075 Electrical Identification ..... 1 – 5
16159 Panelboards ..... 1 – 3
16859 600V Switchboard ..... 1 – 9

VOLUME 3 OF 5

APPENDICES

Appendix A – Geotechnical Report
Geotechnical Evaluation Reservoir 20B ..... 1 – 83
Geotechnical Memorandum: Stairway Plan - Geotechnical Corrective Grading ..... 1 – 4

Appendix B – Initial Study / Mitigated Negative Declaration
Final Initial Study – Mitigated Negative Declaration, SCH No. 2024080496 ..... 1 – 289

VOLUME 4 OF 5

Appendix C – Dublin San Ramon Services District Standards
DSRSD – Standard Procedures, Specifications, and Drawings ..... 1 – 270

Appendix D – Dublin San Ramon Services District Approved Materials List
DSRSD – Approved Materials List (Water) ..... 1 – 15

Appendix E – Greenbook Standard Plans ..... 1 – 10

Appendix F – PG&E Permit 1

Appendix G – Incidental Take Permit Application ..... 1 – 31

Appendix H – Access Procedures ..... 1 – 4

Appendix I – DSRSD Forms ..... 1 – 3

VOLUME 5 OF 5

DRAWINGS

DIVISION 2 – SITE WORK

SECTION 02050
DEMOLITION AND REMOVAL

PART 1 - GENERAL

1.1 REQUIREMENT

The work of this section consists of the demolition, removal, disposal, abandonment, or salvage of items or facilities as necessary for the performance of this contract, as required by the drawings, or as specified herein. Depth of existing pavement shall be derived from the project Geotechnical Report.

1.2 RELATED SECTIONS

A. Section 01560 - Temporary Environmental Controls

1.3 SUBMITTALS

A. Affidavit of Compliance - Prior to commencing with demolition work, the Contractor shall submit to District an affidavit of compliance detailing the final disposition for items and materials to be removed from the site. Said affidavit shall list the locations of all disposal sites utilized, and shall include the Contractor's certification that those sites are legal for the disposal of the subject items or materials. The affidavit shall include a similar list of recyclers and Contractor's certification, if utilized.

B. Receipts - Contractor shall submit receipts from all disposal sites and recyclers utilized for the disposal of items and materials removed from the site. Said receipts shall account for the entire quantities of all items and materials removed from the site.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRE-BID SITE VISIT

All costs for the demolition, removal, disposal, abandonment, and the salvage of existing facilities shall be included in the Contractor's unit price or lump sum bid price for said Work, unless otherwise shown or listed.

3.2 SALVAGE BY CONTRACTOR FOR THE DISTRICT

Contractor shall remove, salvage and return items as indicated on the Contract Drawings to the District.

3.3 DEMOLITION AND REMOVAL

Contractor shall demolish or dismantle and remove all items scheduled for demolition and removal as shown on the drawings and as specified herein that will interfere with the planned construction, or as otherwise directed by Engineer. Contractor shall comply with all pertinent regulations of OSHA and local codes and practices and practices (e.g. Bay Area Air Quality Management District). The site shall be kept neat and orderly during the demolition. Adjacent public right-of-way and private property shall be kept free of debris at all times. Stockpiles of items or materials to be removed shall be removed from the site on a daily basis, or stored in a dumpster or other portable trash receptacle, which shall be emptied on a weekly basis. Accumulations of flammable material shall not be permitted.

3.4 DISPOSAL AND RECYCLING

All items removed from the site shall be transported in a legal manner and disposed of at a legal disposal site. Concrete and asphalt pavement debris shall be transported to an appropriate recycler of such materials. All disposal sites and recycling facilities shall be approved by the District prior to initiation of the work. Contractor shall provide District with copies of all waste disposal manifests. Hazardous materials shall be handled and disposed of in accordance with all applicable laws, codes, and regulations.

3.5 ABANDONMENT

Abandonment shall be in accordance with the Contract Drawings and Specifications.

END OF SECTION

SECTION 02100
CLEARING, GRUBBING, AND SITE PREPARATION

PART 1 -- GENERAL

1.1 REQUIREMENT

A. Includes all labor, material, equipment and appliances required for the complete execution of any additions, modifications, or alterations to existing building(s) and new construction work as shown on the Drawings and specified herein.

B. Principal items of work include:

1. Notifying all authorities owning utility lines running to or on the property. Protecting and maintaining all utility lines to remain and capping those that are not required in accordance with the Contract Documents, the City of Dublin, and the District.

2. Clearing the site within the existing District easement or property, including removal of grass, brush, shrubs, trees, loose debris and other encumbrances except for trees marked to remain.

3. Boxing and protecting all trees, shrubs, lawns and the like within areas to be preserved.

4. Repairing all injury to trees, shrubs, and other plants caused by site preparation operations shall be repaired immediately. Work shall be done by qualified personnel in accordance with standard horticultural practice and as approved by the Engineer.

5. Removing topsoil to its full depth from designated areas and stockpiling for future use.

6. Disposing from the site all debris resulting from work under this Section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01560 – Temporary Environmental Controls

B. Section 02202 – Slope Protection and Erosion Control

C. Section 02223 – Trenching, Excavation, Backfilling and Compaction

1.3.1 PROTECTION OF PERSONS AND PROPERTY

A. All work shall be performed in such a manner to protect all personnel, workmen, pedestrians and adjacent property and structures from possible injury and damage and shall be in accordance with Section 01560 - Temporary Environmental Controls.

B. All conduits, wires, cables and appurtenances above or below ground shall be protected from damage.

C. Provide warning and barrier fence as specified herein.

D. Contractor shall locate, identify, and protect utilities that are intended to remain from damage.

E. Contractor shall protect any trees, plant growth, and features designated and intended to remain, as final landscaping.

F. Contractor shall protect benchmarks and any existing structures from damage or displacement. If damaged or removed, contractor shall replace and restore the item at the Contractor's expense.

PART 2 - PRODUCTS

2.1 WARNING AND BARRIER FENCE

A. The fence shall be made of a visible, UV-resistance, lightweight, flexible, high density polyethylene material, backed with wire fabric. The fence shall be Guardian Visual Barrier as manufactured by TENAX, or equal.

B. Physical Properties

Fence:

Color:	International Orange
Roll Size:	4' x 100'
Roll weight:	9 lbs.
Mesh opening:	1-3/4" x 1-3/4"

Posts:

ASTM Designation:	ASTM A702
Length:	6 feet long (T-Type)
Weight:	1.25 #/Foot (min)

PART 3 - EXECUTION

3.1 CLEARING OF SITE

A. Before removal of topsoil, and start of excavation and grading operations, the areas within the clearing limits shall be cleared and grubbed. Ensure work is completed within the timelines and conditions required in Section 01560 - Temporary Environmental Controls and appropriate District staff and representatives are coordinated and onsite as needed (e.g. biologist, cultural/archaeology, etc).

B. Clearing shall consist of cutting, removal, and satisfactory disposal of all trees, fallen timber, brush, bushes, rubbish, sanitary landfill material, fencing, and other perishable and objectionable material within the areas to be excavated or other designated areas. Prior to the start of construction, the Contractor shall survey the entire Contract site and shall prepare a plan which defines the areas to be cleared and grubbed, trees to be pruned, extent of tree pruning, and/or areas which are to be cleared but not grubbed. This plan shall be submitted to the Engineer for approval. Should it become necessary to remove a tree, bush, brush or other plants adjacent to the area to be excavated, the Contractor shall do so only after written permission has been granted by the Engineer.

C. Excavation resulting from the removal of trees, roots and the like shall be filled with suitable material, as approved by the Engineer, and thoroughly compacted per the requirements contained in Section 02223 – Trenching, Excavation, Backfilling and Compaction.

3.2 STRIPPING AND STOCKPILING EXISTING TOPSOIL

A. Existing topsoil and sod on the site within areas designated on the Drawings shall be stripped to whatever depth it may occur, and stockpiled for use in restoration.

B. The topsoil shall be free of stones, roots, brush, rubbish, or other unsuitable materials before stockpiling the topsoil.

C. Care shall be taken not to contaminate the stockpiled topsoil with any unsuitable materials.

3.3 GRUBBING

A. Grubbing shall consist of the removal and disposal of all stumps, roots, logs, sticks and other perishable materials to a depth of at least 6-inches below ground surfaces.

B. Large stumps located in areas to be excavated may be removed during grading operations, subject to the approval of the Engineer.

3.4 DISPOSAL OF MATERIAL

A. All debris resulting from the clearing and grubbing work shall be disposed of by the Contractor as part of the work of this Contract. Material designated by the Engineer to be salvaged shall be stored on the construction site as directed by the Engineer for reuse in this Project or removal by others.

B. Burning of any debris resulting from the clearing and grubbing work will not be permitted at the site.

3.5 WARNING AND BARRIER FENCE

A. Coordinate with the District to identity location for the barrier fence, prior to installation. Install barrier fence around the perimeter of the area cleared and grubbed.

B. Drive posts 18 inches into ground every 8'. Wrap wire fabric and fence material around first terminal post allowing overlap of one material opening. Use metal tie wire or plastic tie wrap to fasten material to itself at top, middle and bottom. At final post, cut with utility knife or scissors at a point halfway across an opening. Wrap around and tie at final post in the same way as the first post.

C. Use tie wire or tie wrap at intermediate posts and splices as well. Thread ties around a vertical member of the fence material and the post and bind tightly against the post. For the most secure fastening, tie at top, middle and bottom. Overlap splices a minimum of four fence openings, tie as above, fastening both edges of the fence material splice overlap.

END OF SECTION

SECTION 02202
SLOPE PROTECTION AND EROSION CONTROL

PART 1 - GENERAL

1.01 SCOPE

A. This section includes materials and installation for slope protection and erosion control.

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.

ACI 301 - Specifications for Structural Concrete for Buildings

ACI 318 - Building Code Requirements for Reinforced Concrete

ASTM A 185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete

ASTM C 90 - Standard Specification for Load-Bearing Concrete Masonry Units

ASTM C 150 - Standard Specification for Portland Cement

ASTM C 476 - Standard Specification for Grout for Masonry

ASTM C 615 - Standard Specification for Granite Dimension Stone

ASTM E 162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source

1.03 LOCAL AND STATE AGENCY REQUIREMENTS

Slope protection and erosion control shall be in accordance with the requirements of the Agency of Jurisdiction, the Regional Standards, and the Regional Water Quality Control Board.

PART 2 - MATERIALS

2.01 PERFORMANCE

Trench dams shall be installed as shown on Plans and per District Standard Details and Specifications. Reinforcing Steel and Welded Wire Reinforcement: Bars shall be per ASTM A 615, Grade 60. Welded wire reinforcement shall be per ASTM A 185. Reinforcing steel and welded wire reinforcement shall be installed in accordance with the Standards Drawings.

2.02 HYDRO SEED MIX

A. Seed shall be applied in the early fall, between October 15 and October 31. If feasible, seed shall be applied immediately prior to the first rain event.

B. Seed mixes shall include only locally native species at a ratio appropriate to the site, with an emphasis on native bunchgrasses and other grassland species. Local native wildflower seeds may also be included in the mix. Seed may be collected from within the project area. Additional seed

shall be sourced from within 50 miles of the project area (i.e., original genetic material shall have been collected within this radius); however, the seed may be purchased from a seed farm outside of this area if seed is not otherwise available. For seeding and mulching exposed slopes, the seed blend may include one or two sterile non-native perennial grass species.

C. The hydro seed mix shall be a bonded matrix consisting of wood fiber, fertilizer and high-quality live seed as follows:

D. Blended Mix:

Material	**Lbs/Ac**
Seed (See following paragraph)	75
Wood Fiber Mulch	2,000
R Binder	60
Fertilizer (20-20-10)	400
Water	As needed for application

E. The following seed mix may be used with the approval from the project's designated Biologist:

Seed Variety	**Lbs/Ac**
Regreen	36
Zorro	6
Blando	15
Rose Clover	8
Cal Poppy	4
Blue Lupine	6
Total	**75**

PART 3 - EXECUTION

3.01 SURFACE RESTORATION

A. Owner will provide a Vegetation Restoration Plan (Restoration Plan) to restore habitat that will be temporarily disturbed during construction to pre-project or better conditions. Owner will be responsible for submitting the Restoration Plan to California Department of Fish and Wildlife (CDFW) for approval within at least 15 days prior to the start of restoration activities. The Restoration Plan shall include results of soil analysis which will include ground-truthing soil conditions (e.g., type, texture, chemical composition and pH) by taking a soil sample and submitting the sample to an analytical lab. The Restoration Plan shall identify plant species damaged or removed during project activities. The Restoration Plan shall include the restoration standards and success criteria as described in the following sections.

B. Hand Seeding and Hydro Seeding

1. Unimproved areas disturbed during the course of construction shall be reseeded by one of the following methods. Hand seeding may be used when the area to be seeded is 0.4 Hectare (1.0 acre) or less. Hydro seeding shall be used in all areas in excess of 0.4 Hectare (1.0 acre). The landscape contractor shall provide all labor, materials, tools and equipment necessary to complete all work as required.
    a. Hand seeding shall be performed using the seed mixture outlined in this Specification. Seeding shall be performed on prepared and presoaked topsoil. Depending on the time of year, application of water may be required to speed germination.
    b. Hydro seeding shall be performed using the mixture outlined in this Specification. A landscape contractor licensed to perform this type of work shall install hydro seeding. Preparation of the topsoil and maintenance of the area after seeding shall be performed per the requirements and recommendations of the hydro-seeding contractor. Apply the hydro seed mixture in the form of slurry consisting of fiber mulch, seed, soil binder, fertilizer, and water. When hydraulically sprayed on the soil surface, the mix shall form a uniform blotter-like ground cover of seed, fertilizer, binder and fiber mulch.
2. Seeding shall be completed as soon as possible, but no later than October 31 of the year of the impact. At the discretion of the CDFW, all exposed areas where seeding is unsuccessful after 90 days shall receive appropriate soil preparation and a second application of seeding, straw, or mulch as soon as is practical on a date mutually agreed upon.
3. Maintenance Requirements
    a. The revegetated areas shall be monitored and maintained for a period of three years. All revegetated areas shall be maintained by the Contractor until final approval by the District. The maintenance period begins on the first day following project substantial completion.
    b. Prior to final approval at the end of the three year period, the District may require corrective action including but not limited to weed eradication and removal, replanting, the provision or modification of temporary irrigation systems (if needed), and the repair of any soil erosion or slope slippage, at no cost to the District.
    c. Weeding, herbicide, and/or pesticide application shall be done regularly by contractor. Weeding shall be done at a minimum of bi-weekly for the first two months and monthly throughout the first six months of maintenance, then every six months to the end of the maintenance period.
    d. Contractor shall obtain approval from the District prior to herbicide/pesticide application and shall apply herbicide/pesticide per manufacturer's recommendation and any State or California guidelines. Contractor must possess a valid State pesticide and/or herbicide license at all times.
    e. Reporting Requirements

        (a) At the conclusion of the first six months following completion of restoration activities, the District will submit a brief monitoring report (10 pages or less, not including figures) detailing vegetation establishment, percent invasive plant cover,

and other relevant observation regarding success of the restoration project to CDFW. If restoration has been successful, the District may submit the report at the end of Year 1 and annually thereafter.

(b) If the survival and/or cover requirements are not meeting the performance standards, Contractor is responsible for replacement planting, additional watering, weeding, invasive plant eradication, or any other practice, to achieve these requirements. The District shall continue to submit monthly restoration reports to CDFW until the standards have been met.

f. No more than 15 percent of the vegetation in each restoration site shall consist of species designated as high or moderate invasive plants in the California Invasive Plant Council's (Cal-IPC) California Invasive Plant Inventory Database (https://www.cal-ipc.org/plants/inventory/). If the presence of invasive species exceeds this threshold, Contractor is responsible for conducting appropriate control activities in coordination with the property owner.

g. Summary Table of Maintenance Requirements

Period Following Completion of Revegetation	**Contractor Activities**	**Reporting**
0 - 2 months	Bi weekly weeding	Picture documentation of initial planting
2 – 6 months	Monthly weeding Reseed areas as necessary. Repair of slope as necessary.	The District will submit a monitoring report to CDFW. Contractor shall take necessary measures to ensure establishment of plants (e.g. reapply seed, provide temporary irrigation, install straw wattles).
6 months – 3 years	Weeding and reseeding areas as necessary. Repair of slope as necessary.	District to submit an annual or monthly monitoring report to CDFW.

h. Success Criteria

(a) 70% plant coverage at the end of the three year maintenance period

C. Slope Protection:

1. Slopes from 0% to 20%:

Apply hand seeding or hydro seeding per directions described above.

2. Slopes from 20% and greater:

In addition to the seeding, at a minimum the following additional slope protection shall be employed as directed by the field Geotechnical Engineer:

a. Straw Wattles: Place along contours at 10 feet vertically
b. Trench Dam: Trench Dams shall be installed in accordance with the Standard Drawings and as shown on plans.
c. Geogrid: Tensar BX1200 biaxial geogrid shall be installed with 3-foot vertical spacing and extending 12 feet back from face of slope where shown on Plans.

END OF SECTION

SECTION 02223
TRENCHING, EXCAVATION, BACKFILL AND COMPACTION

PART 1 - GENERAL

1.01 SCOPE

A. This section includes materials, testing and installation for trench excavation, backfill, and compaction of piping, conduit, manholes and vaults.

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 C 131 -	Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 150 -	Portland Cement
ASTM D 75 -	Practice for Sampling Aggregates
ASTM D 1556 -	Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557 -	Test Method for Moisture-Density Relations of Soils Using a Modified Effort
ASTM D 2419 -	Test Method for Sand Equivalent Values of Soil and Fine Aggregate
ASTM D 2922 -	Test Method for Density of Soil in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017 -	Test Method for Water Content of Soil and Rock in Place by Nuclear Methods
ASTM D 3776 -	Test Method for Mass Per Unit Area (Weight) of Woven Fabric
ASTM D 4253 -	Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Plate
ASTM D 4254 -	Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D 4632 -	Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751 -	Test Method for Determining the Apparent Opening Size of a Geotextile
CAL-OSHA -	Title 8 General Industry Safety Orders

1.03 RELATED WORK SPECIFIFED ELSEWHERE

A. Dublin San Ramon Services District – Standard Procedures, Specifications, and Drawings

1.04 GEOTECHNICAL TESTING

The Developer or Contractor shall engage the services of a geotechnical engineering firm or individual licensed in the State of California to monitor soil conditions during earthwork, trenching, bedding, backfill and compaction operations. Sampling and testing procedures shall be performed in accordance with the Reference Standards and as follows:

A. The soils technician shall be present at the site during all backfill and compaction operations. Failure to have the soils technician present will subject such operations to rejection.

B. Density and optimum moisture content of soil shall be determined by the use of the sand cone method, ASTM D 1556, or nuclear density gauge method, ASTM D 6938. Since the composition of the pipe and the walls of the trench have an effect on the nuclear density gauge output, a minimum of 25% of the density and optimum moisture tests shall be made using the sand cone method.

C. Determine laboratory moisture-density relations of existing soil by ASTM D 1557, Method C and/or D (formerly ASTM D 4253 and ASTM D 4254).

D. Determine the relative density of cohesionless soils by ASTM D 1557, Method C and/or D (formerly ASTM D 4253 and ASTM D 4254).

E. Sample backfill material by ASTM D 75.

F. R-value and expansion testing.

G. Express "relative compaction" as a percentage of the ratio of the in-place dry density to the laboratory maximum dry density.

A report of all soils tests performed shall be stamped and signed by the soils firm or individual and shall be submitted by the Contractor prior to the filing of the Notice of Completion by the District. The report shall document the sampling and testing of materials, the location and results of all tests performed, and shall certify that materials and work are in compliance with this specification.

1.05 PROTECTION OF EXISTING UTILITIES AND FACILITIES

A. The Contractor shall be responsible for the care and protection of all existing utilities, facilities and structures that may be encountered in or near the area of the work in accordance with Division 1 – General Requirements.

1.06 PROTECTION OF EXISTING LANDSCAPING

A. The Contractor shall be responsible for the protection of all trees, shrubs, fences, and other landscape items adjacent to or within the work area in accordance with Division 1 – General Requirements .

1.07 ACCESS

A. The Contractor shall provide continuous, unobstructed access to all driveways, water valves, hydrants, or other property or facilities within or adjacent to the work areas.

1.08 SAFETY

A. Protection of workers within trenches shall be as required by the California Labor Code and in accordance with Division 1 – General Requirements .

B. All excavations shall be performed in a safe manner and shall be protected and supported in accordance with CAL-OSHA regulations.

C. Barriers and traffic delineators shall be placed in accordance with the requirements of the agency having jurisdiction.

1.09 BLASTING

A. Blasting for excavation shall not be performed without the written permission of the District. Procedures and methods of blasting shall conform to all Federal, State and local laws and ordinances.

1.10 EXCESS EXCAVATED MATERIAL

A. The Contractor shall remove and legally dispose of all excess excavated material and demolition debris.

B. It is the intent of these specifications that all surplus material shall be legally disposed of by the Contractor. Before acceptance of the work by District, the Contractor shall provide the District with written releases signed by all property owners with whom the Contractor has entered into agreements for disposing of excess excavated material, absolving the District from any liability connected therewith.

1.11 FILTER FABRIC

A. Filter fabric shall be used when excessively wet, soft, spongy, or similarly unstable material is encountered or in areas of suspected high groundwater in accordance with the soils technician's recommendation and the approval of the District Engineer.

1.12 HYDROSTATIC TESTING

A. Pre-testing of the piping system may be performed for the Contractor's convenience at any time. However, the final hydrostatic pressure test shall be as described in Section 15044.

PART 2 - MATERIALS

2.01 GENERAL

A. The Contractor shall furnish backfill material as specified below. All materials used within the trench shall be capable of attaining the required relative density.

B. Imported material should have an expansion index less than 50.

2.02 EMBEDMENT ZONE - CLASS 1 EMBEDMENT

A. Class 1 Embedment per District Standard Specifications I-D6-2 shall be used for pressure pipe and gravity pipe as shown on the Contract Documents.

B. Native materials may not be used in lieu of Class 1 Embedment within the Embedment Zone unless such native materials meet all of the requirements specified above and specific written permission has been obtained from the District Engineer.

2.03 BACKFILL ZONE

A. Reference District Standard Specifications I-D7 for trench backfill above the pipe embedment zone.

2.04 SAND-CEMENT SLURRY

A. Sand-cement slurry shall consist of two sacks, 85.3kg (188 pounds) of Portland cement per cubic yard of sand and sufficient moisture for workability. District approval is required for use of sand-cement slurry as a backfill material.

2.05 TRENCH PLUGS

A. Trench plugs consisting of sand-cement slurry shall be installed on piping systems that are backfilled with crushed rock.

2.06 FILTER FABRIC

A. Filter fabric shall be manufactured from polyester, nylon, or polypropylene. Material shall be of non-woven construction and shall meet the following requirements:

Grab tensile strength (ASTM D 4632):	45.4kg (100 lbs) minimum for a 25mm (1") raveled strip
Weight (ASTM D 3776):	152.6g/m^2 (4.5 oz./yd^2)
Apparent opening size (ASTM D 4751):	0.150mm (0.006")

PART 3 - EXECUTION

3.01 CLEARING AND GRUBBING

A. Areas where work is to be performed shall be cleared of all trees, shrubs, rubbish, and other objectionable material of any kind, which, if left in place, would interfere with the proper performance or completion of the contemplated work, would impair its subsequent use, or would form obstructions therein.

B. Organic material from clearing and grubbing operations shall not be incorporated in the trench backfill or other areas of structural backfill, however it can be retained and incorporated into the final topsoil.

C. At a minimum, the top three feet of existing grade that is to be removed for excavation shall be retained and stockpiled onsite. This same soil shall be incorporated into the topsoil of the finished grading.

3.02 PAVEMENT, CURB, AND SIDEWALK REMOVAL

A. Bituminous or concrete pavements, curbs, and sidewalks shall be removed and replaced in accordance with the requirements of the agency having jurisdiction.

3.03 DEWATERING

A. The Contractor shall provide and maintain at all times during construction ample means and devices to promptly remove and dispose of all water from any source entering excavations or other parts of the work.

B. Dewatering shall be performed by methods that will ensure a dry excavation and preservation of the final lines and grades of the bottoms of excavations. Dewatering methods may include well points, sump points, suitable rock or gravel placed as pipe bedding for drainage and

pumping, temporary pipelines, or other means, all subject to the approval of the District Engineer. The cost of all dewatering activities shall be borne by the Developer or Contractor.

C. Sewer systems shall not be used as drains for dewatering trenches or excavations, nor for disposal of collected or accumulated groundwater, without the approval of the agency of jurisdiction.

D. Concrete shall not be poured in water, nor shall water be allowed to rise around concrete or mortar until it has set at least four hours.

E. The Contractor is responsible for meeting all Federal, State, and local laws, rules and regulations regarding the treatment and disposal of water from dewatering operations at the construction site.

3.04 SHORING AND SHIELDING

A. The Contractor's design and installation of shoring shall be consistent with the rules, orders, and regulations of CAL-OSHA.

B. Excavations shall be shored, sheeted, and supported such that the walls of the excavation will not slide or settle and all existing improvements of any kind, either on public or private property, will be fully protected from damage.

C. The sheeting and shoring shall be arranged so as not to place any stress on portions of the completed work until the general construction has proceeded far enough to provide ample strength.

D. Care shall be exercised in the moving or removal of trench shields, sheeting, and shoring to prevent the caving or collapse of the excavation faces being supported.

3.05 CORRECTION OF OVEREXCAVATION

A. Overexcavations shall be corrected by backfilling with approved imported granular material or crushed rock, compacted to 90% relative compaction, as directed by the District Engineer.

3.06 FOUNDATION STABILIZATION

A. When unsuitable soil materials are encountered, the unsuitable material shall be removed to the depth determined necessary in the field by the Soils Technician, and as acceptable to the District Engineer. The sub-grade shall be restored with compacted Imported Granular Material or crushed rock as recommended by the Soils Technician. Place the appropriate bedding or base material on this restored foundation.

B. When rock encroachment is encountered, the rock shall be removed to a point below the intended trench or excavation sub-grade as determined necessary in the field by the Soils Technician, and as acceptable to the District Engineer. The sub-grade shall be restored with compacted Imported Granular Material as recommended by the Soils Technician. Place the appropriate bedding or base material on this restored foundation.

C. When excessively wet, soft, spongy, or similarly unstable material is encountered at the surface upon which the bedding or base material is to be placed, the unsuitable material shall be

removed to the depth determined necessary in the field by the Soils Technician, and as acceptable to the District Engineer. Restore the trench with crushed rock enclosed in filter fabric as directed by the District Engineer. Larger size rocks, up to 3", with appropriate gradation, may be used if recommended by the Soils Technician. Place the appropriate bedding or base material on this restored foundation.

3.07 TRENCH EXCAVATION AND PLACEMENT OF BEDDING

A. Excavate the trench to the lines and grades shown on the drawings with allowance for 4" of pipe bedding material. The trench section shall be as shown on the Standard Drawings.

B. The maximum length of open trench shall be 152m (500') except by permission of the District, City or County. The distance is the collective length at any location, including open excavation and pipe laying, which has not been backfilled to the elevation of the surrounding grade.

C. Trench walls shall be sloped or shored per the requirements of CAL-OSHA.

D. The trench bottom shall be graded to provide a smooth, firm, and stable foundation that is free from rocks and other obstructions.

E. Place the specified thickness of bedding material over the full width of the trench. Grade the top of the pipe base ahead of the pipe laying to provide a firm, uniform support along the full length of pipe.

F. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint.

G. Trenches for main pipelines and all appurtenances shall be backfilled with the materials and methods as specified.

H. Trench widths shall be in accordance with the Standard Drawings.

I. Trench depth shall be as required to install pipelines in accordance with the Contract Documents. Unless shown otherwise on the Plans, the minimum depth of cover for pipelines shall be as follows:

Pipeline Type	Minimum Cover Required
Potable Water	36”
Overflow	36”
Drain	36”

J. Final street sub-grade shall be established prior to the excavation of pipeline trenches. Minimum cover above pipe shall be 24” for hydrotesting.

3.08 MANHOLE AND VAULTS

A. The Contractor shall prepare an excavation large enough to accommodate the structure and permit grouting of openings and backfilling operations. The walls of the excavation shall be sloped or shored per the requirements of CAL-OSHA.

B. Manholes and vaults shall be placed at the location and elevation shown on the plans, on undisturbed soils and 6" of compacted Class 2 Aggregate Base.

C. Manhole and vault excavations shall be backfilled with the materials and methods as specified for backfill.

3.09 COMPACTION REQUIREMENTS

A. Compaction shall be accomplished by mechanical means. Consolidation by water settling methods such as jetting or flooding is prohibited.

B. If the backfill fails to meet the specified relative compaction requirements; the backfill shall be reworked until the requirements are met. All necessary excavations for density tests shall be made as directed by the Soils Technician, and as acceptable to the District Engineer. The requirements of the Agency having jurisdiction shall prevail on all public roads.

C. Compaction tests shall be performed at random depths, and at random intervals not to exceed 150', as directed by the Soils Technician or District Engineer.

D. Relative compaction shall be determined by the impact or field compaction test made in accordance with ASTM D 1557 Procedure C.

E. Unless otherwise shown on the drawings or otherwise described in the specifications for the particular type of pipe installed, relative compaction in pipe trenches shall be as follows:

1. Embedment Zone - 90% relative compaction.
2. Backfill Zone - 90% relative compaction.
3. Structural section in paved areas - per agency requirements, 95% minimum.
4. For over excavation or foundation stabilization - 90% to 95% relative density, reference Project Geotechnical Report

F. All excavations are subject to compaction tests.

3.10 EMBEDMENT ZONE

A. Care shall be taken in placing the imported granular backfill material simultaneously around the main pipeline and appurtenance pipes so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe or on the sides of the pipe. Care shall be taken to place material simultaneously on both sides of the pipe to prevent lateral movement. This area shall be mechanically compacted to attain 90% relative density. Care shall be taken when compacting appurtenance laterals 2” and smaller to prevent the crushing or denting of the copper lateral.

B. Additional lifts of 12" or less thickness may be required on 16" or larger diameter pipe to attain complete support of the haunch area. Soils tests may be taken on this layer of backfill.

C. After the spring line backfill has been approved by the Soils Technician, backfill of the remainder of the Pipe Zone may proceed. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe.

D. Place and compact the material at a maximum of 12” lifts. Compact all material placed in the Embedment Zone by mechanical methods. Sand cone tests shall be taken on this layer of backfill.

E. The use of a backhoe-mounted compaction wheel is prohibited within the pipe zone to 12” above the top of the pipe.

F. Under no circumstances shall consolidation by water settling or water-setting methods (i.e. jetting, diking, etc.) be permitted.

3.11 BACKFILL ABOVE EMBEDMENT ZONE

A. After the Embedment Zone material has been placed, compacted, approved by the Soil Technician and accepted by the District Engineer, backfill in the remainder of the trench may proceed.

B. Compaction using vibratory equipment, tamping rollers, pneumatic tire rollers, or other mechanical tampers shall be performed with the type and size of equipment necessary to accomplish the work. The backfill shall be placed in horizontal layers of such depths as are considered proper for the type of compacting equipment being used in relation to the backfill material being placed. Each layer shall be evenly spread, properly moistened, and compacted to the specified relative density. The Contractor shall repair or replace any pipe, fitting, manhole, or structure damaged by the installation operations as directed by the District Engineer.

C. Replace bituminous and concrete pavement, curbs, and sidewalks removed or damaged during construction in accordance with the requirements of the agency having jurisdiction.

3.12 ROCK EXCAVATION

A. 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. Boulders larger than one half (1/2) cubic yard will be classified as rock, if drilling and blasting are required and actually used for their removal. The demonstration may be waived if, in the Engineer’s opinion, the material is obviously unrippable.

END OF SECTION

SECTION 02225
UTILITY CROSSINGS

PART 1 - GENERAL

1.01 DESCRIPTION

Where utilities cross the pipeline trench but do not conflict with the permanent work to be constructed, the Contractor shall follow the procedures given below and as indicated on the Plans and in the Specifications. For utility crossings not shown on the Plans, follow the General Provisions and the instructions of the District's Representative.

1.02 RELATED WORK DESCRIBED ELSEWHERE

The Contractor shall refer to the following Specification section(s) for additional requirements:

A. Section 02223 – Trenching, Excavation, Backfill and Compaction

1.03 **SUBMITTALS** (Not Applicable)

PART 2 - MATERIALS

2.01 REPLACEMENT IN KIND

Except as indicated below or as specifically authorized by the District's Representative, the Contractor shall reconstruct utilities with new material of the same size, type, and quality as that removed.

PART 3 - EXECUTION

3.01 NOTIFICATION

The Contractor shall notify the utility District forty-eight (48) hours in advance of the crossing construction and shall coordinate the construction schedule with the utility service requirements.

3.02 EXPOSING UTILITIES IN ADVANCE

It shall be the Contractor's responsibility to pothole and determine the true location and depth of all utilities and service connections which may be affected by or affect the work. He shall also determine the type, material, and conditions of these utilities. In order to provide sufficient lead time to resolve unforeseen conflicts, order materials, and take over appropriate measures to ensure that there is no delay in work. All costs incurred in exposing utilities shall be borne by the Contractor.

3.03 PROTECT IN PLACE

The Contractor shall protect all utilities in place, unless abandoned, and shall maintain the utility in service, unless otherwise specified on the Plans or in the Specifications.

3.04 CUT AND PLUG ENDS

The Contractor shall cut abandoned utility lines and plug the ends with brick and mortar, unless otherwise specified on the Plans or in the Specifications. The Contractor shall dispose of the pipe as unsuitable material at his expense.

3.05 REMOVE AND RECONSTRUCT

Where so indicated on the Plans or in the Specifications or as required by the District's Representative, the Contractor shall remove the utility and after passage, reconstruct it with new materials. The Contractor shall take appropriate measures to provide temporary service for the disconnected utility. All reconstruction work shall be in accordance with the applicable specifications.

3.06 COMPACTION

A. Utilities Protected in Place: Contractor shall take special precautions to compact under and around the utility to ensure that no voids are left.

B. Utilities Reconstructed: Prior to replacement of the utility, the trench shall be backfilled and compacted by approved means to an elevation one foot above the top of the ends of the utility. A cross trench of the proper width shall be excavated for the utility, and it shall be laid, backfilled, and compacted as specified herein or as required by the Engineer.

C. Alternate Construction - Sand Slurry: Sand slurry may be substituted for other backfill materials to aid in reducing compaction difficulties as specified in Section 02223. Specific methods and procedures must be submitted for the approval of the Engineer prior to construction.

3.07 ABANDONED UTILITIES

Remove and dispose of all abandoned utilities that are in conflict with proposed Work in accordance with the Contract Documents and applicable local, state and federal regulations.

END OF SECTION

SECTION 02444

CHAIN LINK FENCING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall furnish all materials, labor, tools, and equipment required to completely construct the color chain link fencing, posts, gates, and miscellaneous material, including removal of trees, brush and other obstacles, as shown on the Contract Drawings and as specified in these specifications.

1.02 REFERENCE STANDARDS

A. American Society for Testing Materials (ASTM) Publications:

1) A392 - Zinc-Coated (Galvanized) Steel Chain-Link Fence Fabric
2) A653/A653M: Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
3) A824: Metallic-Coated Steel Marcelled Tension Wire for Use with Chain-Link
4) C33: Concrete Aggregates
5) C150: Portland Cement
6) F567: Standard Practice for Installation of Chain-Link Fence
7) F626: Fence Fittings
8) F668: Polyvinyl Chloride (PVC)-Coated Steel Chain-Link Fence
9) F900 - Industrial and Commercial Swing Gates
10) F934: Standard Colors for Polymer-Coated Chain-Link Fence Material
11) F1043 - Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework

12) F1083 - Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures

13) F1184 - Industrial and Commercial Horizontal Slide Gate

14) F1345: Zinc 5-Percent Aluminum-Mischmetal Alloy-Coated Steel Chain-Link Fence Fabric

15) F1664: Polyvinyl Chloride (PVC) and Other Conforming Organic Polymer-Coated Steel Tension Wire Used with Chain-Link Fence

B. Chain Link Fence Manufacturers Institute, New York, NY.

C. AASHTO M 181

D. Standard Specification and Standard Plans for Public Works Construction (Greenbook)

1.03 SUBMITTALS

A. The fence supplier shall furnish submittals for approval including product data, warranty documentation, instruction manuals, as-built drawings, Operations and Maintenance (O&M) manuals, certified factory test results, and field test reports.

B. Shop Drawings: All features of the design, materials, fabrication, and layout of fence and gate(s) shall be completely described and illustrated.

1. Drawings are to be submitted showing construction (mounting) details and dimensions of motorized gate operators and entry and exit safety loops and pedestals.

1.04 QUALITY ASSURANCE

A. Manufacturer Experience: 5 years’ experience manufacturing fence components.

B. Installer Experience: 5 years' experience installing fence components on similar projects in accordance with ASTM F567.

C. Fence, framework, gates, fittings, fasteners, and accessories shall be obtained from a single source.

D. ASTM current specifications and tolerances shall apply and supersede any conflicting tolerance.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered to project site with manufacturers' tags and labels intact.

B. Gates shall be stored in a manner to prevent warping. Chain-link fabric material shall be kept rolled until ready for installation. Materials shall be stored off the ground to protect against oxidation caused by ground contact.

C. Handling shall be conducted in a manner to prevent damage during loading and unloading of components.

1.06 PROJECT CONDITIONS

A. Fence alignment and grade conditions shall be verified prior to installation. Any necessary repairs to the grade shall be completed to ensure proper fence placement.

B. In areas where the fence fabric and panels cross depressions or ditches, the openings shall be closed to maintain continuity and security of the fence line.

1.07 WARRANTY

A. Manufacturer's standard warranty shall cover fence fabric, panels, posts, and gates against failure and rust from normal use for period of 5 years from date of installation.

B. Manufacturer's standard warranty shall cover gates for 5 years from date of installation. Failure is defined as defects in manufacturing that prevent the gate from operating in a normal manner.

PART 2 - PRODUCTS

2.01 CHAN-LINK FENCE AND GATES

A. General Requirements: Galvanized steel with Black polymer coating. Do not use materials imperfectly galvanized or coated or with serious abrasions.

1. Hot-dip galvanized

    a. Fabric shall conform to ASTM A392, Class 2, with a minimum zinc coating of 20 ounces per square foot.

    b. Posts shall meet ASTM F1083 with a minimum zinc coating of 1.8 ounces per square foot.

2. Polymer Coating

    a. Polymer-coated components shall conform to ASTM F668, Class 2b, with coating fused and adhered to metallic-coated steel wire. Bonding shall be thermally applied per ASTM F1043 and shall be free of pinholes, bubbles, voids, roughness or blistering.

    b. Coating thickness shall be a minimum of 7 mils for fabric, tension wire, and ties, and between 10 to 15 mils for posts, rails, braces, gate frames, accessories, and gates.

    c. Color shall be uniform in accordance with ASTM F934 and shall be Black.

    d. Polymer coating shall be applied to fence components in the shop, and nuts and bolts shall be applied in the field.

3. Steel pipe

    a. Steel pipe shall conform to ASTM F1043, Group IC, Schedule 40, Regular Grade.

    b. External protective coating shall meet ASTM F1043, Type B, consisting of a minimum 0.9 ounces per square foot hot-dip zinc coating, chromate conversion, and a clear polymer coating.

    c. Internal coating shall be either ASTM F1043 Type D, with a minimum 3 mils thick zinc-pigmented coating at 81 percent nominal zinc content, or Type B with a minimum 0.9 ounces per square foot zinc coating.

2.02 POSTS AND BRACES

B. Posts, braces and rails shall be new galvanized pipe manufactured in accordance with ASTM F1083 and shall be of the following sizes and weights:

Post Location	Nom. Size of Post (in.)	Approx. OD (in.)	Pipe Weight
End, corner, and walk gate posts	2 ½	2 7/8	Standard
Line posts	2	2 3/8	Standard
Braces, rails, and gate frames	1 ½	1 7/8	Standard

Braces shall be fitted with clamps on each end, one clamp to fit gate posts and the other clamp to fit standard line posts.

Changes in alignment of more than 30° shall be considered as corners, and corner posts and braces shall be installed.

C. Gate posts, not including walk gates, shall be of the following sizes and weights:

Gate Width		Nom. Size of Post (in.)	Approx. OD (in.)	Pipe Weight
Single	Double			
6’	12’	2 1/2	2 7/8	Standard
>6’ – 12’	12’ – 24’	3 1/2	4	Standard
>12’ – 18’	24’ – 36’	6 5/8	6 5/8	Standard

2.03 CHAIN LINK FABRIC

A. The chain link fabric shall be anti-climb with 1” mesh and 9-gauge galvanized steel wire, with a height of 8 feet unless shown otherwise in the plans. The fabric shall be coated.

2.04 POST TOPS AND CAPS

A. One weathertight cap must be provided for each post closure post per ASTM F626. When top rail is specified per plans, line post loop tops must be provided to secure the top rail.

2.05 TOP RAIL AND BRACE RAIL ENDS

A. ASTM F626 specified rail and brace rail ends are suitable for connections to terminal post.

2.06 TOP RAIL SLEEVES

A. Per ASTM F626, a 7-inch steel expansion sleeve is required with spring to allow for expansion and contraction of top rail.

2.07 TENSION WIRE

A. Type II steel tension wire shall be 7 gauge galvanized and have a minimum breaking strength of 8670 N, Class 4, 75,000 psi, per ASTM F1664.

B. All polymer coated steel tension wire must be 7-gauge and matching the coating class and color to chain-link fabric.

2.08 TIE WIRE AND HOG RINGS

A. Tie wires for fastening fence fabric to line posts and rails shall not be less than 9 gauge steel wire with 9-gauge aluminum alloy hog rings, to conform with ASTM F626. The tie wires and hog rings must match the coating, class, and color to the chain-link fabric.

2.09 BARBED WIRE

A. Barbed Wire - Where called for in the Plans, 3 strands of barbed wire shall be provided on top of the chain link fence. Each strand shall be made of two strands of 12-1/2 gauge galvanized steel wire twisted with two-point No. 14 AWG gauge barbs spaced at not more than 5".

B. Barbed Wire Arms – Where called for in the Plans, galvanized steel or malleable iron having sufficient strength to withstand a weight of 250 lbs is to be applied at

the outer strand of barbed wire. The wire arms are to be installed at a 45 degree angle to the ground with 3 strands of barbed wire per side of V-arm.

2.10 TRUSS RODS

A. Rods for diagonal truss braces shall be made from 5/16" diameter galvanized steel rod, with galvanized turnbuckles.

2.11 POLYMER COATED COLOR FITTINGS

A. Fittings shall conform to ASTM F626 and shall be coated with a polymer layer measuring a minimum of 6 mils in thickness. The coating shall be fused and adhered to the intended surface. Material and color shall match the fence system as specified.

2.12 STRETCHER BARS

A. Flat bars with minimum cross section dimensions of 3/16 in. by 3/4 in., 2 inches shorter than full height of fabric, secured with 11 -gage sheet steel bar bands spaced approximately 15 in. on centers, and bolted with 3/8 in. diameter bolts, for attaching fabric to terminal posts. One tension bar shall be provided for each end and gate post, and two for each corner and pull post.

2.13 HARDWARE

A. All hardware, hinges, clamps, fasteners, bolts, nuts, turnbuckles, fittings, post caps, stretcher bars, and other ferrous material not previously covered in these specifications, shall be manufactured of steel, malleable iron or wrought iron, and shall be galvanized in accordance with the requirements of ASTM F626.

2.14 CONCRETE FOOTINGS

A. Concrete footings shall be per Plans.

2.15 GATES

A. GENERAL

1. Each gate shall be outfitted with approved latches and provisions for padlocking. Latches, hasps and bolts shall be accessible from either side of the gate.

2. Moveable components such as hinges, latches, keeper, and drop rods are to be field-coated using liquid polymer touchup paint provided by the manufacturer.

3. All gates shall have extension arms extended outward with 3-strand barbed wire, positioned in a matter that the gates may be fully opened.

4. All gates shall provide non-lift-off-type hinges to permit 180-degree swing, capable of supporting the gate leaf and allowing opening and closing without binding.

5. All hinge hardware shall be welded to fence posts to prevent gates from shifting.

6. Chain-link swing gates shall be manually operated.

7. Gate frames shall not be used as a rotating hinge element.

8. Gates shall be furnished completely with all necessary fittings and hardware.

B. SWING GATES

1. Swing gates shall conform to ASTM F 900 and be constructed as one-piece units.

2. Walk gates and drive gates shall be the width as shown on the Contract Drawings.

3. Gate frames shall be cross-trussed and constructed from zinc-coated steel conforming to ASTM F1043 or ASTM 1083, matching the material used for fence posts.

4. Frames shall be designed to support the weight of the gate without warping or sagging.

5. Gate frames and posts shall be polymer-coated to match the type and color specified for the fence framework. Welded joints shall be protected with zinc-rich paint in accordance with ASTM Practice A780.

6. The corners of gate frames shall either be welded or mechanically fastened and reinforced with a malleable iron fittings designed for that purpose. Surplus welding material shall be removed prior to galvanizing.

7. Chain-link wire fabric shall be of the same type and height as specified for the fence and shall be fastened to the frame using stretcher bars and hook bolts on all four sides, spaced no more than 12 inches on center.

8. Gates shall be hung by hinges not less than 3" in width so designed as to securely clamp to the gate post and permit the gate to swing back against the fence. Hinges shall be of high malleable iron of the ball and socket type which will permit the gate to swing back against the fence. The lower hinges of the gate shall support the entire vertical load of the gates as well as provide for the resultant horizontal reaction.

9. Swing gates shall be equipped with a double latch system including a drop rod, plunger, and gate stop, suitable for padlocking. A steel mechanical locking keeper shall be provided.

10. Double gates shall include a galvanized drop rod with a center gate stop pipe or receiver to secure the inactive leaf in the closed position.

PART 3 - EXECUTION

3.01 GENERAL

A. Examine conditions under which fence and gates are to be installed. Notify Engineer, in writing, of improper conditions of work. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Verify measurements at site.

C. Do not install fence until final grading is complete and finish elevations are established.

D. With approval from the Engineer, relocate fence alignment as directed to avoid conflicts with existing site conditions or utilities.

E. Do not drive equipment on areas to be landscaped, except as approved by Engineer. Areas not accessible from roads shall be protected with heavy wood planking. Remove barricades and protection at completion of project. Repair damaged landscape surfaces.

3.02 INSTALLATION

A. Footings

1. Concrete fill shall be placed in a continuous pour, tamped for consolidation, and crowned to shed water.

2. Rod and compact concrete around posts. Slope top of footings above level of adjacent grade and trowel finish.

3. Size per Plans

4. Time of Set: 48-hrs before rails are erected or before fabric is applied or stretched.

B. Framing

1. Install line posts not more than 10 ft. apart and distribute them evenly along each section of fence.

2. Install corner posts where the fence line changes direction by more than 30°.

3. Install brace posts no more than 500 feet apart and at locations where an abrupt vertical change in grade occurs.

4. Set posts in concrete footings, plumb and true to line and grade.

5. Install horizontal and diagonal bracing at corner, gate, terminal, and brace posts, as well as location with abrupt changes in vertical grade. Brace and truss end, pull, corner, and gate posts to adjacent line posts.

6. Provide brace to match top rail spaced midway between top rail and tension wire and extending to adjacent line posts. Truss diagonally with tension rod with turnbuckle.

7. Fasten top rail to end, pull, gate and corner posts. Pass top rail through fittings of line posts.

8. Install horizonal pipe bracing at mid-height on each side of terminal and intermediate brace posts. Attach bracing with the appropriate fittings. Install diagonal truss rods and tension to keep posts plumb.

9. Fasten bottom tension wire to end, pull, gate, corner, and line posts. Weave top and bottom tension wire through fabric and secure using hog rings or wire clips spaced at 24-inch intervals.

10. Use galvanized sleeve and grout posts or install with suitable galvanized flange casings and galvanized anchor bolts as directed by Engineer.

C. Fabric

1. Place fabric on outside of posts and stretch to avoid bulging or buckling. Leave approximately 2 inches between finished grade and bottom selvage.

2. Fasten at line posts, top rail, and bottom tension wire with galvanized ties. Space ties no more than 15 in. apart on line posts and not more than 24 in. apart on rail and tension wire.

3. Fasten to terminal posts with stretcher bars threaded through or clamped to fabric at 4-inch intervals and secure to posts with metal bands spaced 16 inches on center using 5/16 in. x 1-1/4 in. galvanized carriage bolts and nuts.

4. Make tie connections on interior side of fence. Use U-shaped tie wires that conform to the diameter of the pipe, clasping pipe and fabric firmly. Twist ends at least two full turns and bend to minimize hazard to persons or clothing.

5. Bottom tension wires and fabric shall be stretched straight from post to post excavating at high places. Filling of low places will not be permitted.

6. Install gates plumb, level, and secure for full width of opening and hardware adjusted for smooth operation.

D. Gates

1. Install gates plumb, level, and secure.

2. Attach hardware to prevent unauthorized removal. Install nuts and hardware bolts on side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3. Provide a full opening with a lack of interference.

4. Install ground-set items in concrete for anchorage as recommended by the fence manufacturer.

5. Adjust hardware for smooth operation and lubricate.

6. Provide grounding bond strap between gate and fence.

3.03 TOUCH-UP AND REPAIR WORK:

A. Remove and replace fencing which is improperly located or is not true to line, grade and plumb within tolerances as indicated.

B. Repair damaged components as recommended by manufacturer.

C. Repair damaged coatings in shop or during field erection per manufacturer's recommendations.

D. Field-apply polymer coating provided by the manufacturer to nuts and bolts, all scratched or damaged areas, and moveable part in accordance with manufacturer's recommendations.

END OF SECTION

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DIVISION 3 – CONCRETE

SECTION 03000
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, valve support blocks 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 A 185 - Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
- ASTM A 615/A 615M - Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- ASTM C 150 - Specification for Portland Cement
- ASTM C 494 - Specification for Chemical Admixtures for Concrete
- ASTM C 881 - Specification for Epoxy-Resin-Base Bonding Systems for Concrete
- CRSI - Recommended Practice for Placing Reinforcing Bars
- SSPWC - Standard Specifications for Public Works Construction "Greenbook"

1.03 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, support blocks for valves 100mm (4") and larger, collars, cradles, curbs, encasements, gutters, manhole bases, protection posts, sidewalks, splash pads, and other miscellaneous cast-in-place items, all in accordance with the Standard Drawings.

B. Certified hand-mixed concrete may be permitted when the volume of concrete required is less than 0.76 cubic meters (1.00 cubic yards) with approval from the District Engineer.

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 6.35mm (¼") in depth or 12.7mm (½”) 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 the District Engineer.

1.04 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. All applications shall use a minimum of Class 560-C-3250 concrete, unless otherwise directed by the District Engineer. Mix design requirements for 560-C-3250 concrete shall be in conformance with the latest edition of the Greenbook, Section 201. The maximum slump shall be 100mm to 150mm (4" to 6”).

C. In certain circumstances, rapid-setting concrete may be required. Accelerating admixtures shall conform to ASTM C-494 and may be used in the concrete mix as permitted by the District Engineer. Calcium chloride shall not be used in concrete.

D. Certified hand mixed concrete materials type and proportions shall be submitted and approved by the District Engineer prior to application on site. The maximum slump shall be 100mm to 150mm (4” to 6”).

2.02 REINFORCING STEEL

A. Reinforcing steel shall conform to ASTM A 615, Grade 60.

B. Reinforcing steel shall be fabricated in accordance with the current edition of the Manual of Standard Practice, published by the Concrete Reinforcing Steel Institute.

2.03 WELDED WIRE REINFORCEMENT

Welded wire reinforcement shall conform to ASTM A 185.

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 of the District Engineer. 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 part cement and two 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 C 881. 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 C 881. 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 C 881. 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 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 the District Engineer a minimum of one working day in advance of intended placement of concrete to allow for checking the form lines, grades, and other

required items before placement of concrete.

B. The form surfaces shall be cleaned and coated with form 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 19mm (¾") chamfered.

3.02 REINFORCEMENT

The following procedures apply to all cast-in-place concrete with the exception of thrust blocks and valve support blocks. No reinforcement is required for concrete thrust blocks or concrete valve support blocks.

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 the District Engineer.

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 the District Engineer, 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 50mm (2") 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, welded wire reinforcement, 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 Engineer.

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 150mm (6") 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 same size diagonal bar at the four 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. Welded wire reinforcement is to be rolled flat before being placed in the form. Support and tie welded wire reinforcement to prevent movement during concrete placement.

N. Extend welded wire reinforcement to within 50mm (2") of the edges of slabs. Lap splices at least 1-1/2 courses of the reinforcement and a minimum of 150mm (6"). Tie laps and splices securely at ends and at least every 600mm (24") with 16-gage black annealed steel wire. Pull the welded wire reinforcement into position as the concrete is placed by means of hooks, and work concrete under the reinforcement to ensure that it is at the proper distance above the bottom of the slab.

O. Reinforcing steel as specified herein may be used in place of welded wire reinforcement shown in the Standard Drawings or on the Approved Plans with the approval of the District Engineer.

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. Hand mixed concrete mixing method shall be in accordance with SSPWC 201-1.4.4.

B. All concrete shall be placed in forms before taking its initial set.

C. No concrete shall be placed in water except with permission of the District Engineer.

D. 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.

E. 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 Engineer.

B. The surfaces of concrete exposed to view shall be smooth and free from projections or depressions.

C. Exposed surfaces of concrete not poured against forms, such as horizontal or sloping surfaces, shall be screeded to a uniform surface, steel-toweled to densify 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 pouring.

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 the District Engineer, 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 0.5 mm (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 50mm (2"), add aggregate to the repair mortar as recommended by the manufacturer. On vertical or overhead surfaces, for repair depths greater than 50mm (2"), 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 6.35mm (¼") 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 should be approximately 6.35mm (¼") 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 coats of protective epoxy coating for a total dry film thickness of
0.254 - 0.381mm (10 –15 mils). Allow the material to cure between coats and prior to continuing the installation through the penetration.

3.11 DAMP-PROOFING FOR 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 300mm (12”) above the water table or indications of seepage or moisture as directed by the District Engineer. Apply two 0.381mm (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

The Design Engineer shall be responsible for sizing all thrust blocks and anchor blocks required for the project in accordance with the requirements of the District’s Standard Drawings.

A. Thrust Block Placement: Thrust blocks shall be located at all unrestrained pipe fittings and shall 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). Thrust block concrete shall not hinder maintenance access to the valve operators. The shape and location of all thrust block excavations shall be approved by the District Engineer prior to pouring concrete. Prior to filling the pipeline with water,

   concrete thrust blocks shall cure for a minimum of three (3) days unless an approved

accelerating admixture, as described earlier in this section, is used.

B. Anchor Block Placement: 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. Prior to filling the pipeline with water, concrete anchor blocks shall cure for a minimum of seven (7) days. Accelerating admixtures shall not be used in concrete anchor blocks.

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 300mm (12").

B. Support blocks shall extend up to the height of adjoining pipe and shall have a minimum depth below the valve of 300mm (12").

C. Support blocks shall be installed so that the valves will be accessible for repairs.

END OF SECTION

SECTION 03100
CONCRETE FORMWORK

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The contractor shall furnish all materials for concrete formwork, bracing, shoring, and supports and shall design and construct all falsework, all in accordance with the provisions of the Contract Documents.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01300 - Submittals

B. Section 03000 – CastinPlace Concrete

C. Section 03200 - Reinforcement Steel

D. Section 03314 – Strand-Wound, Prestressed Concrete Tank

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of these specifications, all work specified herein shall conform to or exceed the requirements of the Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section; provided, that for Building Codes, the latest edition of the code, as adopted as of the date of award by the agency having jurisdiction, shall apply to the work.

1. Codes and Standards:

   The Building Code, as referenced herein, shall be the Uniform Building Code (UBC) of the International Conference of Building Officials (ICBO).

2. Government Standards:

   PS 1 - U.S. Product Standard for Concrete Forms, Class I.

   PS 20 - U.S. Product Standard for Lumber Construction.

   Division of Industrial Safety, State Safety Orders of California

3. Commercial Standards:

   ACI 117 - Standard Tolerances for Concrete.

Construction and Materials.

ACI 347 - Recommended Practice for Concrete Formwork.

1.4 CONTRACTOR SUBMITTALS

A. The contractor shall, in accordance with the requirements of the in Section 01300 – Contractor Submittals, submit detailed plans of the falsework proposed to be used. Such plans shall be in sufficient detail to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the falsework, and typical soil conditions. All shoring, bracing and falsework shall be designed and certified by a California State registered Civil Engineer or responsible person as required by Title 8 of the California Administrative Code. These plans shall be signed and sealed by a California registered Civil Engineer in accordance with the California Administrative Code.

1.5 QUALITY ASSURANCE

A. Tolerances: The variation from established grade or lines shall not exceed 1/4-inch in 10 feet and there shall be no offsets or visible waviness in the finished surface. All other tolerances shall be within the "Suggested Tolerances" specified in ACI 117.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials for concrete forms and falsework shall conform to the applicable provisions of SSPWC Subsection 303-1.3 and the requirements stated herein.

B. Except as otherwise expressly accepted by the Engineer, all lumber brought on the job site for use as forms, shoring, or bracing shall be new material. All forms shall be smooth surface forms.

C. Refer to Section 03314 titled “Strand-Wound, Prestressed Concrete Tank” for formwork requirements specific to the tank.

2.2 FORM AND FALSEWORK MATERIALS

A. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:

1. Lumber shall be Douglas Fir or Southern Pine, construction grade, in conformance with U.S. Product Standard PS20.

2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine plywood manufactured

especially for concrete framework and shall conform to the requirements of PS 1 for Concrete Forms, Class I, and shall be edge sealed.

3. Form materials shall be metal, wood, plywood, or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade indicated. Metal forms shall be an approved type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

B. Unless otherwise shown, exterior corners in concrete members shall be provided with 3/4-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise shown.

C. Forms and falsework to support the roof and floor slabs shall be designed by the contractor for a minimum dead load plus a live load of 50 psf, plus any and all such additional loadings as may occur.

2.3 EPOXY ADHESIVE

An approved non-sag epoxy adhesive shall be applied over all dry-packed holes on the inside surface of the corewall. An acceptable material is Sikadur 31 Hi-mod Gel, as manufactured by SIKA, or equivalent.

PART 3 – EXECUTION

3.1 GENERAL

A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The contractor shall assume full responsibility for the adequate design of all forms, and any forms, which are unsafe or inadequate in any respect, shall promptly be removed from the work and replaced at the contractor's expense. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable local, state and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by contractor's personnel and by the Engineer and shall be in sufficient number and properly installed. During concrete placement, the contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.

3.2 FORM DESIGN

A. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and

vibrating the concrete. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Plywood, 5/8-inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. The forms shall be tight so as to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1 to 1-½ inch diameter polyethylene rod held in position to the underside of the wall form.

Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be acceptable to the Engineer.

Blockouts or other types of wall openings, other than those shown in the Contract Documents, shall not be incorporated into the formwork.

B. Roof Forms:

1. Form Finish and Alignment

The finished form surface shall be smooth, true to elevation and alignment and all joints between boards, plywood sheets or form panels shall be mortar-tight, or be made mortar-tight by taping or other means as the situation calls for, before any concrete pour may be started.

2. Form Removal

In accordance with Part 3.5 of this Section, removal of the forms will be permitted only when the concrete has fully attained the minimum 28-day compressive strength specified in these Specifications or shown on the Drawings and a minimum of 14 days has elapsed.

3. Form Adjust and Release

The contractor shall provide either wedged under timber posts, screw jacks under shoring, or provide other means to adjust the forms and relieve the load.

4. Tolerance

a. Unless stated otherwise on the drawings, the permissible tolerance at any point for flat or dome-roof form-surfaces shall not exceed plus or minus 1/4-inch from the specified elevation or thickness. The finished roof surface shall be capable of completely draining. Contractor shall camber or provide necessary forming supports to prevent low spots and

to insure drainage. If low spots should occur, contractor shall submit a corrective procedure to the Engineer for approval, and shall perform all remedial work.

b. Any transition between high and low points shall be gradual, smooth and even and shall be to the satisfaction of the Engineer.

C. Bulkheads and Screeds for Floors and Roofs

Unless free-spanning vibrating and finishing screeds are used, sufficient floor and roof screeds shall be installed to ensure that the finished concrete surface will conform to the slopes, elevations, and tolerances specified in these documents.

3.3 CONSTRUCTION

A. Vertical Surfaces: All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is called for on the drawings. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

B. Construction Joints: Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to the Engineer. Where a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.

C. Form Ties: Holes left by the removal of tie cones or form ties shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified for "Finish of Concrete Surfaces" in Section 03000, entitled "CastinPlace Concrete." Wire ties for holding forms will not be permitted. No formtying device or part thereof, other than metal, shall be left embedded in the concrete, nor shall any tie be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snapties, which cause spalling of the concrete upon form stripping or tie removal, will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete. Where taper ties are approved for use, the larger end of the taper tie shall be on the wet side of walls in water retaining structures. After the taper tie is removed, the tie hole shall be thoroughly cleaned and sandblasted or roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the middle third of the corewall. The plugs must be driven into the hole with a steel rod, placed in a cylindrical recess made therefore in the plug. At no time

shall plugs be driven on the flat area outside the cylindrical recess. Plugs shall be A-58 Sure Plug as manufactured by Dayton Superior, Santa Fe Springs, California (phone: 714/522-3442), or an approved equivalent. The tie holes shall then be coated with a water insensitive epoxy or an acceptable bonding agent and properly filled through damp-packing with a nonshrink grout of dry consistency. The amount of water to be added to the cement-sand mix shall be such that the mortar can be driven into the voids and will compact properly. The outside of the tie hole shall be drypacked no sooner than 7-days after the inside has been dry packed. Embeco or other fast-setting cements/additives shall not be used for damp-packing such cavities. Interior tank wall surfaces, which have been damp-packed, shall be covered with an approved 10 mil. thick water insensitive non-sag epoxy coating (Select Bond GP-3000 epoxy or equal). Exposed faces of walls shall have the outer 2 inches of the exposed face filled with a cement grout, which shall match the color and texture of the surrounding wall surface. Finish surfaces shall be free from sand streaks or voids.

3.4 REUSE OF FORMS

A. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces, which are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the Engineer.

3.5 REMOVAL OF FORMS

A. Careful procedures for the removal of forms shall be strictly followed, and this work shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. In the case of roof slabs and aboveground floor slabs, forms shall remain in place until test cylinders for the roof concrete fully attain the 28-day compressive strength specified in Section entitled, "Strand-Wound Prestressed Concrete Tank"; 03314 provided, that no forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained 100 percent of the specified 28-day strength and has been in place for a minimum of **[14 days]**. The time required to establish said strength shall be as determined by the Engineer who will make several test cylinders for this purpose from concrete used in the first group of roof panels placed. Forms for all parts of the work not specifically mentioned herein shall remain in place for periods of time as determined by the Engineer.

3.6 MAINTENANCE OF FORMS

A. Forms shall be maintained at all times in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Forms, when in place, shall conform to the established alignment and grades. Before concrete is placed, the forms shall be thoroughly cleaned. The form surfaces shall be treated with nonstaining material

oil or other lubricant acceptable to the Engineer. Any excess lubricant shall be satisfactorily removed before placing the concrete.

Where field oiling of forms is required, the contractor shall perform the oiling at least two weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

3.7 FALSEWORK

A. The contractor shall be responsible for the design, engineering, construction, maintenance, and safety of all falsework, including staging, walkways, forms, ladders, and similar appurtenances, which shall equal or exceed the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, the requirements of the Construction Safety Orders of the California Division of Industrial Safety, and the requirements specified herein.

B. All falsework shall be designed and constructed to provide the necessary rigidity and to support the loads. Falsework for the support of the superstructure shall be designed to support the loads that would be imposed if the entire superstructure were placed at one time.

C. Falsework shall be placed upon a solid footing, safe against undermining, and protected from softening. When the falsework is supported on timber piles, the maximum calculated pile loading shall not exceed 20 tons.

END OF SECTION

SECTION 03251
EXPANSION AND CONSTRUCTION JOINTS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. This section covers the work necessary to furnish and install concrete expansion and construction joints.

B. All products furnished per the requirements of this specification section shall be NSF61-certified for contact with potable water.

1.2 SUBMITTALS

A. Furnish certified mill certificates showing that the material meets all of the requirements specified herein. The Engineer, at his option, may take samples of any materials and have them tested by an independent testing laboratory to verify their compliance with these Specifications. All such costs shall be borne by the District. If any materials should fail to meet these Specifications, all costs for further testing of the replacement material shall be borne by the Contractor.

1.3 OBSTRUCTIONS

A. Contractor shall pay particular attention to removing all obstructions such as concrete, nails, etc., from joints when movements of floor, wall and roof sections can be expected under prestressing, temperature and other conditions.

PART 2 - PRODUCTS

2.1 JOINT SEALERS

A. Joints shall be sealed with a joint sealer material in accordance with the manufacturer's instructions and as indicated on the contract drawings (no substitutions permitted).

B. Primer materials, if required by the sealant manufacturer, shall conform to the printed instructions of the sealant manufacturer.

2.2 PREFORMED JOINT FILLER

A. Preformed joint filler material shall be of the preformed non-extruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Bituminous fiber type will not be permitted. All non-extruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D1752 for Type I, except as otherwise specified herein.

2.3 BACKING ROD

A. Backing rod shall be an extruded closed-cell, polyethylene foam rod. The material shall be compatible with the joint sealant material used and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi. The rod shall be 1/8-inch larger in diameter than the joint width except that a one-inch diameter rod shall be used for a ¾-inch wide joint.

PART 3 - EXECUTION

3.01 JOINT SEALERS

A. Joint sealed areas shall be sandblasted or roughened and blown clean of dust and sand with compressed air before the material may be applied.

B. Joints shall be primed (if required) and the sealant shall be applied in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 03255
TANK WALL BASE JOINT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section covers the work necessary for the tank wall base joint as shown on the contract drawings, complete.

1.2 SUBMITTALS

A. The Contractor shall provide the Engineer a 2-foot minimum length of each of the closed cell neoprene pads and the neoprene bearing pads in order that the Engineer can test the pads for compliance with these Specifications.

B. Furnish certified mill certificates showing that the material meets all of the requirements specified herein. The Engineer, at his option, may take samples of any materials and have them tested by an independent testing laboratory to verify their compliance with these Specifications. All such costs shall be borne by the District. If any materials should fail to meet these Specifications, all costs for further testing of the replacement material shall be borne by the Contractor

PART 2 - PRODUCTS

2.1 CLOSED CELL NEOPRENE PADS

A. Closed cell neoprene pads shall be used as indicated in the contract drawings.

B. The materials shall be medium grade closed cell neoprene conforming to 2A3 of ASTM D 1056-00 and as further specified herein and on the contract drawings.

1. Compression deflection:	9 to 13 PSI
2. Shore 00 durometer:	60 to 80 PCF
3. Density:	12 to 28 PCF
4. Water absorption by weight:	5%
5. Temperature range:	
a. Low (flex without cracking):	-30° F
b. High continuous : 150° F	
c. High intermittent:	200° F
6. Heat aging (7 days @ 158° F)	
lineal shrinkage (max.):	5%
Tensile strength:	175 PSI min.
7. Elongation:	180% min.
8. Resilience (Bayshore-% rebound average 1/2" thickness @ 72° F):	20% to 40%

C. Product AA60-003 by DACON Industries, or approved equal, are acceptable materials.

2.2 40 DUROMETER BEARING PAD

A. Bearing pads shall be neoprene with a hardness of 40 durometer and shall meet the requirements of ASTM D2000 Line Call-Out M 2 BC 410 A1 4 B14 or M 2 BC 414 A14 C12 F17 for 40 durometer material.

PART 3 - EXECUTION

3.1 BEARING AND FILLER PADS

A. Bearing and filler pads shall be installed as indicated on the contract drawings.

B. Bearing and filler pads shall be glued to the concrete with an approved rubber cement material to prevent uplift of the pads during concrete pouring.

C. In addition, all pads shall be held down with approved plastic shim plates placed under the reinforcing steel.

D. Nailing down pads will not be permitted

E. Closed cell neoprene shall be ordered at least 1/4-inch wider than theoretically required to facilitate placing and to reduce development of voids between filler pads, bearing pads and waterstops.

F. Contractor's workmanship shall be such that no cement grout or concrete seepage will occur through the bearing and filler pad area resulting in a restraint of radial wall movements.

G. A continuous neoprene pad and one or more sponge filler pads are required between the top of the wall and the underside of the roof. Any void areas between such pads shall be caulked and sealed to prevent any mortar from the wall pour to come in contact with the wall top.

END OF SECTION

SECTION 03314
STRAND-WOUND PRESTRESSED CONCRETE TANK

PART 1 – GENERAL

1.1 WORK OF THIS SECTION

A. This section specifies the qualifications for the Tank Contractor and requirements for the construction of AWWA D110 strand wound, prestressed, concrete circular tanks; including all site work, excavation, reinforcing, concrete work, appurtenances, disinfection, testing, and backfill directly related to the tank unless otherwise specified.

B. In the event of discrepancy between this section of the Specifications and any other section of the Specifications or drawings, this specification shall govern.

C. The Tank Contractor shall furnish all labor, materials, tools, and equipment necessary to construct, disinfect and test the strand wound, prestressed concrete tank and appurtenances as indicated on the drawings, and as specified.

1.2 RELATED WORK

A. Related work specified in other sections:

Section 03000 – Cast-in-Place Concrete
Section 03100 – Concrete Formwork
Section 03200 – Reinforcement Steel
Section 03251 – Expansion and Construction Joints
Section 03255 – Tank Wall Base Joint
Section 05500 – Miscellaneous Metals
Section 02223 – Trenching, Excavation, Backfill and Compaction

1.3 DESCRIPTION OF SYSTEM

A. The constructed tank shall consist of circumferential prestressing strand, reinforcing steel, and earthquake cables with shotcrete cover.

1.4 CODES AND STANDARDS

A. All Codes, Standards, Specifications and Reports cited herein shall be considered the most current version of that document unless noted otherwise:

A. ACI 301 Specifications for Structural Concrete

B. ACI 305R for Hot Weather Concreting

C. ACI 306R for Cold Weather Concreting

D. ACI 309R Guide for Consolidation of Concrete

E. ACI 318 Building Code Requirements for Structural Concrete and Commentary

F. ACI 350 Code Requirements for Environmental Engineering Concrete Structures and Commentary

G. ACI 350.3 Seismic Design of Liquid-Containing Concrete Structures and Commentary

H. ACI 350.5 Specifications for Environmental Concrete Structures

I. ACI 372R Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures

J. ACI 506R Guide to Shotcrete

K. ASTM A123/A123M Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

L. ASTM A416 Standard Specification for Steel Strand, Uncoated Seven-Wire Stress-Relieved, for Prestressed Concrete

M. ASTM A475 Standard Specification for Zinc-Coated Steel Wire Strand

N. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

O. ASTM A706/A706M Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

P. ASTM A722/A722M Standard Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete

Q. ASTM A1060/A1060M Standard Specification for zinc coated (galvanized) steel welded wire reinforcement, plain and deformed, for concrete.

R. ASTM C31 Standard Practice for Making and Curing Concrete Test Specimens in the Field

S. ASTM C33 Standard Specification for Concrete Aggregates

T. ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

U. ASTM C173/C173M Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

V. ASTM C231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

W. ASTM C618, Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

X. ASTM C920 Standard Specification for Elastomeric Joint Sealants

Y. ASTM C1116/C1116M Standard Specification for Fiber-Reinforced Concrete

Z. ASTM D698 Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5lb Rammer and 12-inch Drop

AA. ASTM D1056 Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber

BB. ASTM D1556 Standard Test Method for Density of Soil in Place by the Sand-Cone Method

CC. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort [56,000 ft. – lbf/ft^3 (2700 kN-m/m^3)]

DD. ASTM D2000 Classification System for Rubber Products in Automotive Applications

EE. ASCE Standard 7 Minimum Design Loads for Buildings and Other Structures

FF. AWWA C652 Standard for Disinfection of Water Storage Facilities

GG. AWWA D110 Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks

HH. California Building Code (CBC)

II. US Army Corps of Engineers Specification CRD-C572, Specification for Polyvinyl-Chloride Waterstops

1.5 DESIGN CRITERIA

A. General

1. The prestressed concrete tank shall be constructed in accordance with the applicable provisions of AWWA D110, ACI 350, ACI 350.3, ACI 350.5, ASCE 7 and the CBC.

2. Horizontal prestressing shall be continuous. Discontinuous prestressing tendons or strands will not be allowed.

B. Tank Dimensions and Capacities

1. The Tank Contractor shall use the following tank capacities and tank dimensions for estimating purposes:

Tank Characteristic:	20B
Design Storage Capacity (note 1)	1.3 Million Gallons
Inside Tank Diameter	100 feet
Max Side Water Depth (note 2)	25 feet

Note 1: The indicated design storage capacity is the nominal "rated" tank capacity per the contract drawings.

Note 2: The indicated maximum side water depth is to tank overflow level and does not reflect sloshing during a seismic event.

1.6 SUBMITTALS

A. Construction Submittals shall be submitted for Review and Approval Prior to Use:

1. Design proportions for all concrete and shotcrete per this Section

2. Reinforcement detailing per this Section

3. Earthquake Cables per Section

4. Elastomeric materials per this Section

5. Vertical post-tensioning assemblies per this Section
   a. Certified mill certificates per ASTM A722
   b. Epoxy grout per this Section
   c. PT Ram Calibration certificate

6. Circumferential prestressing materials per this Section
   a. Certified mill certificate for each heat and coil per ASTM A416
   b. Certified galvanizing certificate
   c. Stressing system calibration certificate

7. Qualifications Statement. Submit contractor qualifications

8. NSF International (NSF Standard 61) approval letters for all materials in contact with the reservoir water. All materials in contact with the reservoir water shall be designed and manufactured specifically for reservoirs containing treated (potable) water, shall have

been satisfactorily demonstrated by prior use to be suitable for such use, and shall be approved by NSF 61 and any other regulatory agencies having jurisdiction for such use.

B. Contractor qualifications. The following information is required.

1. The name(s) of the proposed qualified superintendent who will be in direct charge of the reservoir construction for the full duration of the Contract.

2. An experience list of at least two AWWA D110 Type I prestressed concrete reservoir jobs successfully completed by each of the superintendents listed by the Contractor. The list shall include a reservoir description, the name and location of the Owner and the Consultant, and the approximate completion date of each reservoir while directly employed by the Contractor.

3. Descriptive literature of the strand wrapping, the vertical prestressing and the automated shotcrete machinery meeting all of these Specification requirements and a letter confirming the Tank Prestressor has two-strand wrapping and automated shotcrete machines meeting the requirements of the Prestressed Concrete Reservoir specification. Include in such data photographs or prints of the means of recording of both the circumferential and vertical prestressing applications and copies of actual photographs, print-outs or other records of applied wrapping forces (as well as force-elongation diagrams if available) taken from jobs in which the machinery has been used.

1.7 QUALIFICATIONS

A. Due to the critical nature of the project, it is the intent of these Specifications and Design Drawings to obtain a first-class product with emphasis on overall safety, quality, and quality control, both during and after the construction process. Only Contractors who have constructed in their own name strand wrapped prestressed concrete reservoirs are qualified to bid on and construct the reservoir portion of this project. The Contractor shall have successfully constructed in their own name at least two (2) AWWA D110 Type I circular prestressed concrete Reservoirs located within a region with a mapped spectral response acceleration, Ss, of 0.5g or greater in the past ten years. Tanks utilized as qualifying experience must have been 1.0 million gallons (MG) or larger. If the reservoir construction is subcontracted by the Contractor, the Reservoir Subcontractor shall be required to meet the above-specified experience qualifications.

B. All AWWA D110 Type I prestressed concrete reservoirs listed for the Reservoir Contractor's experience requirements must have been built in the Reservoir Contractor's own name.

C. The proposed reservoir construction superintendent shall be currently employed by the qualified Contractor and shall have been the reservoir construction superintendent on no less than two (2) AWWA D110 Type I circular prestressed concrete reservoirs of at least 0.5 MG or larger during the last five years, within a region with a mapped spectral response acceleration, Ss, of 0.5g or greater. The qualified reservoir superintendent shall have been in the direct employment of the qualified Contractor or Reservoir Subcontractor for both of the reservoirs listed and will be required to be on the project site in responsible charge, fulltime, during all reservoir concrete construction activities.

1.8 GUARANTEE

A. The Tank Contractor shall guarantee the structure against defective materials or workmanship for a period of one year from the date of completion. If any materials or workmanship prove to be defective within one year, they shall be replaced or repaired by the Tank Contractor at the Tank Contractor's expense.

B. A diving inspection shall be performed 11 months following the Owner's acceptance. Inspection shall be in accordance with AWWA D110-13 Section 6.4 Routine Inspections, and shall include, at a minimum, visual observations and dye testing. The dive inspection shall be led by a registered professional engineer-diver.

PART 2 – PRODUCTS

2.1 CONCRETE

A. Concrete shall conform to ACI 301.

B. Cement shall be Portland cement, Type II. Cement used in concrete mixtures which are in contact with potable water shall be NSF-61 certified.

C. Admixtures, other than air-entraining, superplasticizers, shrinkage reducing and water reducing admixtures, damp-proofing will not be permitted unless approved by the Engineer. Admixtures used in concrete mixtures which are in contact with potable water shall be NSF-61 certified.

D. A crystalline waterproofing/damp-proofing admixture, Penetron Admix (or approved equal), shall be added to the tank's roof concrete, wall footing concrete, floor and footing, and wall shotcrete. Admixture shall be added per the manufacturer's instructions for damp-proofing.

E. Concrete for all tank elements shall have a minimum compressive strength of 4,000 psi at twenty-eight days and a maximum water to cement ratio of 0.42 unless otherwise indicated on the contract drawings.

F. Concrete for the tank footings, pipe encasement, and all other work shall have a minimum compressive strength of 4,000 psi at twenty-eight days, shall not be air-entrained and shall have a maximum water to cement ratio of 0.42. Cement shall be Type II. Maximum slump shall be 4" (Maximum slump of 8" shall be permitted after introduction of a water-reducing admixture). Maximum aggregate size shall be 1-1/4". Maximum aggregate size for wall concrete shall be ¾". Weight of fine aggregates shall not exceed 42% of total weight of fine and coarse aggregates combined. Maximum allowable shrinkage at 28 days is 0.042% as measured in accordance with the methods and specifications of ASTM C157. Thoroughly consolidate concrete using mechanical vibrators in accordance with the methods and specifications of the latest addition of ACI 309R.

G. Proportioning for concrete shall be in accordance with ACI 301.

H. All concrete shall have a maximum water soluble chloride ion concentration of 0.06% by weight of cement.

2.2 SHOTCRETE

A. Shotcrete shall conform to ACI Standard 506R, except as modified herein.

B. The wet mix process shall be employed for shotcreting.

C. Shotcrete used for covering prestressed strand shall consist of not more than three parts sand to one part Portland cement by weight. Additional coats of shotcrete shall consist of not more than four parts sand to one part Portland cement by weight. Polypropylene fibers shall be included in the shotcrete used for the finish cover coat. Fibers shall be Fibercast 500 by Propex, Fibermesh or equal. Fibers shall be virgin polypropylene and comply with ASTM C1116 performance level I. Fiber length shall be ¼ inch. The amount of the fibers added to the shotcrete used for the finish cover coat shall conform to the Manufacturer's recommendations. Fly ash may be incorporated into the finish cover coat. Fly ash shall conform to ASTM C618, Type F. Shotcrete shall have a minimum compressive strength of 4,500 psi at twenty-eight days and have a maximum water-cement ratio of 0.42.

D. Rebound material shall not be reused in any form for shotcrete.

E. If used by the Tank Contractor, the total volumetric air content of the shotcrete before placement shall not exceed 7% (±1%) as determined by ASTM C173 or ASTM C231.

F. Fine Aggregates:

1. The fineness modulus shall be between 2.7 and 3.0. A well-graded coarse sand shall be used for all shotcrete applications.

2. The gradation for the fine aggregates shall adhere to Gradating No. 1 requirements listed in "Table 1.1.1 – Grading Limits for Combined Aggregates" of ACI 506R-16.

G. All shotcrete shall have a maximum water soluble chloride ion concentration of 0.06% by weight of cement.

2.3 REINFORCING STEEL

A. Reinforcing steel shall conform to ASTM A615, Grade 60, as shown on the contract drawings, meeting the requirements of ASTM A615. Welded wire fabric and weldable reinforcing steel shall conform to ASTM A1060 and ASTM A706, respectively.

B. Reinforcing steel shall be accurately fabricated and shall be free from loose rust, scale, and contaminants.

C. Reinforcing steel shall be accurately positioned on supports, spacers, hangers, or other reinforcements and shall be secured in place with wire ties or suitable clips.

D. Circumferential reinforcing shall be lap spliced as indicated on the contract drawings.

E. Continuous reinforcing through joints, where applicable, shall have a Class A galvanized coating.

2.4 BASE RESTRAINT (EARTHQUAKE) CABLES

A. Base restraint cables shall be hot-dip galvanized seven-wire strand and shall be manufactured in accordance with ASTM A416 prior to galvanizing, and ASTM A475 after galvanizing. Only seven-wire strand will be allowed.

B. Hot-dip galvanized seven-wire strand shall have a nominal strand diameter of 0.60 in. Strand having 0.60 inch diameter strand shall have a minimum ultimate strength (MUS) after galvanizing of 58.6 kips and a minimum yield strength at 1% extension of 52.74 ksi. All strand wires shall have a minimum weight of zinc coating of 0.85 oz/sq-ft.

C. Neoprene sleeves for base restraint cables shall be closed-cell conforming to ASTM D1056, Type 2, Class A, and Grade 3. The sleeves shall have a compression deflection limited to 25% at 9 to 13 psi, hardness of 60 to 80 durometer, a minimum tensile strength of 175 psi, a minimum elongation of 180%, and a maximum compressive set of 35%.

2.5 CIRCUMFERENTIAL PRESTRESSING STEEL

A. Steel for prestressing shall be galvanized seven-wire strand.

B. Galvanized strand shall meet the requirements of ASTM A416 with zinc coating for galvanizing meeting the requirements of ASTM A475. Each wire shall be individually hot-dip galvanized before being stranded. The minimum weight of zinc coating per unit area of uncoated wire surface shall be no less than 0.85 ounces per square foot.

C. Splices for horizontal prestressed reinforcement shall be ferrous material compatible with the reinforcement and shall develop the full strength of the strand. Strand splice and anchorage accessories shall not nick or otherwise damage the prestressing.

2.6 ELASTOMERIC MATERIALS

A. Sponge filler shall be closed-cell neoprene or rubber conforming to ASTM D1056, Type 2, Class A, and Grade 3. Compression deflection limited to 25% at 9 to 13 psi.

B. Polysulfide or polyurethane sealant will be a two or three component elastomeric compound meeting the requirements of ASTM C920. Sealants shall have permanent characteristics of bond to metal surfaces, flexibility, and resistance to extrusion due to hydrostatic pressure. Air cured sealants shall not be used.

C. The remaining voids below the wall, not taken up by the solid neoprene or natural rubber pads, shall be filled with closed cell rubber pads and soft mastic to ensure a substantially unrestrained free movement of wall.

2.7 EXTERIOR COATINGS

A. None.

2.08 APPURTENANCES

A. The Tank Contractor shall provide all appurtenances as shown on the contract drawings. Appurtenances shall include the following:

1. Interior Ladder: The ladder elements shall be made out of 316 stainless steel and all bolts of 316 stainless steel. Location as shown on the drawings. Cleaning and passivation:
    a. Following shop fabrication of stainless-steel members and bolts, clean and passivate fabrications at point of manufacture.
    b. Finish requirements: Remove free iron, heat tint oxides, weld scale and other impurities, and obtain a bright passive finished surface with no etching, pitting, frosting, or discoloration.
    c. Provide quality control testing to verify effectiveness of cleaning agents and procedures and to confirm that finished surfaces are clean and passivated:
        i. Conduct sample runs using test specimens with proposed cleaning agents and procedures as required to avoid adverse effects on surface finishes and base materials.
    d. Pre-clean, chemically de-scale ("pickle"), passivate, and final-clean fabrications in accordance with the requirements of ASTM A380:
        i. If degreasing is required before cleaning (pickling) to remove scale or iron oxide, cleaning with citric acid treatments is permissible; however, such treatments shall be followed inorganic cleaners.
        ii. Pickle and passivate stainless steel using a nitric acid solution in accordance with ASTM A380, Annex A2, Table A2.1, Part II.
        iii. Pickling by citric acid treatment or sulfuric acid treatment is not considered to satisfy the requirements of this Section.
    e. Inspect after cleaning using methods specified for "gross inspection" in ASTM A380. Improperly or poorly cleaned and passivated materials shall not be shipped and will not be accepted at the site.

2. Hatches: The security reservoir & roof door shall be model SRR-I as manufactured by USF Fabrication, Inc., or approved equal.

PART 3 – EXECUTION

3.1 SAFETY

A. Every precaution shall be taken to keep personnel and visitors outside the prestressing area.

B. At no time shall anyone stand in the line of stressed strand.

C. No personnel are allowed other than the prestressing crew, within 100 feet from the exterior tank wrapping operation. Additional precautions shall be taken by Tank Contractor should this specified clearance not be available.

D. Where access to the site by unauthorized persons is outside the Tank Contractor's control while prestressing work is in progress, Tank Contractor shall erect protective fencing.

E. Tank Contractor shall conform to, and enforce, all local and Federal OSHA safety rules and regulations.

F. The Tank Contractor shall submit a safety plan for approval.

3.2 ABRASIVE BLASTING

A. The exterior surface of concrete wall areas, which will receive strand-wrapped prestressing/shotcrete, shall be abrasively blasted by a mechanical etching or shot blast system combined with a vacuum recovery system, or a self-contained waterblasting system.

B. The surface shall be blasted sufficiently to remove all laitance, form oil, or other type coatings.

C. The surface shall be cut sufficiently to provide a good mechanical bond between the shotcrete covercoat and the concrete wall. The surface shall be cut to a minimum CSP5 profile, as established by the International Concrete Repair Institute (ICRI), over a minimum 95% of the area as measured over any one-foot-square area.

D. Systems that have not been used in the past to prepare circular tank wall surfaces for shotcreting and strand-wrapping or systems which rely on sandblasting or steel shot without a vacuum system will not be allowed.

E. All abrasive blasting shall be done to the satisfaction of the Engineer.

3.3 CONCRETE

A. All concrete shall be conveyed, placed, finished, and cured as required by pertinent ACI standards.

B. Weather Limitations:

1. Unless specifically authorized in writing by the Engineer, concrete shall not be placed without special protection during cold weather when the ambient temperature is below 35 degrees Fahrenheit and when the concrete is likely to be subjected to freezing temperatures before initial set has occurred and the concrete strength has reached 500 psi. Concrete shall be protected in accordance with ACI 306R. The temperature of the concrete shall be maintained in accordance with the requirements of ACI 301 and ACI 306R. All methods and equipment for heating and for protecting concrete in place shall be subject to the approval of the Engineer.

2. During hot weather, concreting shall be in accordance with the requirements of ACI 305R.

3. Placement of concrete during periods of low humidity (below 50%) shall be avoided when feasible and economically possible, particularly when large surface areas are to be finished. In any event, surfaces exposed to drying wind shall be covered with polyethylene sheets immediately after finishing, or flooded with water, or shall be water cured continuously from the time the concrete has taken initial set. Curing compounds may be used in conjunction with water curing, provided they are compatible with coatings that may later be applied, or they are degradable.

C. Finishes: The tank shall be given the following finishes:

1. The top of the wall footing shall receive a steel trowel or magnesium trowel finish.

2. Exterior shotcrete shall receive a natural gun /nozzle finish.

3. The roof shall receive a medium broom finish.

D. Curing: Concrete shall be cured using water methods, sealing materials, or curing compounds. Floor slabs shall be wet cured for seven days minimum. Curing compounds shall not be used on surfaces to which decorative coatings, mortar, or shotcrete is to be applied. Curing compounds used within the tank shall be suitable for use with potable water.

E. Testing:

1. For all concrete, five test cylinders shall be made for every 40 cubic yards. Two cylinders shall be tested at seven days, two at twenty-eight days, and one held as a spare.

2. Slump, air content and temperature testing shall be performed on each truck where cylinders are taken.

3. All initial concrete testing shall be in accordance with ASTM C31 and C39, at the expense of the Agency.

3.4 SHOTCRETING

A. Weather Limitations:

1. Shotcrete shall not be placed in freezing weather without provisions for protection against freezing. Shotcrete placement can start without special protection when the temperature is 35 degrees Fahrenheit and rising, and shall be suspended when the temperature is 40 degrees Fahrenheit and falling. The surface to which the shotcrete is applied shall be free from frost. Cold weather shotcreting shall be in accordance with ACI 506R, ACI 301 and ACI 306R.

2. Hot weather shotcreting shall be in accordance with the requirements of ACI 506R, ACI 301 and ACI 305R.

B. Coating Over Prestressing Strand:

1. Each prestress strand shall be individually encased in shotcrete. Shotcrete thickness shall be sufficient to provide a clear cover over the strand of at least 3/8 inch.

2. Finish cover coat shotcrete shall be applied as soon as practical after the last application of strand coat.

3. The minimum final shotcrete cover over the outermost prestressing strand layer shall be 1.5 inches.

C. Placement of Shotcrete:

1. Shotcrete shall be applied by automated shotcrete equipment using the wet mix process only. Nozzles shall be kept mounted on power driven machinery enabling the nozzle to travel parallel to the surface to be sprayed at a uniform linear or bi-directional speed. The nozzle shall be kept at a uniform constant distance from the surface, always insuring a right angle spray of the material to the surface. The high velocity impact shall be developed pneumatically by injecting compressed air at the nozzle.

2. For localized touchup, manually applied shotcrete is allowed. The shotcrete nozzle shall be held at a small upward angle not exceeding 5 degrees and constantly moving during application in a smooth motion with the nozzle pointing in a radial direction toward the center of the tank. The nozzle distance from the prestressing shall be such that shotcrete does not build up or cover the front face of the strand until the spaces behind and between the prestressing elements are filled.

D. Curing:

1. Shotcrete shall be cured using water curing methods, sealing materials or curing compounds at the option of the Tank Contractor. Curing compounds shall not be used on surfaces to which decorative coatings, mortar or shotcrete is to be applied. Curing compounds used within the tank wall shall be suitable for use with potable water. Intermediate layers of shotcrete shall be kept damp by water curing or other means no sooner than twelve hours after the shotcrete has been applied.

2. Water curing is not required should additional shotcrete be applied on the entire wall surface within the following twelve hours.

3. Completed shotcrete surfaces, which do not receive any additional coatings, may be water cured for a period of at least seven days by encapsulating the shotcrete inside of plastic sheeting.

E. Testing:

1. Testing of shotcrete shall be in accordance with ACI 506R, except as specified herein. One test panel shall be made for each of the following operations: strand cover and cover

coat. Test panels shall be made from the shotcrete as it is being placed, and shall, as nearly as possible, represent the material being applied. The method of making a test sample shall be as follows: A frame of wire fabric (1 foot square, 3 inches in depth) shall be secured to a plywood panel and hung or placed in the location where shotcrete is being placed. This form shall be filled in layers simultaneously with the nearby application. After twenty-four hours, the fabric and plywood backup shall be removed and the sample slab placed in a safe location at the site.

2. The sample slab shall be moist cured in a manner identical with the regular surface application. The sample slab shall be sent to the testing laboratory. Nine 3 inch cubes shall be cut from the sample slab and subjected to compression tests in accordance with current ASTM Standards. Three cubes shall be tested at the age of seven days, three shall be tested at the age of twenty-eight days, and three shall be retained as spares. Testing shall be by an independent testing laboratory, approved by the Engineer and at the District's expense.

3. At the Tank Contractor's option, testing of shotcrete applied with an automated process shall be in accordance with ACI 301.

3.5 PRESTRESSING

A. Circumferential Prestressing:

1. The circumferential stressing system shall produce a continuously, electronically (or substantial equivalent) monitored permanent stress or force recording along its full length as it is being applied and the stress variation in any strand at any point around the circumference shall not be greater than ± 1.5% of the ultimate strength of the steel. In addition to this recording, any system which deflects the tensioned prestressing material between the tensioning device and the wall after it has left the tensioning device shall provide a similar continuously monitored stress or force record along its full length as it is being applied to the wall. These recordings shall show that either before or after deflection the stress variation in the prestressing material at any point around the circumference shall not be greater than ± 1.5% of the ultimate strength of the steel.

2. No manual, individual or intermittent force readings taken on wrapped strand in full bodily contact with the wall will be accepted. Force readings based on anything other than instantaneous force readings, as the strand is being tensioned, and wrapped around the tank, will not be accepted. This requirement shall be strictly adhered to.

3. The prestressing system shall be capable of applying a continuous wrapped force at any point around the circumference within the specified tolerances. Circumferential stressing systems based on jack-operated cable or rod-type tendons will not be allowed.

4. Each coil of prestressing strand shall be temporarily anchored at sufficient intervals to minimize the loss of prestress in case a strand breaks during wrapping.

5. Minimum clear distance between prestressing strands is 3/8 inch. Any strands not meeting the spacing requirements shall be respaced. Prestressing shall be placed no

closer than 2 inches from the top of the wall, edges of openings, or inserts, nor closer than 3 inches from the base of walls or floors where radial movement may occur.

6. The band of prestressing normally required over the height of an opening shall be displaced into circumferential bands immediately above and below the opening to maintain the required prestressing force. Bundling of the prestressing strand shall be prohibited.

7. Ends of individual coils shall be joined by suitable steel splicing devices capable of developing the full strength of the prestressing strand.

3.6 DISINFECTION

A. The Tank Contractor shall, at the completion of tank construction, thoroughly clean the interior of the tank.

B. The Tank Contractor shall notify the Engineer prior to disinfecting the tank. Disinfection shall meet with the approval of the Engineer, AWWA C652, and the appropriate state agency.

C. The tank floor and interior of the wall shall be disinfected by using a solution of chlorine and water per Method 3 of AWWA C652.

D. Prior to placing the tank in service, a bacteriological test shall be taken, and successful results received. Testing shall be by an independent testing laboratory at the expense of the Agency.

3. 8 WATERTIGHTNESS TEST

A. General Requirements:

1. Prior to placing backfill to the tank, and the area surrounding the tank and appurtenant equipment required to isolate the tank from the distribution system, the tank shall be tested to determine watertightness. The tank shall be filled with potable water to the maximum level. Water will be furnished to the tank by the Agency. The test shall consist of visual inspection of the exposed walls, footings, appurtenant piping, and isolation valves for any leaks and by measuring the liquid level every twenty-four hours over a 72-hour period to determine if any change has occurred. If leaks are visually identified or if a change in the level of the tank is observed and exceeds the maximum allowance, the test shall be extended to a total of five days. Leaks visually identified shall be noted on the contract drawings and immediately brought to the District's attention. If at the end of five days no visual leaks are detected and the average daily change has not exceeded the maximum allowance, the test shall be considered satisfactory. See 3.8.2 Detailed Requirements below.

2. The liquid volume loss for a period of twenty-four hours shall not exceed $1/80^{th}$ of 1% of the tank capacity, 0.000125 x tank volume. If the liquid volume loss exceeds this amount, it shall be considered excessive, and the tank shall be repaired and retested.

3. Damp spots will not be permitted at any location on the tank wall. Damp spots are defined as spots where moisture can be picked up on a dry hand. All such areas shall be repaired as necessary.

4. Damp spots or standing water on the footing may occur upon tank filling and are permissible within the allowable volume loss. Measurable flow in this area is not permissible and shall be corrected.

C. Detailed Requirements:

1. The watertightness test shall be performed in accordance with AWWA D110. The allowable leakage shall be determined by ACI SPEC-350.1-22 with the reservoir being considered as a structure with floors that are monolithically placed (without joints) and designed to be shrinkage crack free.

2. Fill the hydraulic structure that is to be leak tested after completion of tank construction with water to the maximum operating liquid level. Filling shall not exceed 8 feet of water depth per 24-hour period. Filling shall be at a uniform rate over a 24-hour period with continuous monitoring. Repair any running leaks which appear during filling before continuing with the leak test.

3. After the structure has been kept full for 48 hours, it will be assumed for the purposes of the test that the absorption of moisture by the concrete in the structure is complete. Close all valves and gates to the structure and measure the change in water surface each day over a 72-hour period.

4. During the test period, examine exposed portions of the structure, and mark visible leaks or damp spots. Repair visible leaks or damp spots after dewatering. If the drop in water surface in a 24-hour period exceeds 1/80th of 1%, or 0.0125% of the normal volume of liquid contained in the structure, the leakage shall be considered excessive. Liquid level shall be measured using the proposed level transmitter. The level transmitter shall be installed and tested prior to leak testing.

5. The determination of surface moisture evaporation shall be aided with a 24-inch deep, white-colored, water-tight container with not less than 10 square feet of surface area exposure. Position container to experience environmental conditions similar to the structure being tested. Subtract the water loss due to evaporation from the measured water loss in the structure to determine the water loss due to leakage.

6. If the leakage is excessive, drain the structure, repair leaks and damp spots, and refill the structure and, again, test for leakage. Continue this process until the drop in water surface in a 24-hour period meets the test requirements.

7. Inspect the underdrain/footing system for evidence of leaks in floor slabs. If leakage is indicated, locate and repair.

8. Repair visible leaks and damp spots whether leakage exceeds the allowable leakage rate or not.

9. Make repairs and additional filling and testing (including the cost of water) at no additional cost to the District.

3.8 CLEAN-UP

A. The premises shall be kept clean and orderly at all times during the work. Upon completion of construction, the Tank Contractor shall remove or otherwise dispose of all rubbish and other materials caused by the construction operation. The Tank Contractor shall leave the premises in as good a condition as it was found.

END OF SECTION

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SECTION 03350
CONCRETE FINISHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete finishes for all horizontal and vertical concrete surfaces.
   2. Sealers, hardeners and curing compounds for concrete.

B. Related Sections:
   1. Section 03000: Cast-in-Place Concrete

1.2 REFERENCES

A. American Society of Testing and Materials (ASTM):

1.	ASTM C156	Test Method for Water Retention by Concrete Curing Materials
2.	ASTM C171	Specifications for Sheet Materials for Curing Concrete
3.	ASTM C309	Specification for Liquid Membrane-Forming Compounds for Curing Concrete
4.	ASTM C1028	Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
5.	ASTM D882	Test Method for Tensile Properties of Thin Plastic Sheeting
6.	ASTM E96	Test Methods for Water Vapor Transmission of Materials

B. Uniform Building Code (UBC), 1997 or latest edition.

C. "Evaluation Reports" published by the International Conference of Building Officials.

1.3 SUBMITTALS

A. Submit in accordance with Section 01300.

1.4 QUALITY ASSURANCE

A. Contractor Qualifications: Five years of experience exclusively providing concrete finishes on flat work and formed surfaces exposed finishes of the type required on this project. Use skilled cement finishers to perform all work.

B Regulatory Requirements: Comply with applicable requirements in the Uniform Building Code, adopted edition, including without limitation Chapters 10, 11, 11A and 11B.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONCRETE SURFACE FINISHES FOR SLABS AND PAVING

A. General:
   1. Finish slabs so they do not deviate more than 1/4-inch (6.3 mm) in 10 feet from a straight edge. Finish elevations to within 1/8-inch (3.2 mm) elevations shown or required to match adjacent existing conditions. Provide "as-built" slopes for drainage no less than those shown or specified. Slopes are shown on drawings.
   2. Finish edges and surfaces smooth, true and clean.

B. TROWEL FINISH:
   1. Applies to all slabs indicated to receive a Trowel finish.
   2. Complete the work required under "Preliminary Steps for Other Finishes."
   3. Apply a second steel troweling after the concrete has set sufficiently so mortar does not adhere to the edge of the trowel and sufficient pressure can be applied to further consolidate the surface.
   4. Apply a third steel troweling when the concrete has set sufficiently so the trowel produces a ringing sound. Apply sufficient pressure so the trailing edge of the trowel will produce a dense smooth surface without burning.
   5. Apply a fourth troweling and additional trowelings as required to produce a dense smooth finish.

C. DETAIL WORK: Applies to all concrete flatwork and to exposed top edges of all formed concrete.
   1. Edging Slabs: Tool a 3/8-inch radius on all exposed edges of slabs, curbs and other exposed horizontal edges unless a formed chamfered edge is called for. Repeat tooling with each floating or troweling operation.
   2. Apply a Trowel finish to the top of the formed walls, curbs and machine bases.

3.2 CONCRETE FINISHES FOR FORMED SURFACES

A. General:
   1. Complete all patching and finishing within 10 days after stripping forms.

B. FILLED FINISH:
   1. Remove fins, drips, runs and other projections by scraping. Correct offsets larger than 1/8-inch by power grinding a taper of at least 1:16.
   2. Fill solidly form tie holes and "bug" holes over 1/2-half inch in maximum dimension with cement mortar described in Part 2.
   3. Finish filled holes flush with adjacent surface of the wall.
   4. Keep surface damp for 48 hours.

3.3 COATINGS

A. See and 09910 for coatings.

END OF SECTION

SECTION 03462
PRECAST CONCRETE VAULTS

PART 1 - GENERAL

1.01 SCOPE

A. This section includes the materials and installation of precast concrete vaults.

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.

ACI 318 - Building Code Requirements for Reinforced Concrete

ASTM A 48 - Gray Iron Castings

ASTM A 615A615M Deformed and Plain Billet-Steel Bars for Concrete Reinforcement, Grade 60

ASTM C 478 - Precast Reinforced Concrete Manhole Sections

ASTM C 478M - Precast Reinforced Concrete Manhole Sections [Metric]

1.03 RELATED WORK SPECIFIFED ELSEWHERE

A. Dublin San Ramon Services District – Standard Procedures, Specifications, and Drawings

1.04 DESIGN REQUIREMENTS

A. Precast concrete vaults and access doors shall be designed for H-20 highway wheel loading.

1.05 SUBMITTALS

A. Submit manufacturer's catalog data on precast items. Provide details and dimensions of the vault including reinforcing steel, the thickness of concrete sections, and locations of the hatch, ladder, sump, and other required items.

1.06 PANEL VAULTS

A. Panel vaults, consisting of individually cast floor, wall and lid panels assembled on the project site, shall be used only where shown on the Approved Plans or as approved by the District Engineer.

1.07 DAMP-PROOFING

A. A damp-proofing material shall be applied to the exterior surfaces of precast concrete vaults when located at or below the water table or when moisture or seepage is indicated. Carboline 50WB or approved equal.

PART 2 - MATERIALS

2.01 PRECAST CONCRETE VAULT

A. Precast components and appurtenant materials shall be obtained from the manufacturers included on the Approved Materials List, shall be designed for H-20 highway loading, and shall comply with applicable portions of ASTM C 478 and the Standard Drawings.

B. Reinforcing steel shall conform to ASTM A 615, Grade 60. Installation of reinforcing steel shall conform to ACI 318. Welding of reinforcing steel is prohibited.

C. Precast vault components shall conform to the shapes and dimensions indicated on the Approved Plans. The minimum wall thickness shall be 150mm (6”).

D. Openings or "knockouts" in precast concrete vaults shall be located as shown on the Approved Plans and shall be sized sufficiently to permit passage of the largest outside dimension of pipe or fittings.

E. The precast vault base or floor slab shall incorporate a drain as shown on the Approved Plans. The drain shall be located on the vault floor so as to avoid conflict with the piping and appurtenances to be installed and shall not be located directly beneath the access ladder. The vault floor shall be constructed with a 2% slope to the sump.

2.02 CRUSHED ROCK BASE AND BACKFILL MATERIALS

A. Crushed rock base and backfill materials shall be in accordance with Section 02223.

2.03 CONCRETE

A. Concrete used for cast-in-place items shall be in accordance with Section 03000.

2.04 JOINT SEALING COMPOUND

A. Joint sealing material shall be a pre-formed, cold-applied, adhesive, rope-like, butyl rubber gasket to form a watertight seal between precast sections.

B. A-Lok Butyl Lok, ConSeal CS-102, Press-Seal Corporation Pro-Stik or approved equal.

2.05 MORTAR

A. Mortar used for finishing the joints between precast sections shall be in accordance with Section 03000.

2.06 PIPE PENETRATIONS

A. Adjustable-linked rubber seal devices shall be used to provide seals around pipe penetrations through precast concrete vaults.

B. Non-shrink grout shall be used to provide seals around pipe penetrations through precast concrete vaults instead of, or in addition to, adjustable-linked rubber seal devices when indicated on the Approved Plans or directed by the District Engineer. Non-shrink grout shall be in accordance with Section 03000.

2.07 REPAIR MORTAR AND EPOXY BONDING AGENT

A. Repair mortar and epoxy bonding agent shall be used to repair minor surface damage to precast concrete vault sections at the discretion of the District Engineer. Repair products shall be in accordance with Section 03000.

2.08 DAMP-PROOFING

A. Damp-proofing materials shall be in accordance with Section 03000 and shall be selected from the Approved Materials List.

2.09 VAULT ACCESS DOORS

A. Vault access doors shall be fabricated aluminum unless otherwise shown on the Approved Plans or directed by the District Engineer.

B. Access doors shall be equipped with stainless steel hardware, compression spring operators, an automatic hold-open arm with release handle, and a locking device. The frame shall incorporate a drain gutter with an outlet routed to the exterior of the precast lid.

C. All vaults shall have H-20 rated traffic doors.

D. Access hatches shall have provisions prevent water intrusion into the vault. A drip ring with a connection to pipe drain or equivalent drainage considerations shall be provided.

E. Vault hatch shall have recessed padlock clip behind hinged access door suitable for the District's preferred padlock.

F. Vault access doors shall be Bilco, USF, EJ or equal.

2.10 LADDERS

A. Ladders shall be aluminum (high strength 6061-T6 aluminum alloy), Type 304 stainless steel or fiberglass as shown on the plans or as directed by the District Engineer. Rung diameter shall be 1" minimum, with 12" between rungs, and 450mm (18") between ladder rails. Ladders shall have a minimum of three pairs of brackets for wall attachment. Ladders shall meet the requirements of CAL/OSHA and ANSI Standards.

B. Extendable handrails (ladder-ups) shall be(48" long when fully extended. The handrail shall have a telescoping tubular section that locks automatically when fully extended and a release lever to allow it to be returned to its lowered position. Handrails shall be 1½" square aluminum tubing.

C.

2.11 VAULT ACCESSORIES

A. The following accessories shall be installed in vaults as required. The detailed specifications for each item can be found in the Approved Materials List or within these Contract Documents.

1. Vault Access Door Switch (Intrusion alarm).
2. Floor Drain

PART 3 - EXECUTION

3.01 INSTALLATION

A. The vault base section shall be placed on a 6" thick minimum base of compacted crushed rock over undisturbed soils and shall be graded level to the elevation shown on the Approved Plans.

B. The concrete vault base section and successive precast sections will receive a joint sealing compound prior to setting the precast sections in place. The joint sealing compound shall be installed according to the manufacturer's recommendations to provide a watertight joint, which will remain impermeable throughout the design life of the structure. Following placement of the precast sections, the joints shall be mortared and tooled to a smooth finish, free of voids.

C. Assemble the precast sections to the elevation required by the location of the vault as follows:

1. Paved Areas: Top of cover shall be flush with the finished paving surface.
2. Traveled Way: Top of cover shall be flush with the existing surface where it is in a traveled way.
3. Shoulder Areas: Top of cover shall be 1" above the existing surface where outside the limits of a traveled way. Vaults shall not be placed in roadside ditches without the prior approval of the District Engineer.
4. Unpaved Easements: Top of cover shall be 6" above the ground surface. Guard Posts around the vault may be required in this area as directed by the District Engineer.

D. Secure the vault access door in accordance with the manufacturer's recommendations. Access doors shall be built up so that the hatch is installed as required. The Contractor is responsible for placing the cover at the proper elevation where paving is to be installed and shall make all necessary adjustments.

E. Adjustable-linked rubber seal devices providing seals around pipe penetrations through precast concrete vaults shall be assembled and installed in accordance with the manufacturer's recommendations.

F. Non-shrink grout providing seals around pipe penetrations through precast concrete vaults instead of, or in addition to, adjustable-linked rubber seal devices shall be installed in accordance with Section 03000.

G. Where vaults are to be given a protective coating, they shall be free of seepage and surface moisture.

H. After the vault and all appurtenances are in place and are approved by the District Engineer, backfill shall be placed to the original grade or to the limits shown on the approved plans. 1.00 cu ft of crushed rock shall be placed adjacent to the hatch gutter drain outlet.

I. Install ladders using Type 316 stainless steel anchors secured in place using an epoxy adhesive in accordance with Section 03000. If required, extendable handrails shall be mounted to the outside portion of the ladder railing.

J. Replacement of asphalt or concrete pavement shall be in accordance with the requirements of the agency having jurisdiction.

3.02 DAMP-PROOFING

A. Damp-proofing material shall be applied to the exterior surface of vaults in accordance with the manufacturer's recommendations and Section 03000.

END OF SECTION

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DIVISION 5 – METALS

SECTION 05220
CONCRETE BOLTS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

A. The Contractor shall provide concrete anchor bolts, inserts, complete, in accordance with the contract documents. Principal items are anchor bolts placed in concrete, adhesive anchors, and drilled anchors.

1.2 RELATED SECTIONS

A. The work of the following sections apply to the work of this section. Other sections, not referenced below, shall apply to the extent required for proper performance of the work.

1. Section 03200 Reinforcement Steel
2. Section 03300 Cast-in-Place Concrete
3. Section 05500 Miscellaneous Metals
4. Steel supports hangers, brackets and other miscellaneous items such as bolts accessory to mechanical and electrical installations indicated or detailed on the contract drawings and in Divisions 11, 13, 15 and 16 (where apply).

1.3 REFERENCE, SPECIFICATIONS, CODES AND STANDARDS

A. Except as otherwise indicated in this section of the specifications, the Contractor shall comply with the latest adopted editions of the Standard Specifications for Public Works Construction (SSPWC), together with the latest adopted editions of the Regional Amendments.

B. The latest edition of the California Building Code (CBC).

C. Federal Specifications (Current Edition):

MIL-A-907E	Antiseize Thread Compound, High Temperature

D. ASTM Standards in Building Codes (Current Edition):

ASTM A193	Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and other Special Purpose Applications
ASTM A194	Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A276	Specification for Stainless Steel Bars and Shapes
ASTM F593	Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs

ASTM F594 Specification for Stainless Steel Nuts

1.4 CONTRACTOR SUBMITTALS

A. An ICC Evaluation Service, Inc. report listing the ultimate load capacity in tension and shear for each size and type of adhesive concrete anchor used shall be submitted for review. The Contractor shall submit manufacturer's recommended installation instructions and procedures for all adhesive anchors for review and approval. The Contractor shall follow approved procedures during installation of concrete anchors.

B. No substitution for the indicated adhesive anchors will be considered unless accompanied with ICC Evaluation Services, Inc. report verifying strength and material equivalency, including temperature at which load capacity is reduced to 90 percent of that determined at 75 degrees F.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Anchor Bolts: Unless otherwise indicated, anchor bolts shall be fabricated of materials as follows:

1. Stainless steel bolts, nuts, washers ASTM F 593, Type 316
2. Stainless Steel nuts ASTM F594, Type 316
3. Plates and washers ASTM A276

B. Buried or Submerged Bolts: Unless other corrosion-resistant bolts are indicated, all bolts, anchor bolts, nuts and washers which are buried, submerged, or below the top of the wall inside any hydraulic structure shall be Type 316 stainless steel conforming to ASTM A193 for bolts and to ASTM A194 for nuts. All threads on stainless steel bolts shall be protected with an antiseize lubricant suitable for submerged stainless steel bolts, to meet government specification MIL-A-907E.

1. Antiseize lubricant shall be classified as acceptable for potable water use.
2. Antiseize lubricant shall be "PURE WHITE" by Anti-Seize Technology, Franklin Park, IL 60131, AS-470 by Dixon Ticonderoga Company, Lakehurst, NJ, 08733, or approved equal.

C. Bolt Requirements:

1. All bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series (where apply).
2. The length of all bolts shall be such that after joints are made up, each bolt shall extend through the entire nut, but in no case, more than 1/2 inch beyond the nut.

D. Epoxy Adhesive Anchors: Grout for epoxy adhesive anchors shall be as specified on the contract drawings. No substitutions will be considered unless accompanied with ICC evaluations Services, Inc., report verifying strength and material equivalency.

PART 3 - EXECUTION

3.1 FABRICATION AND INSTALLATION REQUIREMENTS

A. Fabrication and Installation: Except as otherwise indicated, the fabrication and installation of anchor bolts shall conform to the requirements of the American Institute of Steel Construction “Steel Construction Manual".

B. Install adhesive and drilled anchor bolts in accordance with method specified in the ICC evaluation report for manufacturer product.

3.2 INSPECTION

C. The Agency reserves the right to inspect all materials and workmanship covered in this section. Such inspections will not relieve the Contractor of its responsibility to furnish materials and workmanship in accordance with the specifications. If inspections indicate that the materials or workmanship are defective, the Contractor shall remove and replace the defective work at no additional cost to the Agency.

END OF SECTION

SECTION 05500
MISCELLANEOUS METALS

PART 1 - GENERAL

1.01 WORK OF THIS SECTION

A. The Contractor shall provide miscellaneous metals and appurtenances, complete, in accordance with the contract documents.

B. Work included in this section. Principal items are:

1. Shop/erection drawings and samples.
2. Ladders.
3. Metal grating.
4. Bolts (not including bolts associated with piping or pipe installation).
5. Shop prime paint.
6. Pipe rails and railings.
7. Pipe and conduit supports and bracing.
8. Embedded steel channel and angle frames.

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 03000 Cast-in Place Concrete
2. Section 03200 Reinforcement Steel
3. Section 03314 Strand Wound, Prestressed Concrete Tank
4. Section 05220 Concrete Bolts
5. Steel supports, hangers, brackets and other miscellaneous items such as bolts accessory to mechanical and electrical installations indicated on the drawings or covered in Divisions 11, 13, 15 and 16 (where applicable).

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Except as otherwise indicated in this section of the specifications, 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 Amendments.

B. The latest edition of the California Building Code (CBC).

C. Except as otherwise indicated, the current editions of the following commercial standards apply to the work of this section:

1. Commercial Standards:

Aluminum Design Manual	Aluminum Association
AISC 360	Specification for Structural Steel Buildings
AISC 301	Code of Standard Practice for Steel Buildings and Bridges
AISC	Steel Design Guide 27 – Structural Stainless Steel
AISI MANUAL	Cold-Formed Steel Design
AWS D1.1	Structural Welding Code – Steel
AWS D1.2	Structural Welding Code – Aluminum
AWS D1.6	Structural Welding Code – Stainless Steel
AWS QC1	AWS Certification of Welding Inspectors
NFPA 101	Life Safety Code

2. ASTM Standards in Building Codes:

ASTM A36	Specification for Structural Steel
ASTM A48	Specification for Gray Iron Castings
ASTM A53	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A123	Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A167	Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
ASTM A193	Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A194	Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High-Temperature Service
ASTM A276	Specification for Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A283	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A307	Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
ASTM A312	Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A320	Specification for Alloy Steel Bolting Material for Low-Temperature Service
ASTM A424	Specification for Steel, Sheet for Porcelain Enameling

ASTM A500	Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A536	Specification for Ductile Iron Castings
ASTM A563	Specification for Carbon and Alloy Steel Nuts
ASTM A569	Specification for Steel, Carbon (0.15 Maximum Percent), Hot Rolled Sheet and Strip Commercial Quality
ASTM A575	Specifications for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A786	Specification for Rolled Steel Floor Plates
ASTM B98	Specification for Copper-Silicon Alloy Rod, Bar and Shapes
ASTM B210	Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
ASTM B221	Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes
ASTM B438	Specification for Bronze-Base Powder Metallurgy (PM) Bearings (Oil-Impregnated)

3. Trade Standards:

Specifications for Stainless Steels as published by the Specialty Steel Industry of North America, Washington, DC.

Porcelain Enamel Institute, Inc.

1.04 CONTRACTOR SUBMITTALS

A. Shop Drawings: Shop drawings shall be submitted in accordance with Section 01300.

B. Layout Drawings: Layout drawings for grating shall be submitted showing the direction of span, type and depth of grating, size and shape of grating panels, seat angle details, and details of grating hold down fasteners. Load and deflection tables shall be submitted for each style and depth of grating used.

C. Product List and Product Data Sheets: A product list shall be submitted with product data sheets of intended shop coats.

1.05 QUALITY ASSURANCE

A. Miscellaneous metals shall be fabricated and erected in accordance with the latest edition of the AISC "Specification for Structural Steel Buildings", and "Code of Standard Practice for Steel Buildings and Bridges", except wherever there is a discrepancy between the contract drawings and this specification, the drawings shall govern.

B. Aluminum work shall be fabricated and erected in conformance with applicable requirements of the CBC and referenced standards of the Aluminum Association.

C. Continuous Inspections:

1. The Contractor shall perform all welding and high strength bolting of structural steel assemblies under the continuous inspection of a certified Special Inspector approved by the Engineer. Should such fabrication be performed in the shop of a licensed Fabricator approved by the Engineer, only the field welding and high strength bolting of structural steel assemblies will be required to be performed under continuous inspection of the certified Special Inspector.

2. The Contractor shall notify the Engineer at least 24 hours in advance of the needed inspection.

3. The Contractor shall provide copies of inspection reports to the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Steel: Steel shall conform to the following requirements:

1. Shapes, Plates, Bars: ASTM A36

2. Pipe, Pipe Columns, Bollards: ASTM A53, Type E or S, Grade B Schedule 40 unless noted otherwise.

3. Tubes: ASTM A500, Grade B

B. Stainless Steel: Unless otherwise designated or approved, stainless steel alloy types shall conform to ASTM A276 and ASTM A312 as follows:

1. Stainless steel plates, pipe and structural shapes: Type 316.

2. Stainless steel bolts, nuts and washers: Type 316L where connecting or bearing on aluminum.

C. Aluminum: Aluminum structural shapes shall be new and conform to applicable Federal Specification for 6061-T6 alloy and temper, unless otherwise noted. Aluminum pipe shall conform to Schedule 40 or greater.

2.02 LADDERS

A. Ladders: Ladders which may be partially or wholly submerged, or which are located inside a hydraulic structure, shall be entirely of fiber-reinforced plastic (FRP). All other ladders shall be of aluminum, or as otherwise indicated with skid resistant rungs.

B. Pop-Up Extensions: Ladders that do not have an exterior handhold shall be equipped with a pop-up extension. Pop-up extension device shall be manufactured of the same material and finish as the ladder with telescoping tubular section that locks automatically when fully extended. Upward and downward improvement shall be controlled by stainless steel spring balancing mechanisms. Units shall be completely assembled with fasteners for securing to ladder rungs in accordance with the manufacturer's instructions.

C. Fall Prevention Systems: The fall prevention system shall be provided for ladders used to ascend heights exceeding 20 feet unless otherwise indicated on the drawings. All necessary components shall be provided, including 2 safety belts for each fall prevention installation to provide a complete and fully operational fall prevention system. A rail extension shall be provided for each installation. At all locations where fall prevention systems are installed, a safety chain with a snap hook shall be permanently attached to the top of the ladder. The chain shall be long enough to allow a person to connect the belt to the chain while standing on the landing adjacent to the ladder. The chain and snap hook shall have a minimum allowable capability of 500 pounds. Safety belts shall fit a waist range from 23 inches to 54 inches. Safety rails and associated accessories shall match the ladder material.

2.03 METAL GRATING

A. General: Metal grating shall be of the design, sizes and types indicated. All grating shall be completely banded at all edges and cutouts using materials and cross section equivalent to the bearing bars. Such banding shall be welded to each cut bearing bar. Where grating is supported on concrete, embedded support angles matching grating material shall be used on all sides, unless indicated otherwise. Such angles shall be mitered and welded at corners. Grating shall conform to the following requirements:

1. All pieces of grating shall be fastened in two locations to each support.
2. Where grating forms the landing at the top of a stairway, the edge of the grating, which forms the top riser, shall have an integral nonslip nosing, width equal to that of the stairway.
3. Where grating depth is not given, grating shall be provided which will be within allowable stress levels, and which shall not exceed a deflection of 1/4 inch of the span divided by 180, whichever is less. For standard duty plank and safety grating, the loading to be used for determining stresses and deflections shall be uniform live load of the adjacent floor or 125 psf, whichever is greater or a concentrated load of 1,000 pounds.

B. Grating Materials: Grating materials shall conform to the following requirements:

1. Grating material shall be aluminum, welded steel, galvanized after fabrications or stainless steel as specified on the contract drawings. Cross bars shall be welded in position.
2. No single piece of grating shall weigh more than 80 pounds, unless indicated otherwise.
3. Cross bars shall be welded into position so that there is no movement allowed of bearing and cross bars.

C. Grating Fastening Devices: For metal gratings, either welded or mechanical attachments shall be used except where otherwise noted.

2.04 HATCHES

A. The security reservoir & roof door shall be model SRR-I as manufactured by USF Fabrication, Inc., or approved equal, with the size being specified on the plans.

1. Door leaf shall be 3/16-inch thick aluminum diamond plate reinforced for 150 psf. live load. The frame shall be 3/16-inch aluminum structural angle with 7/16-inch diameter holes for

bolting to curb or roof deck and have an extruded U-shaped EPDM rubber weatherseal gasket where the cover closes on the frame. The access door shall be equipped with a 316 stainless steel slamlock with fixed exterior and interior handles and interior padlock staple. A 316 stainless steel hold open arm with push/pull handle shall automatically keep the cover in its upright, open position. The door shall have a mill finish and hinges fabricated with aluminum lugs and 316 stainless steel pins. The door shall have stainless steel gas shocks to assist in opening the door and reducing the force during closing. Installation shall be in accordance with the manufacturer's attached instructions with others being responsible for providing an effective seal between the frame and the mounting surface. The door shall be manufactured and assembled in the United States. Manufacturer shall guarantee the door against defects in materials and workmanship for a period of ten years.

2.05 ROOF VENTS

A. Roof vents shall be Greenheck GRS-24 or approved equal.

2.06 BOLTS

A. Bolt Requirements: Bolts shall comply with the following:

1. Nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirement of the American Standard for Screw Threads. Bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.

2. The length of all bolts shall be such that after joints are made up, each bolt shall extend through the entire nut, but in no case more than 1/2 inch beyond the nut.

B. Standard Service Bolts (Except for Buried or Inside Tanks or Channels): Except where otherwise indicated, bolts, nuts and washers shall be cadmium-plated steel in conformance with Vista Irrigation City Standard Specifications and Approved Material List.

C. Bolts Buried or Inside Tanks or Channels: Unless otherwise indicated, bolts, anchor bolts nuts and washers which are buried, submerged or below the top of the wall inside any hydraulic structure shall be of Type 316 stainless steel.

2.07 SHOP PRIME PAINT

A. Shop Prime Paint: To ensure compatibility with deferred field-applied paint or coating systems for ferrous metals other than stainless steel, ductile iron, galvanized steel, and cast iron, provide surface preparations and use shop prime paint product and manufacturer as painting, or protective coating system intended for field application. Shop prime shall not be provided on portions of work immediately adjacent to intended field welds, nor portions intended for embedment.

PART 3 - EXECUTION

3.01 FABRICATION AND INSTALLATION REQUIREMENTS

A. Fabrication and Erection: Except as otherwise indicated, the fabrication and erection of structural steel shall conform to the requirements of the AISC "Steel Construction Manual".

1. The work of this section shall be coordinated with related trades. Particular attention is required for items to be embedded in concrete work. All punching and drillings, indicated or required, shall be provided for the attachment of other work to that of this section.

2. Compliance with Safety Requirements. Dimensions required for the fabrication and installation of handrails, ladders, grating, plate, pipe hangers etc. which are not shown on the drawings, shall conform to the Division of Occupational Health and Safety, General Industrial Safety Orders, State of California.

B. Protection: The Contractor shall provide and be responsible for protection and repair of adjacent surfaces and areas which may become damaged as a result of work in this section. Work performed hereunder shall be protected until completion and final acceptance of project by the Agency. The Contractor shall repair or replace all damaged or defective work to original specified condition at no additional cost to the Agency.

1. Finished floor surfaces and adjacent work shall be protected from damage. Concrete floors shall not be overloaded. Mobile equipment used in placing steel shall have pneumatic tires. Steel members shall not be placed directly on floors; pads of timber of other material shall be used for cushioning.

2. Where welding is done in proximity to glass or finished surfaces, such surfaces shall be protected from damage due to weld sparks, spatter or tramp metal.

C. Ladders: Ladders shall be fabricated of FRP (interior) or aluminum (exterior), with skid resistant rungs, as shown on the drawings. Ladder fabrication shall conform to requirements shown on the drawings and CAL/OSHA (and/or OSHA). Aluminum units shall have a flaw-free polish finish. Rails shall be extended where indicated. Aluminum units shall be secured with stainless steel anchoring devices. Fall prevention systems shall be provided on all ladders used to ascend heights exceeding 20 feet unless otherwise indicated on the drawings.

D. Pipe Rails and Railings: Pipe rails and railing shall be fabricated of stainless steel (316) or aluminum completed with stanchions, toe plates, welded and bolted fittings, attachments and expansion/contraction provisions true to size configurations to meet or exceed the requirements of CAL/OSHA and as shown on the drawings. The Contractor shall grind and polish welds flush and smooth. Curves, where indicated or necessary, shall be bent on a radius of not less than 5 inches.

1. Safety chains shall be 1/2 inch link chain of same material as the railing with stainless steel harness-type snap to meet or exceed the requirements of CAL/OSHA.

2. Provisions shall be made to drain water from rail systems by drilling weep holes in concealed locations at the lowest possible elevations.

E. Pipe and Conduit Supports and Bracing: Supports and bracing for pipe and conduit shall be fabricated and installed as detailed on the contract drawings and in accordance with the requirements described in the City of Upland Standard Specifications in a fully coordinated manner with the work of other trades. Where shown or indicated, hot-dip galvanizing using materials specified in this section. Unless otherwise indicated, members shall be shop primed with a rust-inhibitive primer.

F. Embedded Channel and Angle Frames: Embedded steel channel and angle frames shall have continuously welded joints. Exposed welds shall be ground flush. Hot-dip galvanizing shall be provided after fabrication.

3.02 WELDING

A. Welding Steel: Welding shall be performed in accordance with the "Structural Welding Code-Steel", AWS, D1.1, and current revisions, except where the Gas Metal Arc Welding (GMAW) process is used, the short-circuited mode shall only be used for light gauge material (12 gauge and lighter). Welders shall be qualified by tests in accordance with AWS B3.0.

B. Welding Aluminum: Welding shall be performed in conformance with AWS D1.2.

C. Welding Stainless Steel: Welding shall be performed in conformance with AWS D1.6

3.03 PAINTING

A. Painting: One or more shop coats of paint shall be given on all ferrous metals, except cast-iron, ductile iron, stainless steel and galvanized metals. Before priming, surfaces shall be thoroughly cleaned. Shop coats shall be allowed to dry before materials are loaded for delivery to the job site. After erection, all areas shall be painted where the shop coats have been rubbed off or omitted and all field bolding and welding areas as specified for shop priming.

B. Isolation of Dissimilar Metals: Aluminum members shall be isolated from contact with dissimilar metals, concrete and masonry to provide protection from electrolytic deterioration. The Contractor shall use non-absorptive tape or gaskets, a heavy brush coat of approved zinc chromate primer made with a synthetic resin vehicle or a heavy coat of approved alkali-resistant bituminous paint unless otherwise indicated on the contract drawings.

END OF SECTION

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

SECTION 07100
WATERPROOFING

PART 1 - GENERAL

1.1 SECTION INCLUDES

This section provides specifications for waterproofing systems as follows:

A. Self-adhering sheet membrane for earth faces of buried concrete or masonry walls.

B. Prefabricated drainage composite system for buried concrete walls to be used in conjunction with the self-adhering sheet membrane system.

1.2 SUBMITTALS

Prior to purchase or delivery of materials, contractor shall submit the following:

A. Complete descriptions and details of application procedures intended to be used for each system.

B. Provide samples of sheeting, membrane, drainage composite, and protection boards.

C. Provide complete manufacturer's product literature, including material data and recommended installation procedures.

1.3 GUARANTEES

A two (2) year materials guarantee shall be provided by the manufacturer for all materials specified and installed under the requirements of this section.

1.4 RIGHT OF REJECTION

The District shall have the right to reject all unsatisfactory work or material and require replacement of either or both at the expense of the contractor.

1.5 QUALITY ASSURANCE

A. Waterproofing system installer shall be acceptable to District. Installer shall be experienced and specialized in the installation of work similar to that required for this project, and shall be approved by the manufacturer of the waterproofing system to install the waterproofing systems.

B. Contractor shall provide the services of a representative of the waterproofing system manufacturer to provide field service during construction and to provide a final inspection of the waterproofing and drainage system assembly.

PART 2 - PRODUCTS

2.1 NOT USED

2.2 SELF-ADHERING SHEET MEMBRANE

Self-adhering sheet membrane waterproofing system shall be Miradri 860/861 as manufactured by Nicolan/Mirafi Group, Bituthene System as manufactured by W.R. Grace Construction Products, or an approved equivalent product.

2.3 PROTECTION BOARD

Except where drainage composite panels are provided, all waterproofed surfaces subject to backfill shall be protected by permanent placement of 1/8-inch minimum thickness protection board. Protection board shall be Sealtight Protection Course as manufactured by W.R. Meadows, Inc., Semi-Rigid Backfill Backer Board No. 501-A as manufactured by J&P Petroleum Products, or an approved equivalent product.

2.4 PREFABRICATED DRAINAGE COMPOSITE SYSTEM

Prefabricated drainage composite shall be Miradrain 6200 as manufactured by Nicolan/Mirafi Group, or an approved equivalent product.

PART 3 - EXECUTION

3.1 GENERAL

Waterproofing systems shall be installed in accordance with the instructions and recommendations of the system manufacturer, except as otherwise provided in the Contract Documents.

3.2 NOT USED

3.3 SELF-ADHERING WATERPROOFING MEMBRANE INSTALLATION

A. Scope: Provide waterproofing of earth faces of concrete or masonry walls from footings to finish grade, including exterior edges of slabs, flashings of penetrations, angles and joints or cracks.

B. Surface preparation: All surfaces shall be clean, free of excessive dampness, frost, dust, laitance or loose concrete, and films of oil or grease, curing compounds, or other substances which could affect the adhesion of membrane. All concrete and masonry surfaces shall be surface dry and cured for a minimum of fourteen days, free of voids, loose stones, and sharp protrusions.

C. Application:

1. Priming: Prime concrete surfaces with primer. Apply by brush or roller and allow to dry until tack-free. Apply only to the area to be covered in 24 hours, and if not covered with Bituthane membrane within 36 hours, reprime surfaces. Wood and metal surfaces need not be primed but must be clean, dry, free of grease, oil, dust, and other contaminants.

2. Membrane application: Conform strictly to manufacturer's printed directions. Apply membrane vertically in strips of 8 feet or less. For higher walls, apply in two or more sections with the upper section overlapping the lower by at least 2-1/2 inches. Membrane must be smoothed down over the entire area with heavy hand pressure or small roller, with the top and bottom edges finished with a troweled bead of mastic over the exposed edge.

    a. Seams in membrane must all overlap at least 2-1/2 inches and be completely and firmly rolled into full contact. Misaligned or inadequately lapped seams must be repaired with a patch of Bituthene membrane. At base of walls, membrane must be drawn down to the base of the wall or over the edge of the footing, rolled down firmly, and finished with a troweled bead of mastic at the edge of membrane.
    b. Corner details: Double cover all inside and outside corners using an initial strip of 12-inch minimum width, centered along axis of the corner. Then completely cover this strip by regular membrane applications.
    c. Projections and penetrations through membrane shall be double covered with Bituthane membrane for a minimum of 6 inches in each direction from the protrusion or penetration. Then membrane edges shall be liberally coated with mastic.
    d. Carefully inspect membrane before placing protection and backfill. Patch any holes or tears with Bituthane membrane. Also patch any misaligned or wrinkled seams with membrane.
    e. Exposed edges of partially completed membrane shall be finished with a troweled bead of mastic to prevent water from getting under the membrane before it is completely installed.
    f. Compatibility: The specified systems are generally incompatible with tars, pitches, and certain liquid waterproofing products and sealants. Care shall be exercised to avoid direct contact of the adhesive layer with such systems. Consult material manufacturers for recommendations for specific application.

D. Protection: Within five (5) days after installation, protect applied membrane surfaces subject to backfill by bracing of a 1/8-inch minimum thickness protection board. Exposed edges of membrane shall be covered with weather resistant flashing for protection of the polyethylene against damage and sunlight.

3.4 DRAINAGE PANEL INSTALLATION

A. Vertical Surfaces:

1. Over waterproofing membrane: Place the panel over the waterproofing membrane. Use two-sided tape or construction adhesive to secure the panel to the waterproofing membrane. Most methods used to secure protection board are acceptable. Tape or construction adhesive shall be provided by the waterproofing system manufacturer and shall be compatible with said system.
2. Connecting Adjacent Panels: Connect adjacent panels at the longitudinal edge by pulling the filter fabric back to expose the flange. The flangeless panel edge should be placed on top of the flange of the adjacent panel and butted dimple to dimple. Panel end attachments can also be completed by pulling the filter fabric back to expose two (2) rows of dimpled core. The end of the next panel may be placed over two (2) dimples and interlocked. All connections should be completed in shingle fashion so that moisture will flow with the overlap and not against it. Overlap fabric in the direction of water flow. Cover all terminal edges with the filter fabric flap by tucking in behind the core.

END OF SECTION

SECTION 07900
CAULKING AND SEALANTS

PART 1 – GENERAL

1.1 SCOPE

Seal all joints shown on drawings and elsewhere as required to provide a positive barrier against passage of air and water.

1.2 LOCATIONS OF USE

A. Caulking Compound: Use at joinery indicated on drawings.

B. Synthetic Polyurethane Base Sealant: Use at both exterior and interior faces, edges or perimeters of members, other than glass, occurring within or about exterior walls and/or surfaces.

1.3 COORDINATION WITH OTHER TRADES

Cooperate with other trades where caulking in involved. Coordinate the work of this section with all related trades.

1.4 GUARANTEE

A. The contractor shall deliver to the District a written guarantee on the form provided in Division 1, stating that the job will remain weather tight and watertight for a period of two years.

B. Defective work will be adjudged a failure due to leakage, hardening, cracking, crumbling, melting, shrinkage or running of the caulking compound or sealant, or staining to any adjacent work.

1.5 SUBMITTALS

Samples: Submit all products with descriptive literature and samples, per Section 01300 - Submittals.

1.6 STANDARDS

A. Comply with Federal Specification publications (Federal Specifications).

B. All products used on the interior of the tank or in contact with potable water shall comply with NSF-61.

PART 2 – PRODUCTS

2.1 CAULKING COMPOUND

Compound shall be acrylic latex based, conforming to Federal Specifications TT-C-598, Type or II as applicable.

2.2 SYNTHETIC POLYURETHANE BASED SEALANT

Compound shall be one-component, non-sag type, chemically curing conforming to Federal Specifications TT-S-230. Material shall be supplied in ready-to-use form. Compounds shall be non-toxic and non-staining. Colors shall be as selected by District. Use pour grade, self-leveling at joints where applicable. Provide "Vulkem," "Dow Corning," or equal.

2.3 SILICONE BASE SEALANT

Compound shall be one component material conforming to Federal Specifications TT-S-230, supplied on ready-to-use form. Compounds shall be non-toxic and non-staining. Color shall be clear or as selected by the District.

2.4 BACKSTOPS

Shall be glass fiber roping, or closed cell neoprene, or polyurethane foams free from oil or other staining elements. Oakum and other asphaltic base types of absorptive materials shall not be used as backstops for sealant.

2.5 BOND PREVENTIVE MATERIAL

Shall be polyurethane felt adhesive type as recommended by the manufacturer of sealant compound.

2.6 PRIMERS

Primers: Use primer wherever primer is required by sealant manufacturer.

PART 3 – EXECUTION

3.1 GENERAL

This specification is intended to be general in its scope as to where caulking or sealing is to be installed. The Contractor shall check all drawings and details and thoroughly familiarize himself with the extent of the caulking or sealing involved. Only a complete and absolutely watertight and weather tight job will be accepted. All sealant and caulking shall be applied in accordance with the recommendations of the manufacturer.

3.2 SURFACE PREPARATION

Surfaces shall be clean, dry, free of grease, oil, wax, lacquer, paint or other foreign matter. All joints shall be closed on three sides. Grooves for caulking shall be cleaned out to depth indicated. Prime as required.

3.3 BOND PREVENTIVE MATERIAL

Apply at back or bottom of joint cavities in which no backstop material is required, covering full width and length of joint cavity to allow for adhesion to opposite sides of joints only.

3.4 PROTECTION AND CLEANING

Areas adjacent to joints to be caulked shall be protected against smearing; paper masking tape may be used if removed after joint is filled and cured. Fresh compound that have been accidentally smeared on masonry shall be scraped off immediately and rubbed clean with recommended cleaning solvent.

3.5 APPLICATION OF COMPOUNDS

Apply in strict accordance with manufacturer's directions, using a gun with nozzle of proper size to fit joint width. Force compound into grooves with sufficient pressure to fill grooves completely. Material shall be uniformly smooth and free of wrinkles, and unless indicated otherwise, tooled and left sufficiently convex to result in a flush joint when dry.

END OF SECTION

SECTION 07920
JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in the following vertical surfaces and nontraffic horizontal surfaces:

a. Control and expansion joints in unit masonry.
b. Other joints as indicated.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of joint sealant required. Install joint sealants in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Product Certificates: Signed by manufacturers of joint sealants certifying that products furnished comply with requirements and are suitable for the use indicated.

E. Product Test Reports: From a qualified testing agency indicating sealants comply with requirements, based on comprehensive testing of current product formulations.

1.4 QUALITY ASSURANCE

A. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to joint substrates as follows:

1. Conduct field tests for each application indicated below:

a. Each type of elastomeric sealant and joint substrate indicated.

2. Test Method: Test joint sealants by hand-pull method described below:

a. Install joint sealants in 60-inch-long joints using same materials and

methods for joint preparation and joint-sealant installation required for the completed Work. Allow sealants to cure fully before testing.

b. Make knife cuts from one side of joint to the other, followed by two cuts approximately 2 inches long at sides of joint and meeting cross cut at one end. Place a mark 1 inch from cross-cut end of 2-inch piece.

c. Use fingers to grasp 2-inch piece of sealant between cross-cut end and 1-inch mark; pull firmly at a 90-degree angle or more in direction of side cuts while holding a ruler alongside of sealant. Pull sealant out of joint to the distance recommended by sealant manufacturer for testing adhesive capability, but not less than that equaling specified maximum movement capability in extension; hold this position for 10 seconds.

d. For joints with dissimilar substrates, check adhesion to each substrate separately. Do this by extending cut along one side, checking adhesion to opposite side, and then repeating this procedure for opposite side.

3. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.

4. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer.

2. When joint substrates are wet.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated for each type of sealant indicated.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Engineer from manufacturer's full range for this characteristic.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant in the Elastomeric Joint-Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.

B. Additional Movement Capability: Where additional movement capability is specified in the Elastomeric Joint-Sealant Schedule, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the specified percentage change in the joint width existing at the time of installation and remain in compliance with other requirements of ASTM C 920 for uses indicated.

C. Stain-Test-Response Characteristics: Where elastomeric sealants are specified in the Elastomeric Joint-Sealant Schedule to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Suitability for Contact with Water: Where elastomeric sealants are indicated for joints that will come in repeated contact with water, provide products that comply with NSF 61.

2.4 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

1. Type C: Closed-cell material with a surface skin.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.5 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a

clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.

2. Remove laitance and form-release agents from concrete.

3. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.

2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.

E. Install sealants by proven techniques to comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.

2. Completely fill recesses provided for each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3. Provide concave joint configuration per ASTM C 1193, unless otherwise indicated.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

END OF SECTION

DIVISION 9 – FINISHES

5SECTION 09810
POLYETHYLENE TAPE PIPE COATING (TAPE WRAPPED)

PART 1 - GENERAL

1.01 WORK OF THIS SECTION

A. The Work of this Section shall include, but not be limited to, furnishing all labor, materials, tools, testing, equipment performing all Work required for polyethylene tape pipe coating complying with AWWA C209 and AWWA C214 with a reinforced cement-mortar overcoat (rock shield) in accordance with AWWA C205 for steel pipe sizes 4 inches and larger.

B. Supervisors of tape coating and cement-mortar coating operations shall have at least two years continuous recent experience in the application of tape and cement-mortar coating systems for steel pipe. The manufacturer of the tape coatings shall demonstrate a minimum of five years successful application of this product on large diameter steel water pipelines.

1.02 RELATED WORK SPECIFICATIONS

A. Standard Specifications 02223, 09910, 13110, and Division 15

1.03 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section.

B. Reference herein to “SSPC Specifications” or “SSPC” shall mean the published standards of the Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburg, PA 15213.

C. Commercial Standards:

AWWA C200	Steel Water Pipe 6 inches and larger
AWWA C205	Cement-Mortar Linking and Coating for Steel Water Pipe 100 Mm (4") and Larger Shop Applied
AWWA C209	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines
AWWA C216	Heat Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections and Fittings for Steel Water Pipelines

1.04 SHOP DRAWINGS AND SAMPLES

The following shall be submitted in compliance with Section 01300 - Submittals:

A. Coating Materials List: The Contractor shall submit a list of the tape coating materials which indicates the manufacturer, product numbers, and thickness of the materials.

B. Materials Information: For each material, the Contractor shall submit technical data sheets which itemize technical and performance information that indicates compliance with this Section.

C. Samples: Samples of the materials shall be submitted for testing by the Engineer. Each sample shall be clearly identified for catalog number, size, color, and other information required for testing.

1.05 CONTRACTOR SUBMITTALS

The following shall be submitted in compliance with Section 01300 – Submittals:

A. Submit certificates of tests of physical and performance characteristics of each batch of primer and tape wraps.

B. Submit method approved by tape manufacturer to minimize voids at weld seams. Submit method approved by tape manufacturer to minimize disbondment of free ends of tape during shipping and storage.

C. Submit application procedure approved by tape manufacturer, including the pattern of distribution and method of application of the weld seam tape system.

D. Submit an affidavit of compliance with AWWA C209 and AWWA C214.

E. Submit schedule for application of tape coating. Schedule coating to be accomplished during normal working hours (if plant operates two shifts, working hours shall be discussed between manufacturer and the District's Representative). Provide a minimum two weeks notice to the District's Representative prior to commencing or rescheduling work.

F. Submit the names and qualifications of the workers and supervisors to be employed on the coating operation a minimum of 14 days prior to the start of taping operations.

1.06 COORDINATION WITH TAPE MANUFACTURER

A. The pipe manufacturer shall require the tape material manufacturer to furnish qualified factory technical representative to visit the project site for technical support at the beginning of the pipe installation as required to instruct the Contractor on appropriate tape application methods in the field or to resolve problems. This visit shall be coordinated to allow District staff to

participate in the instruction. The Contractor shall allow time for the representative to give field taping instruction to the workforce.

1.07 FACTORY AND FIELD INSPECTION AND TESTING

A. The Contractor shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture. The Contractor, however, will not be responsible for the District Representative's expenses, including travel, time, meals and overnight expenses.

B. The Contractor shall provide the District Representative a minimum of 14-days advance notice of the start of any shop coating work and a minimum of 3-days advance notice for field work.

C. Unless otherwise granted by the District Representative, all coating work shall be performed in the presence of the District Representative. All coating work done in the absence of the District Representative without prior approval shall be subject to rejection at no additional cost to the District.

D. The Contractor shall retain the services of trained technicians to test the coating system in the shop and field and prepare and provide the District Representative with reports at no additional costs to the District. As a minimum, the tests shall include holiday detection and coating film thickness.

E. Tape application to straight pipe sections shall be monitored using instrumentation devices that continuously measure and record the tape width drawdown and the tape temperature. Each tape application station shall be equipped with the instrumentation devices. The tape tensions and temperatures shall be controlled using the data obtained from the instrumentation devices.

F. The Contractor shall require the tape material manufacturer to furnish a qualified factory technical representative to visit the pipe coating shop for technical support at the beginning of the tape coating operation and as may be necessary to resolve shop or field problems.

G. Prior to application of the first layer of mechanical protection tape, the inner layer tape shall be electrically tested for coating flaws with a holiday detector approved by the District Representative. Holidays detected shall be immediately repaired and retested before application of the first layer of mechanical protection tape.

PART 2 - MATERIALS

2.01 POLYETHYLENE TAPE COATING

A. Provide polyethylene tape coating in accordance with AWWA C209, AWWA C214, and as specified herein. Furnish plant and field applied primer and polyethylene tape, and plant and field applied repair tape by a single manufacturer. Meet or exceed the physical properties of tape materials for plant and field application criteria listed when tested in accordance with the methods described in AWWA C209 and AWWA C214, Section 4.12, "Coating System Tests."

B. The exterior tape coating system shall consist of a primer on the blast cleaned bare metal surface of steel pipe, a multiple-layer cold-applied polyethylene tape coating system and a protective cement-mortar coating (rock shield) applied over the tape system. Tape width shall not exceed 12 inches regardless of pipe diameter. This system shall be applicable to:

   a. Plant applications on straight run of pipe.
   b. Plant applications on special sections, connections and fittings, and plant repairs of cold-applied tape.
   c. Field applications to pipe joints, field coated fittings and repair of field cold-applied tape.

2.02 PRIMER

A. Primer shall be comprised of 100 percent Butyl rubber with resins for adhesion, cathodic disbonding and stress corrosion cracking inhibitors. The primer shall be Polyken No. 1039, Polyken No. 1033A or District approved equal.

2.03 PLANT COLD-APPLIED POLYETHYLENE TAPE COATING SYSTEM FOR STRAIGHT RUN PIPE

A. Anti-corrosion inner layer tape shall be Polyken No. 989 or District approved equal with the following properties.

Tape Color:	Gray
Backing:	Consists of a 98% blend of high and low density polyethylene with the remaining portion a blend of colorants and stabilizers.
Adhesive:	Consists of a 100% Butyl based elastomers with resins for adhesion, cathodic disbonding, and long-term in-ground performance.
Thickness:	Total thickness 20 mils: Backing, 9 mils; Adhesive, 11 mils. Tolerance: -5%, + 10%.

B. First mechanical outer layer shall be Polyken No. 955 or District approved equal, with the following properties:

Color:	Black.
Thickness:	Total thickness 30 mils: Backing, 25 mils; Adhesive, 5 mils. Tolerance: -5%, + 10%.

C. Second mechanical outer layer shall be Polyken No. 956 UV1 or District approved equal, having ultraviolet radiation protection properties as follows:

Color:	White.

Thickness: Total thickness 30 mils: Backing, 25 mils; Adhesive, 5 mils. Tolerance: -5%, + 10%.

D. Total system shall be Polyken YGIII or District approved equal.

2.04 PLANT COLD-APPLIED POLYETHYLENE TAPE COATINGS FOR SPECIALS, FITTINGS, AND PLANT REPAIR OF COLD-APPLIED TAPE

A. Anti-corrosion inner layer shall be Polyken No. 932-50 or District approved equal. Total thickness 50 mils.

B. Mechanical layer outer tape shall be Polyken No. 955 or District approved equal. Total thickness 30 mils.

2.05 FIELD JOINT, FIELD COATED FITTINGS, AND FIELD REPAIR OF COLD-APPLIED TAPE

A. Joint filler tape to be Polyken No. 939 or District approved equal. Color to be black. Thickness 125 mils.

B. Field joint, field coated fitting, and field repair outer layer shall be Polyken No. 932-50 or District approved equal. Total thickness 50 mils.

2.06 HEAT SHRINKABLE PIPE JOINT SLEEVES

A. The sleeve shall consist of an irradiated and cross-linked polyethylene backing and a heat-activated adhesive layer that bonds to the pipe surface and common pipeline coatings such as polyethylene, polyurethane, FBE, and coal tar based coatings.

B. Sleeves shall be provided in strip form pre-cut to length by the manufacturer specifically for the pipe diameter on which it is to be used. The width of the sleeve shall be such that it will overlap the dielectric pipe coating by 3-inches on each side of the joint.

C. The product manufacturer shall demonstrate conformance with the current revision of ANSI/AWWA C216, Standard for Heat-Shrinkable Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.

D. The product manufacturer shall demonstrate that the sleeve will retain its corrosion protection properties when applied prior to internal joint welding. The manufacturer must demonstrate that the product has been tested on large-diameter pipe after three internal weld beads have been fully laid down.

E. Packaging shall protect individual sleeves from damage and prevent adherence to other sleeves or the packaging material. Store the product away from extremes in temperature and out of the rain or other moisture sources.

2.07 MORTAR OVERCOAT (ROCK SHIELD)

A. Cement shall be Type II, low alkali conforming to ASTM C150. Mortar overcoat thickness shall be ¾-inch minimum.

B. Sand shall conform to ASTM C33 with 100 percent of the sand passing through a No. 4 sieve.

C. Water shall be free of organic materials and shall have a pH of 7.0 to 9.0, a maximum chloride concentration of 500 mg/l, and a maximum sulfate concentration of 500 mg/l.

D. The coating shall be reinforced with a spiral wire reinforcement or welded wire fabric in accordance with ANSI/AWWA C205. The welded wire fabric shall be securely fastened to the pipe with welded clips of strips of steel. The wire spaced 2 inches on centers, shall extend circumferentially around the pipe. The ends of reinforcement strips shall be lapped 4 inches and the free ends tied or looped to assure continuity of the reinforcement. Wire shall be ungalvanized conforming to ASTM A185. Wire with excessive rusting shall not be used.

PART 3 - EXECUTION

3.01 GENERAL

A. Apply plastic tape coating in accordance with AWWA C209, AWWA C214, and as modified herein.

B. Certificate of Compliance: Prior to shipment of pipe, provide a certificate of compliance stating that tape materials and work for all pipe delivered complies with the requirements of these Specifications and AWWA C209 and AWWA C214. This certification shall be submitted by the pipe manufacturer and endorsed by the tape manufacturer.

C. The Contractor shall require the tape material manufacturer to furnish a qualified factory technical representative to visit the pipe coating shop for technical support at the beginning of the tape coating operation and as may be necessary to resolve shop or field problems.

D. The Contractor shall retain the services of a representative of the tape manufacturer to ensure that the application of tape to field joints and the coating repairs made in the field are done properly and in accordance with the manufacturer's recommendations.

E. Training Certification: The tape manufacturer shall submit certification that the Contractor has been properly trained to apply tape coatings in the field and that the procedures used by the Contractor in the field meet the tape manufacture's requirements. This certification shall be received by the District's Representative within two weeks of the beginning of pipe laying operations.

3.02 STRAIGHT RUN PIPE APPLICATION

A. Cold-applied polyethylene tape coating applied in the plant on straight run pipe shall be a four-layer system consisting of: (1) primer; (2) anti-corrosion inner layer tape; (3) mechanical protective tape (first outer layer); and (4) mechanical protective tape (second outer layer).

B. The application of cement-mortar lining, primer, tape coating, and cement –mortar coating shall be done at the same facility.

C. The pipe shall be of sufficient stiffness or have sufficient internal bracing to keep pipe cylindrical during taping. Maintain the axis of pipe during application without rocking, pitching, or yawing.

D. Perform the tape coating operation in an environmentally controlled area such that it is protected from direct sunlight, wind, rain, snow, mist, fog, dust, and hail.

E. Remove the exterior weld bead along the entire exterior surface of the pipe. The exterior weld bead shall be flush with the exterior surface of the pipe with a tolerance of plus 1/32 inch. Removal of the weld bead is to be conducted in such a manner that no gouging or nicking of the plate surface will occur. This operation is to result in a smooth exterior surface with no ridges or valleys which may result in bridging or disbonding of the tape from the surface of the pipe.

F. Surface preparation shall conform to AWWA C214 and the following:

1. Bare pipe shall be clean of all foreign matter such as mud, mill scale, dirt, organic matter, weld slag and splatter, wax, coal tar, asphalt, oil, grease, or any contaminants. Burrs, sharp edges, and weld spatter shall be removed prior to abrasive blasting.
2. Prior to blast cleaning, inspect surfaces and, if required, preclean in accordance with the requirements of SSPC SP-1, Solvent Cleaning, to remove oil, grease, and all foreign deposits. Remove visible oil and grease spots by solvent wiping. Use only approved solvents that do not leave any residue.
3. Include in the manufacturer's fabrication plan the cleaning solvent applications procedure and safety precautions. Preheating to remove oil, grease, and mill scale will not be permitted.

G. Blast cleaning shall conform to AWWA C214 and the following:

1. Immediately before application of the primer, abrasive blasting shall be performed using sand, metallurgical slag, or a combination of steel grit and shot to produce a surface in conformance with SSPC-SP6. Steel grit shall comprise of at least 60 percent of the working mix of abrasive, if a centrifugal wheel abrasive blaster is used. The prepared surface shall have a surface profile of a minimum of 2 mils, but not to exceed 4 mils.
2. For plant mortar-lined pipe, perform blast cleaning of pipe exterior surfaces after the initial curing of the spun mortar lining. Perform the exterior blast cleaning in such a manner as not to damage the mortar lining in the pipe. Completely remove corrosion and

foreign substances from the exterior of the pipe in the blast cleaning operation, and apply primer immediately after completion of blast cleaning.

3. Abrasive blasting and primer application shall be done when the substrate surface is at least 5 degrees F above the dew point.
4. Inspect the blast cleaned exterior of each pipe section for adequate surface preparation prior to application of the primer. Surface comparitor tapes are to be used by the pipe manufacturer in three (3) random areas along any given 40-foot length of pipe. The results of the surface comparitor tapes are to be included in the quality control records.
5. Coat each pipe section with primer and tape within the same day of being blast cleaned. Do not allow blasted and/or blasted and primed pipe to sit overnight. All blasted and primed pipe must be coated by the end of the day. No coating will be permitted on pipe sections showing evidence of rust.

H. Primer application shall conform to AWWA C214 and the following:

1. Apply the primer in a uniform thin film at the coverage rate and thickness recommended by the manufacturer. Apply the inner layer of tape only after the primer is dried as specified by the tape manufacturer.
2. Apply primer only to those sections of pipe that can be taped within the same workday. Pipe coated with primer which was not taped within the same workday may be rejected at the discretion of the District's Representative. The primer shall be removed from rejected pipe sections and the surface shall be re-primed.
3. Protect primer-coated pipe sections from moisture, dirt, sand, and other potentially contaminating materials. Suspend primer application operations or provide full protection for the pipe during high wind periods. Pipe sections not adequately protected shall be rejected by the District's Representative. If rejection occurs due to contamination of the primer, completely remove the primer from the exterior of the pipe section and re-application of the primer will be required.
4. Store, mix and apply primer in strict compliance with the manufacturer's recommendations.

I. Application of Tape

1. Pipe shell temperature shall be maintained within a range of 45 degrees F to 100 degrees F during application of the tape system.
2. Inner layer tapes shall be maintained at a minimum temperature of 70 degrees F during application. Middle and outer layer tapes shall be maintained at a minimum temperature of 90 degrees F during application.
3. Tape application tension shall be maintained at a value that produces a tape width reduction equal to 1.0 to 2.0 percent of the tape width during application, as recommended by the tape manufacturer. This width reduction shall be maintained simultaneously with the minimum tape temperature.
4. At the point of tape application, all tape, including weld stripping tape, shall be pressed onto the pipe with a pressure roller that maintains a constant pressure. Enough pressure shall be used to fully bond the tape at welds.

5. Filler tape shall be used at lap joints, weld step-downs, and other discontinuities.
6. The tape application equipment and materials shall result in a fully bonded tape coating system, without blisters, voids, wrinkles or any areas that have a lack of bond to the pipe.
7. Succeeding layers of tape shall be applied so that the laps are staggered by at least 2-inches.
8. Before tape application, the primer shall be dried sufficiently so that the primer is in a tacky to dry condition.
9. Primer shall be applied while it is in a temperature range of 50 to 80 degrees F, using airless spray equipment and a drum agitator. The primer application shall be uniform thickness on all pipe surfaces.

J. Mortar Overcoat (Rock Shield):

1. Apply 3/4 inch thick cement-mortar overcoating in accordance with AWWA C205 immediately after the application of the tape coating layers. Allow 3-1/2-inch cutback beyond the edge of the tape coating to the cement mortar overcoat at each pipe end or where field joints occur. Ends of the coating shall be left squared and uniform. Feathered or uneven edges will not be permitted.
2. Defective coatings, as determined by the District's Representative, shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective coatings shall be cut back to a square shoulder in order to avoid feather-edge joints.
3. The progress of the application of mortar overcoat shall be regulated in order that all hand work, including the repair of defective areas is cured in accordance with the provisions of AWWA C205. Cement mortar for patching shall be the same material as the mortar for machine coating, except that a finer grading of sand and mortar richer in cement shall be used. Field inspections indicate that such mix will improve the finished coating of the pipe.
4. Allow the mortar to take initial set before the pipe section is removed from the coating fixture and placed on rollers or timbers.

3.03 FITTINGS COATED AT THE PLANT

A. Coat fittings which cannot be machine coated in accordance with AWWA C209 using materials as specified herein. Weld bead preparation, surface preparation, blast cleaning, primer and tape application shall be as specified for straight run pipe. Apply an inner layer tape of Polyken No. 932-50 or District approved equal, with a 1-inch nominal, 3/4-inch minimum, tape overlap on all plant coated fittings. Apply an outer layer of cold-applied polyethylene tape as specified herein with a 55 percent overlap on all plant coated fittings. Provide a minimum thickness of 110 mils for the total tape coat system for plant coated fittings.

B. Test all completed tape coated fittings in the presence of the District's Representative with an electrical holiday detector prior to installation of cement-mortar coating. Applied voltage shall be in the range of 11,000 to 15,000 volts. Repair any holidays found.

C. Follow the procedure described herein for field tape coating repairs on fittings and for coating field joints.

D. Apply cement-mortar coating in accordance with AWWA C205 immediately after completion of tape coating, holiday testing indicating no holidays and inspections.

3.04 COATING OF FIELD JOINTS USING COLD-APPLIED POLYETHYLENE TAPE

A. Field cold-applied polyethylene tape coating shall be in accordance with AWWA C209, as modified herein.

B. Protect the tape coating from heat and weld splatter damage at welded joints by wrapping an 18-inch-wide strip of heat resistance material completely around the coated pipe sections covering the exposed tape on each side of the joint prior to welding. Do not use the coated portion of the pipe for grounding.

C. For exterior welded lap joints, remove the storage primer and wire brush areas to be welded immediately prior to welding.

D. No field tape coating will be permitted until the welding has been completed and the pipe section has cooled sufficiently so as to not damage the integrity of the tape coating system.

E. Do not permit trapped air under the tape in the joint.

F. After joint welding, remove flash rusting by mechanical means, such as a wire brush. Wire brush the weld, storage primed steel and all exposed steel. Remove all burrs and weld slag to achieve a smooth surface.

G. Clean the pipe surface free of dirt, mud, mill scale, wax, tar, grease, or any foreign matter. Remove visible oil or grease using an approved solvent that will not leave any residue on the pipe surfaces. The pipe surface shall be free of any moisture and all foreign matter prior to the application of primer.

H. Pack irregular surfaces in the joint with elastomeric joint filler.

I. Apply primer immediately after surface is cleaned by brush or roller (4 mils wet, 1 mil dry). Overlap primer onto plant applied tape coating.

J. After primer has dried, apply tape to the joint and extend a minimum of 3 inches onto the plant applied tape coat. End splices shall be a minimum of 6 inches and shall be staggered. Maintain 55 percent overlap on all field joint tape to produce a minimum thickness of 100 mils.

K. Apply tape with sufficient tension to conform to the surface irregularities. The finished tape wrap shall be smooth and wrinkle-free.

L. Test the final applied joint tape coating in the presence of the District's Representative with an electrical holiday detector. Repair all holidays and physical damage to the final applied tape coating prior to application of the mortar coating.

M. Apply mortar joint coating and reinforcement over tape coating using fabric diapers to retain the mortar. Apply the mortar coating immediately upon completion of tape wrapping, testing and inspections. Mortar at field joints shall overlap the shop-applied mortar overcoat a distance of not less than 5 inches. The thickness of the mortar shall be 3/4 inch minimum.

3.05 COATING OF FIELD JOINTS USING HEAT-SHRINKABLE PIPE JOINT SLEEVES

A. Protect the tape coating from heat and weld splatter damage at welded joints by wrapping an 18-inch-wide strip of heat resistance material completely around the coated pipe sections covering the exposed tape on each side of the joint prior to welding. Do not use the coated portion of the pipe for grounding.

B. For exterior welded lap joints, remove the storage primer and wire brush areas to be welded immediately prior to welding.

C. No field tape coating will be permitted until the welding has been completed and the pipe section has cooled sufficiently so as to not damage the integrity of the tape coating system.

D. Do not permit trapped air under the tape in the joint.

E. After joint welding, remove flash rusting by mechanical means, such as a wire brush. Wire brush the weld, storage primed steel and all exposed steel. Remove all burrs and weld slag to achieve a smooth surface.

F. Pack irregular surfaces in the joint with elastomeric joint filler.

G. Clean the exposed steel and adjacent pipe coating to remove all dirt, mud, mill scale, wax, tar, grease, oil, and other surface contaminants. Remove visible oil or grease using an approved solvent that will not leave any residue on the pipe surfaces. Wire brush the steel surface to remove all sharp edges and weld splatter. Lightly abrade the pipe coating with course sandpaper to a distance of 2 inches beyond the end of the sleeve or up to the mortar over coating.

H. The edges of bell ends or butt-strapped joints shall be beveled to remove sharp edge. Apply a compatible mastic filler tape to provide a 2:1 slope to create a smooth transition across the step. More than one strip of filler tape may be required. The tape shall be pressed into the joint to eliminate voids.

I. Two workers shall apply heat to the pipe surface from opposites sides of the pipe using a minimum 300,000 BTU propane torch with a flame spreader tip. The target pipe steel

temperature of 140 degrees (F) and 100 degrees (F) for the coating. Apply sleeve quickly after heating to minimize heat loss.

J. Roll up strip from both ends and center over top of pipe. Center the sleeve over the weld such that it overlaps the pipe coating by 3-inches on both sides. Allow material to drape over both sides of pipe.

K. Adjust the sleeve so that the two ends meet at the 4 o'clock position. Pull the lower section of material around the bottom quadrant of the pipe and bring up to meet the other end.

L. Ensure the circumference of the sleeve is pressed down so that a gap of no more than 1 inch is present between the sleeve and the pipe at the bottom.

M. Test the final applied joint tape coating in the presence of the District's Representative with an electrical holiday detector. A properly completed application will have no trapped air pockets and no scorched or overheated areas. Repair all holidays and physical damage to the final applied tape coating prior to application of the mortar coating.

N. Apply mortar joint coating and reinforcement over tape coating using fabric diapers to retain the mortar. Apply the mortar coating immediately upon completion of tape wrapping, testing and inspections. Mortar at field joints shall overlap the shop-applied mortar overcoat a distance of not less than 5 inches. The thickness of the mortar shall be 3/4inch minimum.

3.06 INSPECTION OF TAPE COATING

A. Inspection: The District's Representative shall have access to witness the application of coatings on all pipe sections at his or her discretion.

1. Provide the District's Representative with reasonable facilities and space at the pipe fabrication plant for the inspection and testing of the pipe coating. Assist the District's Representative in obtaining any information required to determine the characteristics of the material to be used. Furnish to the District's Representative at least two electrical pipe coating flaw detectors at the plant and one electrical pipe coating flaw detector per pipe installation heading in the field to aid in the inspection of the tape coating.
2. Provide free access to the District's Representative to plants of the manufacturer furnishing the materials and to mill or the worksite.

B. Holiday detection for tape coating:

1. Prior to the application of the mechanical outer layer tapes, electrically test the inner layer tape for any flaws in the coating with a suitable holiday detector as approved by the District's Representative. The detector shall impress a voltage conforming to NACE Standard RP-02. The voltage to be used to electrically test the tape shall be fully documented.

2. Clearly mark all holidays electrically or otherwise detected and immediately repair. Do not start wrapping the first mechanical outer layer tape until all detected holidays have been repaired. Perform repairs per tape manufacturer's recommendations. After the repair, retest the affected areas with the holiday detector prior to the application of the outer layer wrap. This process will be done until the coating has successfully passed the test.

3.07 PROTECTING COATED PIPE

A. The mortar overcoat provides mechanical protection for the underlying tape coating; however, normal precautions are required to protect the mortar from damage and additional care must be taken to protect the exposed tape at the ends of each pipe section. At the fabrication plant, handle the coated pipe sections only after application of the cement-mortar coating using minimum 12-inch-wide belt slings with spreader bars or padded forklifts.

B. While laying tape coated steel pipe, the pipe shall not be rolled or skidded when it is in contact with the ground at any point. Immediately before the coated pipe is lowered into the trench the Contractor shall provide a visual and holiday inspection of the coating on the entire pipe coating system. The use of chains, hooks, or other equipment which might damage the pipe coating will not be permitted. All other pipe handling equipment and methods shall be approved by the Engineer. Pipe stored alongside of the trench shall be supported on padded skids, sand bags, or rock-free sand berms.

END OF SECTION

SECTION 09910
FIELD PAINTING AND COATING

PART 1 - GENERAL

1.01 SCOPE

A. This section includes materials and field application of painting and coating systems for exposed surfaces.

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 C 210 - Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines

AWWA C 218 - Liquid Coating Systems for the Exterior of Aboveground Steel Water Pipelines and Fittings

SSPC - Steel Structure Painting Council

1.03 RELATED WORK SPECIFIFED ELSEWHERE

A. Dublin San Ramon Services District – Standard Procedures, Specifications, and Drawings

1.04 RESTRICTION ON CONTACT WITH POTABLE WATER

A. Under no circumstances shall paint materials specified in this Section be used where they may come in contact with the public water supply or for buried installations. These products are intended for exposed exterior use only.

B. Painting and coating materials in contact with potable and recycled water or for buried installations shall be in accordance with Section 15000.

1.05 QUALITY CONTROL

A. Notify the District 48 hours in advance of field operations involving surface preparation and coating application.

B. The District will inspect shop-and field-prepared surfaces. The Contractor shall not proceed with paint application until the surface preparation has been approved by the District Engineer.

C. The District will inspect application of all prime, intermediate, finish, and touch-up coatings to verify the integrity of the coating and compliance with the specifications. Each coating application will be checked and deficiencies marked. Items exhibiting an improper finish or color, or insufficient surface preparation or dry film thickness shall be prepared as necessary and corrected, utilizing the specified paint materials to obtain compliance.

1.06 SURFACES NOT TO BE FIELD PAINTED

A. Generally, the following items or materials are not to be field painted unless specifically required elsewhere in the specifications:

1. Buried mortar-coated pipe and fittings.
2. Stainless steel.
3. Interior surfaces of valves, fittings and pipe.
4. Nameplates.
5. Grease fittings.
6. Brass, copper, bronze, or galvanized items except as required for recycled water system identification.
7. Buried pipe and appurtenances except as required in the piping specifications.

1.07 COLOR AND PAINT SYSTEM SCHEDULE

ITEM	COLOR	PAINT SYSTEM
Blow Off Box Lids	Blue	Acrylic Traffic Paint
Gate Well Lids	Blue	Acrylic Traffic Paint
Air/Vac Assemblies	Blue	Acrylic or Epoxy/Urethane
Air/Vac Enclosures	White	Acrylic or Fusion Bonded Polyester
Water Test Station Enclosures	White	Acrylic or Fusion Bonded Polyester
Bollards	Safety Yellow	Acrylic or Epoxy/Urethane
Vault Piping	Blue	Acrylic or Epoxy
Above Ground Piping	Blue	Acrylic or Epoxy/Urethane

PART 2 - MATERIALS

2.01 GENERAL

A. Coating products and colors shall be selected from the tables above and the Approved Materials List.

B. All materials of a specified paint system(s), including prime, intermediate, finish, and touch-up coats shall be provided by the same manufacturer.

C. Thinners, cleaners, driers and other additives shall be as recommended by the coating manufacturer for the specified paint system(s) and shall be approved by the District Engineer.

D. All coating products shall be delivered to the job site in original and unopened containers.

2.02 EPOXY PAINT SYSTEM

A. Prime, Intermediate, Finish and Touch-Up Coats: VOC-compliant, two-component, chemically cured epoxy.

2.03 EPOXY/URETHANE PAINT SYSTEM

A. Prime and Intermediate Coats: Field-applied, VOC-compliant, surface tolerant, two-component, chemically cured epoxy.

B. Finish and Touch-Up Coats: Field-applied, VOC-compliant, two-component, chemically cured aliphatic urethane semi-gloss enamel.

2.04 ACRYLIC PAINT SYSTEM

A. Acrylic Paint System may be either solventborne or waterborne as described below:

1. Solventborne Acrylic Paint System:
   a. Prime, Intermediate, Finish and Touch-Up Coats: Field-applied, VOC-compliant, solventborne acrylic paint.
2. Waterborne Acrylic Paint System:
   a. Prime, Intermediate, Finish and Touch-Up Coats: Field-applied, VOC compliant, waterborne acrylic paint.
3. Sherwin Williams DTM acrylic or approved equal.

2.05 FUSION BONDED POLYESTER

A. PRIMERS

1. Powder Epoxy Primer: Primer shall be a one-part, fusion-bonded, heat-cured, thermosetting 100% solids, zinc-rich, dry powder epoxy resin.

B. FINISH COAT

1. Polyester Powder: Powder finish coat shall be a high gloss thermosetting fusion-bonded, 100% solid, dry powder TGIC-Polyester resin.
2. Thinners, cleaners, dryers, and other additives shall be as recommended by the coatings manufacturer for the specified system. Any deviation from the manufacturer's recommendations shall be approved in writing by the Engineer prior to starting work.
3. All coatings, thinners, pigments, and other materials to be used on potable water service shall have FDA approval for use with potable water.

PART 3 - EXECUTION

3.01 LIMITATIONS TO THE APPLICATION OF COATINGS

A. Apply coatings in accordance with the manufacturer's recommendations. Do not apply coatings under adverse weather conditions. If any of the following minimum conditions are present, the application of coatings shall be delayed or postponed until conditions are favorable.

1. During rain, fog, or mist, or when the relative humidity exceeds 80 percent.
2. When the surface to be coated is wet, moist, or contaminated with any foreign matter.
3. When the surrounding air temperature or the temperature of the surface to be coated is below 13° C (55° F).
4. When the temperature of the surface to be coated is more than 2.8° C (5° F) below the air temperature or when the surface temperature is 49 C (120° F) or above.

5. When the surface temperature is less than 2.8° C (5° F) above the dew point or is expected to be so within twelve hours after application of coating. If a change in weather conditions results in damage to a newly applied coating, restore the affected coatings to their specified condition as directed by the District Engineer.

3.02 PROTECTION OF SURFACES NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, nameplates and other surfaces not intended to be painted. Protect working parts of mechanical and electrical equipment from damage during surface preparation and the painting process. Provide drop cloths or masking to prevent paint materials from dripping or accumulating on adjacent surfaces.

3.03 FIELD TOUCH-UP OF SHOP-APPLIED PRIME COATS

A. Prior to field touch-up, prepare the surface in accordance with the manufacturer's recommendations and as directed by the District Engineer.

B. Reapply primer as required to cover all scratched, abraded, or deficient areas.

3.04 SURFACE PREPARATION

A. Do not prepare more surface area than can be coated in the same workday.

B. Always refer to manufacturers' surface preparation requirements prior to preparing surface.

C. Surface preparation shall conform to the SSPC specifications as follows:

1.	Solvent Cleaning	SP-1
2.	Hand Tool Cleaning	SP-2
3.	Power Tool Cleaning	SP-3
4.	White Metal Blast Cleaning	SP-5
5.	Commercial Blast Cleaning	SP-6
6.	Brush-Off Blast Cleaning	SP-7
7.	Pickling	SP-8
8.	Near-White Blast Cleaning	SP-10
9.	Power Tool Cleaning to Bare Metal	SP-11

D. Wherever the words "solvent cleaning", "hand tool cleaning", "wire brushing", "blast cleaning" or similar words are used in these specifications or in paint manufacturer's specifications, they shall be understood to refer to the applicable SSPC Surface Preparation Specifications listed above.

E. Surface preparation shall be as specified herein, or as directed by the District Engineer.

F. Unless otherwise directed by the District, do not blast-clean items that have previously been factory primed or painted.

G. All oil, grease, and other contaminants shall be removed by steam or solvent (SP-1) cleaning prior to blasting. Remove all sharp edges, burrs, weld splatter, and gouges.

H. Surfaces to be coated shall be blast cleaned to white metal (SSPC-5). The sand or grit used for blasting shall be of proper gradation to import a profile of 2 to 4 mils. The metal shall be cleaned after blasting with clean, dry compressed air. Use of rags to remove residual dust after sandblasting shall not be permitted.

3.05 PROCEDURES FOR APPLICATION

A. Conform to the requirements of SSPC-PA 1, Shop, Field, and Maintenance Painting. Follow the recommendations of the coating manufacturer, if more restrictive, including the selection of spray equipment, brushes, rollers, mixing, drying time, temperature and humidity limitations during application, and safety precautions. The Engineer will review procedures for the application of coatings. The Engineer's decision will be final as to interpretation and/or conflict between these Specifications and the recommendations of the coating manufacturer.

B. Stir, strain, and keep coating materials at a uniform consistency during application. Where the Engineer permits thinning, do not reduce the coating material more than is necessary to obtain the proper application characteristics and to obtain the specified dry film thickness. Do not exceed the maximum thinning rate allowed by the manufacturer. Stir coating materials at all times when adding thinner.

C. Apply each layer of coating evenly, free from brush marks, sags, runs, bridges, shiners, laps or other imperfections or other evidence of poor workmanship. Visible areas of chipped, peeled, or abraded paint shall be hand or power-sanded, feathering the edges. The areas shall then be primed and finish coated in accordance with the specifications. Finished surfaces shall be free from defects and blemishes prior to final acceptance.

3.06 EPOXY PAINT SYSTEM APPLICATION

A. Surface preparation for the Epoxy Paint System shall be in accordance with SSPC-SP-6, Commercial Blast Cleaning. If Commercial Blast Cleaning is not feasible, prepare surfaces in accordance with SSPC-SP-11, Power Tool Cleaning to Bare Metal.

B. The Epoxy Paint System shall consist of an epoxy prime coat, an epoxy intermediate coat, and epoxy finish coat(s) to provide a total dry film thickness of 9 mils to 15 mils. Apply the coatings in accordance with the manufacturer's recommended film thickness, adding finish coats as necessary to meet the minimum total dry film thickness specified above.

C. Observe minimum and maximum re-coat times and specified by the manufacturer. If these times are exceeded, the surface shall be re-prepared as recommended by the manufacturer and as directed by the District Engineer prior to receiving additional coats.

3.07 EPOXY/URETHANE PAINT SYSTEM APPLICATION

A. Surface preparation for the Epoxy/Urethane Paint System shall be in accordance with SSPC-SP-6, Commercial Blast Cleaning. If Commercial Blast Cleaning is not feasible, prepare surfaces in accordance with SSPC-SP-11, Power Tool Cleaning to Bare Metal.

B. The Epoxy/Urethane Paint System shall consist of an epoxy prime coat, an epoxy intermediate coat, and compatible urethane finish coat(s) to provide a total dry film thickness of 9 mils to 15

mils. Apply the coatings in accordance with the manufacturer's recommended film thickness, adding finish coats as necessary to meet the minimum total dry film thickness specified above.

C. Observe minimum and maximum re-coat times and specified by the manufacturer. If these times are exceeded, the surface shall be re-prepared as recommended by the manufacturer and as directed by the District Engineer prior to receiving additional coats.

3.08 ACRYLIC PAINT SYSTEM

A. Surface preparation for the Acrylic Paint System shall be in accordance with SSPC-SP-6, Commercial Blast Cleaning. If Commercial Blast Cleaning is not feasible, prepare surfaces in accordance with SSPC-SP-11, Power Tool Cleaning to Bare Metal.

B. The Acrylic Paint System shall consist of an acrylic prime coat, an acrylic intermediate coat, and acrylic finish coat(s) to provide a total dry film thickness of 9 mils to 15 mils. Apply the coatings in accordance with the manufacturer's recommended film thickness, adding finish coats as necessary to meet the minimum total dry film thickness specified above.

C. Observe minimum and maximum re-coat times and specified by the manufacturer. If these times are exceeded, the surface shall be re-prepared as recommended by the manufacturer and as directed by the District Engineer prior to receiving additional coats.

3.09 FUSION BONDED POLYESTER APPLICATION

A. APPLICATION

1. Coatings shall be applied the same day as the blast cleaning work is performed.
2. Coatings shall be applied in an environment, which provides for adequate control of temperature and humidity.
3. Powder coatings shall be applied by a qualified applicator in accordance with the latest requirements of the manufacturer.
4. Dry film thickness shall be as follows:
    a. Zinc Epoxy Powder: 3 to 5 mils
    b. TGIC Polyester: 3 to 4 mils
    c. Total System: 6 to 9 mils
5. Canisters shall be primed and finish coated over the entire surface, both inside and outside.
6. All coatings shall provide a satisfactory film with a smooth and even surface. Each coating application shall be applied evenly and free of sags, runs, holidays, bridging and with no evidence of poor workmanship. Finished surfaces shall be free from defects and blemishes.
7. All shop-coated items may be subject to field inspection and testing to verify the dry film thickness and absence of holidays. Those items not meeting the criteria of this specification will be subject to rejection.

B. FIELD REPAIRS

1. Field repairs to the polyester coating shall not be permitted. Enclosures requiring repairs to the coating shall be returned to the supplier or coating vendor for repairs or recoating.

END OF SECTION

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DIVISION 11 – EQUIPMENT

SECTION 11268
RESERVOIR HYDRODYNAMIC MIXING SYSTEM (HMS)

PART 1 - GENERAL

1.01 SCOPE

A. The Hydrodynamic Mixing System (HMS) is defined as a supplemental system installed within a potable water storage reservoir which passively utilizes the energy provided by the inlet water supply (via pumped or gravity head) and generates a sufficient inlet momentum to achieve a complete homogeneous blending of the water volume within the reservoir with the inlet supply flow. Determination of Complete Homogeneous Blending shall be defined by the modeling requirements and supporting hydraulic analysis as conducted by each individual manufacturer for their specific system configuration as defined within these specifications. System submittals not providing this validation shall not be considered as a viable Hydrodynamic Mixing System (HMS) and shall not be accepted as an equivalent to this system specification.

B. The specifications in this section include all components of the Reservoir Hydrodynamic Mixing System (HMS) consisting of a bi-directional flow manifold equipped with variable orifice duckbill inlet nozzles and outlet flow check valves that are NSF61 certified. The HMS manufacturer shall be responsible for designing the system in accordance with the hydrodynamic criteria defined within these specifications and submit design calculations verifying compliance in accordance with the submittal requirements. The following is a description of the Hydrodynamic Mixing System.

C. All modeling and hydraulic and mixing calculations pertaining to the HMS shall originate from the duckbill valve manufacturer. Modeling and calculations provided by parties other than the duckbill valve manufacturer are not allowed.

D. The complete Hydrodynamic Mixing System shall be supplied by the variable orifice nozzle manufacturer to maintain single source responsibility for the system. The complete system shall be defined as all piping and appurtenances within the tank downstream of the tank penetration. Appurtenances include pipe, fittings, horizontal and vertical pipe supports, expansion joints, variable orifice duckbill check valves, and any other equipment specified within this section of the specifications. The pre-approved manufacturer for this system to be included within the Base Bid shall be manufactured by Red Valve Company/Tideflex Technologies, Pittsburgh, PA 15220. Alternate manufacturers must be pre-approved by the Engineer. An alternate manufacturer, even if listed by name, must comply with all specifications contained herein including those in the “Submittals” section. In order for an alternate manufacturer to be approved, the Contractor shall submit to the Engineer at least ten days prior to the bid date a reference submittal package as defined within the “Submittals” section that will confirm they will be in compliance with all specifications.

E. Manufacturers and/or contractors submitting an alternative to the named Red Valve/Tideflex Technologies mixing system shall be responsible for obtaining any and all proprietary rights, license fees, royalties, technology licenses, and/or permissions required to provide such a system. The Manufacturer shall indemnify and hold harmless the Owner and Engineer against all claims, damages, losses, and expenses arising out of any infringement of patent rights or copyright incident relating to this system. Alternate mixing systems, even if listed by name, shall comply with the performance specifications in this section.

1.02 REFERENCED STANDARDS

American National Standards Institute (ANSI)
B16.1 – Cast Iron Pipe Flanges and Flanged Fittings
B16.5 – Pipe Flanges and Flanged Fittings
B36.10 – American National Standard Weights and Dimensions of Welded and Seamless Wrought Steel Pipe

American Society for Testing and Materials (ASTM)
A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A234 – Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
A351 – Standard Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
A536 – Standard Specification for Ductile Iron Castings
C110 – Ductile Iron and Gray-Iron Fittings, 3 In. through 48 In. for Water
D1330 – Standard Specification for Rubber-Sheet Gaskets
D1784 – PVC/CPVC Pipe Compounds
D1785 – PVC Pipe, Schedules 40, 80 & 120
D2466 – PVC Solvent Cement
D2855 – PVC Solvent Joints
D3261 – Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Fittings
D3915 – PVC Pipe Fitting Compounds

American Iron and Steel Institute (AISI)
AISI 304 – 304 Stainless Steel Plate
AISI 316 – 316 Stainless Steel Plate
AISI 1040 – Carbon Steel Plate

American Water Works Association (AWWA)
C104 – Cement-Mortar Lining of Ductile Iron Pipe and fittings for Water
C110 – Ductile-Iron and Gray-Iron Fittings, 3 In. through 48 In. for Water
C115 – Flange Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges

C200 - AWWA Standard for Steel Water Pipe 6" and Larger
C207 – Standard for Steel Pipe Flanges for Waterworks Service – Size 4 In. to 144 In.
C220 – AWWA Standard for Stainless Steel Pipe, 4" and Larger
C900 – AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In. for Water Distribution
C905 – AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In Through 48 In. for Water Transmission and Distribution
C906 – AWWA Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4 In. Through 63 In. for Water Distribution

American Water Works Association Research Foundation (AwwaRF)
Project No. E20-J08 – Physical Modeling of Mixing in Water Storage Tanks (Forthcoming)

National Sanitation Foundation (NSF)
NSF Standard 14 – Plastic Piping System Components and Related Materials
NSF Standard 61 – Drinking Water System Components – Health Effects

PART 2 - PRODUCTS

2.01 TIDEFLEX VARIABLE ORIFICE DUCKBILL INLET NOZZLES

A. Inlet ports/nozzles shall be duckbill-style check valves that allow fluid to enter the reservoir during fill cycles and prevent flow in the reverse direction through the nozzle during draw periods. Inlet ports/nozzles may not be fixed-diameter ports or pipes.

B. The flange drilling shall conform to ANSI B16.1 Class 125/ANSI B16.5, Class 150 standards. The duckbill valve shall be furnished with stainless steel 316 back-up rings for installation.

C. The duckbill valves shall be NSF61 Certified. NSF61 approved/Certified materials will not be accepted in lieu of valve certification.

D. Inlet ports/nozzles shall have a variable diameter vs. flow hydraulic profile that provides a non-linear jet velocity vs. flow characteristic and a linear headloss vs. flow characteristic. The hydraulic characteristics of the duckbill valves shall be defined by "Hydraulic Code".

E. The inlet ports/nozzles shall discharge an elliptically shaped jet. The nozzle must have been modeled by an independent laboratory using Laser Induced Fluorescence (LIF).

F. Manufacturer shall have conducted independent hydraulic testing to determine headloss and jet velocity characteristics on a minimum of eight (8) sizes of duckbill valves ranging from 2" through 48". The testing must include multiple constructions (stiffness) within each size and must have been conducted for free discharge (discharge to atmosphere) and submerged conditions.

G. Manufacturer shall have conducted an independent hydraulic test where multiple valves (at least four) of the same size and construction (stiffness) were tested to validate the submitted headloss characteristics and to prove the repeatability of the manufacturing process to produce the same hydraulic characteristics.

H. Manufacturer shall have conducted independent hydraulic testing to study the flow distribution characteristics of duckbill valves installed on multiport manifolds.

I. Manufacturer to have conducted Finite Element Analysis (FEA) on various duckbill valves to determine deflection, stress, and strain characteristics under various load conditions. Modeling must have been done for flowing conditions (positive differential pressure) and reverse differential pressure.

J. Manufacturer must have conducted in-house backpressure testing on duckbill valves ranging from ¾" to 48".

K. Manufacturer shall have at least fifteen (15) years experience in the manufacturing of "duckbill" style elastomeric valves.

L. Manufacturer must have duckbill valves installed on manifold piping systems in at least 100 distribution system reservoirs.

M. Manufacturer must have representative inspection videos showing the duckbill valves discharging water into the reservoir during an initial fill (unsubmerged). Manufacturer must also have representative underwater inspection videos showing the operation of the valves when submerged. Representative videos can be submitted upon request from the engineer.

N. The duckbill style nozzles shall be one-piece elastomer matrix with internal fabric reinforcing designed to produce the required discharge velocity and minimum headloss requirements as stipulated in the Submittals section. The flange portion shall be an integral portion of the nozzle with fabric reinforcing spanning across the joint between the flange and nozzle body.

O. The elastomer used in construction of the duckbill valves must have been tested by an accredited independent laboratory that confirmed there is no degradation in the elastomer when exposed to chlorine and chloramine per the ASTM D471-98 "Standard Test Method for Rubber Property – Effect of Liquids."

P. The manufacturer's name, plant location, serial number and product part number which designates nozzle size, material and construction specifications shall be bonded onto the surface of the nozzle.

2.02 WATERFLEX OUTLET CHECK VALVES

A. The outlet flow valves shall be perforated disc type with elastomeric membrane.

B. The valves shall be NSF61 Certified. NSF61 approved/Certified materials will not be accepted in lieu of valve certification.

C. The perforated disc shall be fabricated of stainless steel 304 plate with or without welded support gussets depending on maximum backpressure. The disc shall be flanged and drilled to mate with ANSI B16.1, Class 125/ANSI B16.5 Class 150 flanges. The disc shall have three (3) tapped holes used for fastening the membrane and support rod to the disc with stainless steel 304 bolts, nuts, and lock washers. The top of the disc shall be tapped and supplied with lifting eyebolt for installation.

D. The membrane shall be circular, one piece rubber construction with fabric reinforcement. The diameter of the membrane shall allow adequate clearance between the membrane O.D. and the pipe I.D. The membrane shall be vulcanized with a specified convex radius to produce a compression set to allow the membrane to seal against the perforated disc at low reverse differential pressure.

E. The support rod shall be stainless steel 304 and drilled with three (3) longitudinal holes to allow fastening of rod to membrane and perforated disc.

F. When line pressure inside the valve exceeds the backpressure outside the valve, the line pressure forces the membrane to open, allowing flow to pass through the perforations in the disc. When backpressure exceeds the line pressure, the membrane seats on the perforated disc preventing backflow.

G. The valve allows flow out of the reservoir during draw cycles and prevents flow into the reservoir during fill cycles.

H. The elastomer used in construction of the membrane must have been tested by an accredited independent laboratory that confirmed there is no degradation in the elastomer when exposed to chlorine and chloramine per the ASTM D471-98 “Standard Test Method for Rubber Property – Effect of Liquids.”

I. The manufacturer’s name, plant location, serial number and product part number which designates membrane size, material and construction specifications shall be bonded onto the surface of the membrane.

2.03 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. All PVC pipe and PVC fittings shall be a minimum Schedule 80 in accordance with ASTM D1785-83.

B. PVC pipe and fittings shall be NSF61 approved for potable water.

C. PVC pipe compounds shall be in accordance with the standards listed in Section 3.0: Referenced Standards.

D. PVC solvent and solvent joints shall be in accordance with the standards listed in Section 3.0: Referenced Standards.

E. Field solvent welding will not be allowed unless approved by the Engineer.

F. All pipe joints that are to be field connected shall be PVC Van Stone-type flanges. Flange drilling to be in accordance with ANSI B16.1/B16.5.

G. All fittings shall have the same pressure rating as the pipe unless otherwise noted.

2.04 FLANGE GASKETS

A. Flange gaskets shall be full-faced and shall be in accordance with ASTM D1330.

B. Flange gasket drilling pattern shall conform to ANSI B16.1/B16.5.

C. Flange gaskets shall be 1/8" thick.

D. Gasket material shall be EPDM.

2.05 FASTENERS

A. Hex head bolts and nuts shall be stainless steel 316 conforming to ANSI/ASME B18.2.1 and ANSI/ASME B18.2.2.

B. Plastic insulating sleeve/washers shall be utilized to isolate dissimilar bolt and flange metals where required.

2.06 PIPE SUPPORTS

A. For concrete tanks, the support shall be anchored to the concrete floor with stud type expansion anchors, the pull-out rating of the combined anchors shall be a minimum of 10 times greater than the static weight of the vertical pipe section. Supports shall be provided as shown on the Approved Plans.

B. Plastic insulating sleeve/washers shall be utilized to isolate dissimilar metals where required.

2.07 COATINGS

A. Following installation of the manifold system, all carbon steel and ductile iron pipe, fittings, bolted connections, pipe supports, and appurtenances shall be coated according to the interior tank paint specification as specified by the Engineer.

B. Surface preparation and coating procedures shall be provided by the Engineer and the coating supplier.

C. **Tideflex and Waterflex Valves shall not be coated**. The valves shall either be masked or be mounted after coating of the tank and piping. Contractor to ensure masking materials are removed after coating.

2.08 DELIVERY, STORAGE, AND MATERIAL HANDLING

A. Individual nozzles and outlet valves shall be packaged separately from the piping equipment.

B. All flanges shall be protected by using plastic inserts or plank wood, pipe sections are to be fully supported to prevent pipe deflection or damage to fittings or connections.

C. All equipment shall be shipped on pallets capable of fully supporting the pipe sections across their entire length. Pallets should be accessible for fork lift transport or strap and hoist means without causing any load to the pipe equipment.

D. All stainless steel components shall be stored separately away from any carbon steel components or other materials that could stain or deface the stainless steel finish from run-off of oxidized ferrous materials.

E. All pipe equipment should be covered and stored in areas free from contact with construction site sediment erosion to prevent accumulation of materials within the pipe and fittings.

F. Duckbill nozzles should be protected from contact with rigid objects during handling and storage. The contractor shall be responsible for replacing any duckbill nozzles or elastomeric components that are damaged after arrival on the site through installation and start-up of the system.

2.09 SUBMITTALS

A. Independent CFD Modeling Validation

1. The mixing system designer/supplier must supply data or report from at least one project where an independent company conducted CFD modeling on their mixing system design and the modeling results verified the design achieved complete mixing.

B. Full Scale Tracer Study Validation

1. The mixing system designer/supplier must supply data or report from at least one project where a full scale tracer study using calcium chloride was conducted on a circular reservoir and the tracer study results verified the mixing system design achieved complete mixing.
2. The mixing system designer/supplier must supply data or report from at least one project where a full scale tracer study using calcium chloride was conducted on an elevated tank and the tracer study results verified the mixing system design achieved complete mixing.

C. Tideflex Inlet Nozzle and Waterflex Outlet Valve Testing and Validation

1. Verification of independent hydraulic testing to determine headloss and jet velocity characteristics on a minimum of eight (8) sizes of duckbill valves ranging from 2" through 48". The testing must include multiple constructions (stiffness) within each size and must have been conducted for free discharge (discharge to atmosphere) and submerged conditions.
2. Verification of Independent Laboratory Testing for Manufacturing Consistency - the duckbill valve manufacturer shall provide summary documentation of a report conducted by an Independent Laboratory for hydraulic testing where multiple duckbill valves (at least four) of the same size and construction (stiffness) were tested to validate the submitted headloss characteristics and to prove the repeatability and consistency of the manufacturing process to produce the same hydraulic characteristics.
3. Report of independent testing that studied the flow distribution characteristics of duckbill valves installed on multiport manifolds. The manufacturer must have been in the business of manufacturing duckbill valves at the time the report was published.
4. Verification of Finite Element Analysis (FEA) of duckbill valves. The duckbill valve manufacturer shall provide summary documentation of Finite Element Analysis modeling on representative duckbill nozzle sizes to determine deflection, stress and strain characteristics under various load conditions. Modeling must have been done for flowing conditions (positive differential pressure) and reverse differential pressure.
5. Verification of independent hydraulic testing to determine headloss characteristics on a minimum of three (3) sizes of perforated disc/elastomeric membrane check valves ranging from 6" through 36". Testing must have been conducted with and without the membrane installed. At least two (2) sizes shall have tested two (2) different membrane thicknesses.
6. Verification of Finite Element Analysis (FEA) modeling on a perforated disc/elastomeric membrane check valve to determine stress and deflection characteristics under reverse differential pressure.

D. Validation of Long-term performance

1. The mixing system designer/supplier must supply at least one inspection report showing proper operation of, and no deterioration of, the duckbill valves after being in service in a water storage tank mixing application for a minimum of 10 years.

E. NSF61 Certification

1. Copy of the NSF61 Certified listing for the valves used in the Hydraulic Mixing System (HMS).
2. The valves themselves must be NSF61 certified, not just the elastomer used in construction of the valves. NSF61 approved/certified materials will not be accepted in lieu of valve certification.
3. The NSF61 Certification for the valves must be for a minimum volume of 2,000 gallons. Valves with NSF61 Certification for minimum volume of greater than 2,000 gallons are not acceptable.

F. Test Report on Elastomer Exposure to Chlorine and Chloramine

1. Copy of test report from an accredited independent laboratory that confirmed there is no degradation in the elastomer when exposed to chlorine and chloramine per the ASTM D471-98 "Standard Test Method for Rubber Property – Effect of Liquids."

G. System Installation Drawings

1. The duckbill valve manufacturer shall be responsible for providing engineering installation drawings of the complete manifold piping system as supplied by the manufacturer. These drawings shall include plan view piping arrangement, sections and elevations as required, support bracket installation details, duckbill nozzle orientation details, and all dimensions required for locating the system within the specified dimensions of the tank.

H. Design Calculations

1. All Design Calculations, curves, and reference information listed below must originate and be submitted by the duckbill valve manufacturer. **Calculations, curves, and reference information provided by contractors relating to the HMS are not allowed.** The duckbill valve manufacturer MUST include within the submittal package the following design calculations, curves, and reference information:
   a. Calculations showing the fill time required, under isothermal conditions, for the HMS system to achieve complete mix of the reservoir volume at minimum, average and peak fill rates. Complete mixing defined as 95% homogenous solution. The theory and equations used in calculating the mixing times must be from a published AWWA reference manual or paper. The reference document(s) must be submitted with the equations and calculations.

   b. Calculations showing the water level drawdown required to achieve complete mixing on the fill cycles at minimum, average, and peak flow rates.

   c. Calculations of average storage tank water age for both fill-then-draw, and simultaneous fill and draw scenarios. Theory used in calculating water age must be submitted with the calculations.

d. A representative Computational Fluid Dynamics (CFD) model evaluation of the proposed HMS system configuration applied within a reservoir of similar geometry. Model output documentation shall include all design variables applied for the simulation, plot of the 3-D geometry showing the mesh definition, velocity magnitude vector and contour plots at different cross-sections throughout the water volume, simulated tracer animations showing the spatial and temporal distribution of inlet water in real time during the fill cycle.

e. Hydraulic calculations showing the resulting jet velocities of each inlet nozzle at minimum, average, and peak fill rates.

f. Hydraulic calculations showing the flow distribution among all inlet ports at minimum, average, and peak fill rates.

g. Manifold hydraulic calculations showing the total headloss of the HMS at minimum, average, and peak fill and draw rates. Headloss shall include all minor losses and headloss of nozzles and outlet check valves.

h. Hydraulic curves showing thrust vs. flow for the inlet nozzles.

i. Hydraulic curves for each outlet check valves showing headloss vs. flow.

j. Calculations showing the terminal rise height of the jets that discharge at an angle above horizontal. The terminal rise height shall be calculated assuming 10°F and 20°F colder inlet water and calculated at minimum, average and peak fill rates. The theory and equations used to calculate the terminal rise height shall be included.

k. Hydraulic curves for each inlet nozzle of Densimetric Froude number vs. flow

l. If the calculations and supporting data provided do not show compliance with the hydrodynamic requirements of the system as interpreted by the Engineer or Owner then the submittal shall be rejected.

I. Installation, Operation and Maintenance Manuals

1. After final approval of the submittals by the Engineer, the HMS valve manufacturer shall provide one (1) Digital copy of the Installation, Operation and Maintenance (IOM) Manual for the mixing system. Hard copies of the IOM manual can be requested and will be made available at a fee.

2. The IOM manual shall include the following information as a minimum:

- A Cover page listing project specifics
- Table of contents

- Completed sections for the following: equipment list, shipment and storage instructions, assembly and installation instructions, safety notice, operating instructions, troubleshooting guide, and spare parts list.
- Copy of hydraulic, mixing, and water age design calculations for the mixing system and all associates supporting curves and calculations.
- Copy of complete set of the installation plans.
- Copies of valve IOMs, NSF61 Certification listing, chlorine/chloramine exposure test report.
- All validation documentation.
- Component specification sheets for any specialized items supplied with the system.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation of the manifold system shall be in accordance with the installation plans and guidelines provided by the HMS manufacturer, and as specified in the installation section of the IOM manual, and the requirements defined in these specifications.

3.02 INSTALLATION INSPECTION AND START-UP TESTING PROCEDURES

A. The HMS manufacturer's authorized representative shall provide one (1) day inspection to verify that the system has been installed in accordance with the design specifications and installation drawings. It is recommended the flow testing described below is conducted the same day once the representative confirms proper installation of the system.

B. The inspection representative shall provide signed inspection documents confirming the date of the inspection and approval of the installation.

C. Start-Up Flow Testing

1. Following installation of the complete manifold piping system, the contractor shall open the upstream isolation valve to allow flow into the tank through the manifold system. The isolation valve must be opened slowly to prevent surge or over-pressurization of the manifold system. The isolation valve must be fully opened to inspect the flow characteristics of the manifold system.

2. The contractor shall take videos and photos during the filling operation and submit them to the HMS manufacturer. Videos and photos are to confirm:

    a. There is no leakage in the piping system.
    b. That all of the duckbill inlet nozzles are discharging flow into the tank. The only exception is for a system where the duckbill nozzles are at different elevations. If the

water level is not at the elevation of higher duckbill nozzles, those may not discharge flow until the water level approaches those nozzles.

3.03 WARRANTY

A. All piping, pipe supports, expansion joints, and anchors shall be warranted by the HMS manufacturer against failure under design conditions for a period of one (1) year from the date of final Owner acceptance.

B. Duckbill inlet nozzles and perforated disc/elastomeric membrane outlet check valves shall be warranted by the manufacturer against failure under design operating conditions for a period of one (1) year from the date of final installation certification. Elastomer components damaged as a result of maintenance activities, foreign debris, or excessive exposure to direct ultraviolet and thermal radiation shall be excluded warranted coverage.

END OF SECTION

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DIVISION 13 – SPECIAL CONSTRUCTION

SECTION 13000
INSTRUMENT AND CONTROL SYSTEM

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

A. This Section gives general requirements for the instrument and control system (I&CS) which includes primary elements and transmitters, analog display and control elements, discrete display and control elements, control panels, and associated devices.

1.2 RELATED SECTION

A. Section 13470 SCADA PROGRAMMABLE LOGIC CONTROLLER SYSTEM
B. Division 16 Electrical sections
C. Section 01340 Shop Drawings Submittal

1.3 SUBMITTALS

A. Shop Drawings

Shop drawing submittals shall be neatly arranged in 3-ring binders which may have pockets for full-size drawings folded and CD. Tabs shall be used to separate individual items in the submittal. Loose submittals without a binder shall be rejected without review. Deviations if any from the specifications shall be summarized and tabulated on a separate document pages titled “Notes to Reviewer”. Shop drawings that do not follow the required format shall be rejected without being reviewed.

1. Bill of Materials: List of required I&CS equipment.

    a. Group equipment items by common enclosure, and equipment type.
    b. Data Included:

        1) Equipment tag number.
        2) Description.
        3) Manufacturer, complete model number and all options not defined by model number.
        4) Quantity supplied.

2. Catalog Cuts: I&CS Components, Electrical Devices, and Mechanical Devices:

    a. Catalog information.
    b. Descriptive literature.
    c. External power and signal connections.
    d. Scaled drawings showing exterior dimensions and locations of all electrical and mechanical interfaces.

3. Component Data Sheets: Data sheets for all I&CS components.

    a. Format and Level of Detail in accordance with ISA-S20.
    b. Specific features and configuration data for each component:

        1) Location or service.
        2) Manufacturer and complete model number.
        3) Size and scale range.
        4) Set points.
        5) Materials of construction.
        6) Options included.

    c. Name, address, and telephone number of manufacturer's local office, representative, distributor, or service facility.

4. Panel Construction Drawings:

    a. Scale Drawings: Show location of panel mounted devices, doors, louvers, and subpanels.

    b. Panel Legend: List front of panel devices by tag numbers, nameplate inscriptions, service legends, and annunciator inscriptions.

    c. Bill of Materials: List devices mounted within panels that are not listed in panel legend. Include tag number, description, manufacturer, and model number.

    d. Construction Details: NEMA rating, materials, material thickness, structural stiffeners and brackets, lifting lugs, mounting brackets and tabs, door hinges and latches, and welding and other connection callouts and details.

    e. Construction Notes: Finishes, wire color schemes, wire ratings, and wire numbering and labeling scheme.

5. Interconnection Diagrams: For discrete control and power circuits.

    a. Diagram Type: Ladder diagrams in a format similar to those shown on Drawings. Include devices requiring electrical connections. Show unique rung numbers on left side of each rung where applicable.

    b. Item Identification: Identify each item with attributes listed.

        1) Wires: Wire number and color. Cable number if part of multiconductor cable.

2) Terminals: Location (enclosure number, terminal junction box number, or MMC number), terminal strip number, and terminal block number.

3) Discrete Components:

a) Tag number, terminal numbers, and location ("FIELD", enclosure number, or MCC number).

b) Switching action (open or close on rising or falling process variable), set point value and units, and process variable description.

4) Relay Coils:

a) Tag number and its function.

b) On right side of rung where coil is located, list contact location by ladder number and sheet number. Underline normally closed contacts.

5) Relay Contacts: Coil tag number, function, and coil location (ladder number and sheet number).

a) Show each circuit individually. No "typical" diagrams will be allowed.

b) Ground wires and connections.

c) Circuit Names: Show names corresponding to Circuit and Raceway Schedule for circuits entering and leaving a panel. Refer to Division 16, ELECTRICAL.

6. Loop Diagrams: Individual wiring diagram for each analog or pulse frequency loop.

a. Loop diagrams similar to ISA format or one preferred by DISTRICT.

b. Conform to the minimum requirements of ISA S5.4.

c. Under paragraph 5.3 of ISA S5.4, include the information listed under subparagraphs 2, 5, 6 and 9.

d. Drawing Size: Individual 11-inch by 17-inch sheet for three loops maximum. Loop drawings smaller than 11” x 17” will be rejected without review.

e. Divide each loop diagram into areas for field panel, field, terminal junction boxes, control panel and PLC.

f. Show:

1) Terminal numbers, location of DC power supply, and location of common dropping resistors.

2) Switching contacts in analog loops and output contacts of analog devices. Reference specific control diagrams where functions of these contacts are shown.
3) Tabular summary on each diagram:

a) Transmitting Instruments: Output capability.
b) Receiving Instruments: Input impedance.

4) Circuit and raceway schedule.

7. Panel Power Requirements and Heat Dissipation: For control panels tabulate and summarize:

a. Required voltages, currents, and phases(s).

b. Maximum heat dissipations Btu per hour.

c. All calculations.

8. Termination Wiring Diagrams:

a. Diagrams, device designations, and symbols in accordance with NEMA ICS 250.

b. Show:

1) Electrical connections between equipment, consoles, panels, terminal junction boxes, and field mounted components.
2) Component and panel terminal identification numbers, and external wire and cable numbers.
3) Circuit names matching Circuit and Raceway Schedules.
4) Intermediate terminations between field elements and panels for, but not limited to terminal junction boxes and pull boxes.

9. Installation Details: Provide installation details and bill of materials required for the proper installation of AS Components.

10. Spares, expendables, and test equipment.

B. Samples: Color schedule with color samples for control panels.

C. Quality Control Submittals:

1. Testing Related Submittals: In accordance with this Section

2. O&M Manuals:

a. Refer to paragraph Shop Drawings for the following items:

1) Bill of Materials.
2) Catalog Cuts.
3) Component Data Sheets.
4) Interconnection Diagrams, one reproducible copy.
5) Loop Diagrams, one reproducible copy.
6) Termination Wiring Diagrams, one reproducible copy.

b. Device O&M manuals for I&CS components, electrical devices, and mechanical devices shall include:

1) Operations procedures.
2) Installation requirements and procedures.
3) Maintenance requirements and procedures.
4) Troubleshooting procedures.
5) Calibration procedures.
6) Internal schematic and wiring diagrams.
7) ORT Component and Calibration Sheets.
8) List of required test equipment.

c. List of spares and expendables required and recommended.

1.4 DELIVERY, STORAGE, AND HANDLING

A. In accordance with this Section. Store equipment on site with protection to avoid damages prior to installation.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Standard Environmental Requirements: Unless otherwise noted, design AS equipment for continuous operation in these environments:

1. Inside (where applicable):

a. Temperature: 20 to 115 Deg. F.
b. Relative humidity: 10 to 95% non- condensing.
c. NEC classification: Non-hazardous.

2. Outside:

a. Temperature: -32 to 120 Deg. F.
b. Rain
c. NEC classification: Non-hazardous (Unclassified)

B. Furnish and provide I&CS components and panels for continuous operation in its operating environments as shown and located on the Drawings. All equipment shall be suitable and

designed for installation as per California Building Code regarding seismic requirements and compliance.

1.6 SEQUENCING AND SCHEDULING

A. In accordance with the DISTRICT general construction schedule.

1.7 MAINTENANCE

A. Spares Parts:

Provide the following spare parts with no additional cost to the DISTRICT. See section 13470 for additional spare parts for PLC system.

Description	Percent of Each Type and Size Used	No Less Than
Fuses	20	5
Indicating light bulbs	20	10
Relays	2	2
Terminal Blocks	10	5
Hand Switches	2	2

B. Expendables: None

1.8 WARRANTY

A. The Contractor shall provide a written warranty covering the performance, workmanship, and installation of all equipment furnished under this Section for a period of two (2) years. The Contractor shall assume responsibility for all costs incurred in achieving satisfactory performance during the warranty period. Warranties shall be in accordance with these specifications.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT AND TOOLS

Contractor shall provide the following tool to the DISTRICT for no additional cost.

Equipment	Quantity.	Manufacturer and Model number
None		

2.2 I&CS COMPONENTS

A. Components for Each Loop: Components for each loop shall be listed in ISA Data Sheets. Furnish all equipment that is necessary to achieve required loop performance.

2.3 NAMEPLATES AND TAGS

A. Panel Nameplates: Enclosure identification located on the enclosure face.

1. Location and Inscription: As shown on panel Drawing.

2. Materials: 16-gauge, Type 316, stainless steel, stamped, mounted with stainless steel screws.

3. Letters: 1/2-inch, unless otherwise noted.

B. Component Nameplates-Panel Face: Component identification located on panel face under or near component.

1. Location and Inscription: As shown on panel Drawing.

2. Materials: Adhesive backed laminated plastic.

3. Letters: 3/16-inch white on black background, unless otherwise noted.

C. Component Nameplates-Back of Panel: Component identification located on or near component inside of enclosure.

1. Inscription: Component tag number.

2. Materials: Adhesive back, laminated plastic.

3. Letters: 3/16-inch white on black background, unless otherwise noted.

D. Service Legends: Component identification nameplate located on face of component.

1. Inscription: As shown on panel Drawing.

2. Materials: Adhesive backed laminated plastic.

3. Letters: 3/16-inch white on black background, unless otherwise noted.

E. Nametags: Component identification for field devices.

1. Inscription: Component tag number.

2. Materials: 16-gauge, 316 stainless steel.

3. Letters: 1/4-inch imposed.

4. Mounting: Affix to component/field instruments with 16- or 18-gauge stainless steel wire or stainless steel screws.

2.4 PANEL FABRICATION

A. General:

1. Panels with external dimensions and instruments arrangement as shown on Drawings except as modified in Engineer approved shop drawings.

2. Panel Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), state and local codes, and applicable sections of NEMA, ANSI, UL, and ICECA.

3. Fabricate panels, install instruments, wire, and plumb, all at the ICS subcontractor's factory.

4. All panels shall be UL listed and shall bear UL label stating "LISTED ENCLOSED INDUSTRIAL CONTROL PANELS". (UL508)

5. Electrical Work: In accordance with the applicable requirements of Division 16, ELECTRICAL.

B. Temperature Control:

1. Smaller Panels (that are not freestanding): Size to adequately dissipate heat from equipment mounted inside panel or in panel face.

C. Panel Construction:

1. Materials: Sheet steel unless otherwise shown on Drawings with minimum thickness of 10-gauge. For NEMA 4X, 316 stainless steel, powder coat painted shall be used.

2. Panel Fronts:

a. Fabricated from a single piece of sheet steel unless otherwise shown on Drawings.
b. No seams or bolt heads visible when viewed from front.
c. Panel Cutouts: Smoothly finished with rounded edges.
d. Stiffeners: Steel angle or plate stiffeners or both on back of panel face to prevent panel deflection under instrument loading or operation.

3. Internal Framework:

a. Provide structural steel for instrument support and panel bracing.

b. Permit panel lifting without racking or distortion.

4. Lifting rings to allow simple, safe rigging and lifting of panel during installation.

5. Adjacent Panels: Securely bolted together so front faces are parallel.

6. Doors:

a. Full height, fully gasketed access doors where shown on Drawings.
b. Key lockable.
c. Latches: Three-point, Southco Type 44 or equal.
d. Handles: "D" ring, foldable type.
e. Hinges: Full length, continuous, piano type, steel hinges with stainless steel pins.
f. Rear Access Doors: Extend no further than 24 inches beyond panel when opened to 90-degree position.
g. Front and Side Access Doors: As shown on Drawings.

h. Provide a latch to hold door at full open position.

D. Non-Freestanding Panel Construction:

1. Based on environmental design requirements required and referenced in Article ENVIRONMENTAL REQUIREMENTS, provide the following:

a. For panels located inside:

1) Enclosure Type: NEMA 12.
2) Materials: Steel.

b. For all other panels:

1) Enclosure Type: NEMA 4X (316 SS)
2) Materials: SS.

2. Doors:

a. Oil resistant gasket sealed with continuous hinge.
b. Fiberglass lockable quick release latches.

3. Manufacturers:

a. Hoffman or equal.

F. Control Panel Electrical and control components:

Control panel shall be NEMA 3RX stainless steel for outdoor installation specifically identified on the drawings, and shall be NEMA 12 for indoor locations. Panels shall have the following features:

1. Power Distribution, motor starter within panels:

    a. Feeder Circuits and motor starters:

        1) One or more 120V ac, 60-Hz feeder circuits as shown on Drawings.
        2) Make provisions for feeder circuit and starter conduit entry.
        3) Furnish terminal board for termination of wires.

    b. Power Panel: Furnish main circuit breaker and a circuit breaker on each individual branch circuit distributed from power panel.

        1) Locate to provide clear view of and access to breakers when door is open.
        2) Breaker sizes: Coordinate such that fault in branch circuit will blow only branch fuse but not trip the main breaker.
        3) Breaker and motor starter manufacturers and products:

            a) Refer to Division 16, ELECTRICAL.

2. Signal Distribution:

    a. Within Panels: 4 to 20 mA dc signals (may be distributed as 1 to 5V dc with a precision 250 OHM resistor).

    b. Outside Panels: Isolated 4 to 20 mA dc only.

    c. All signal wiring shall be twisted, shielded pairs, minimum 18 AWG.

3. Signal Switching:

    a. Use dry circuit type relays or switches.

    b. No interruption of 4 to 20 mA loops during switching.

    c. Switching Transients in Associated Signal Circuit:

        1) 4 to 20 mA dc Signals: 0.2 mA, maximum.
        2) 1 to 5V dc Signals: 0.05V, maximum.

4. Relays:

    a. General:

1) Relay Mounting: Plug-in type socket.
2) Relay Enclosure: Furnish dust cover.
3) Socket Type: Screw terminal interface with wiring.
4) Socket Mounting: Rail.
5) Provide holddown clips.

b. Signal Switching Relay:

1) Type: Dry circuit.
2) Contact Arrangement: 4 Form C contacts.
3) Contact Rating: 0 to 5 amps at 28V dc or 120V ac.
4) Contact Material: Gold or silver.
5) Coil Voltage: As noted or shown.
6) Coil Power: 0.9 watts (dc), 1.2VA (ac).
7) Expected Mechanical Life: 10,000,000 operations.
8) Expected Electrical Life at Rated Load: 100,000 operations.
9) Indication Type: LED indicator lamp.
10) Seal Type: Hermetically sealed case.
11) Manufacturer and Product: Potter and Brumfield; Series KH/KHA, Idec equivalent, or equal.

c. Control Circuit Switching Relay, Nonlatching:

1) Type: Compact general purpose plug-in.
2) Contact Arrangement: 3 Form C contacts.
3) Contact Rating: 10A at 28V dc or 240V ac.
4) Contact Material: Silver cadmium oxide alloy.
5) Coil Voltage: As noted or shown.
6) Coil Power: 1.8 watts (dc), 2.7VA (ac).
7) Expected Mechanical Life: 10,000,000 operations.
8) Expected Electrical Life at Rated Load: 100,000 operations.
9) Indication Type: Neon or LED indicator lamp.
10) Push to test button.
11) Manufacturer and Product: Potter and Brumfield; Series KUP, Idec equivalent, or equal.

d. Control Circuit Switching Relay, Latching:

1) Type: Dual coil mechanical latching relay.
2) Contact Arrangement: 2 Form C contacts.
3) Contact Rating: 10A at 28V dc or 120V ac.
4) Contact Material: Silver cadmium oxide alloy.
5) Coil Voltage: As noted or shown.
6) Coil Power: 2.7 watts (dc), 5.3VA (ac).
7) Expected Mechanical Life: 500,000 operations.
8) Expected Electrical Life at Rated Load: 50,000 operations.

9) Manufacturer and Product: Potter and Brumfield; Series KB/KBP, Idec equivalent, or equal.

e. Not used.

f. Signal conditioners:
Signal conditioners shall be manufactured by AGM Electronics, Phoenix Contact, or equal. They shall have the following characteristics:
1) Din rail mounted
2) 24VDC power input or two wire as required by design loop drawings.
3) 4-20mADC input with two identical 4-20mADC outputs or
4) Pulse input with 4-20mADC output or
5) 4-20mADC input with isolated 4-20mADC output

g. Intrinsically safe relays:
Where specified and or shown on the drawings,these relays shall be suitable for use with 24VDC power input with pilot devices such as float switches located in the classified hazardous locations as defined by NEC Article 500. Each relay shall have two double-pole double throw contacts, each rated for 5 amperes at 240V. These relays shall be manufactured by Consolidated Electric, Gem Sensors, R. Stahl, Inc, or equal.

5. Centralized Power Supplies:

a. Furnish as required where shown on the drawings to power instruments requiring external dc power, including two-wire transmitters and dc relays.

b. Convert 120V ac, 60-Hz power to dc power of appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances.

c. Furnish redundant dc power supplies connected in such a way that DC output power is uninterrupted when one power supply is removed or is not delivering the correct output voltage.

d. Provide a contact closure for alarm in case of dc power supply failure.

e. Provide a voltmeter for each power supply.

f. Provide output over voltage and over current protective devices to:

1) Protect instruments from damage due to power supply failure.
2) Protect power supply from damage due to external failure.

g. Enclosures: NEMA 1.

h. Mount such that dissipated heat does not adversely affect other components. Fuses: For each dc supply line to each individual two-wire transmitter.

1) Type: Indicating.
2) Mount so fuses can be easily seen and replaced.

i. Manufacturer and Products: Acopian Redundant Power Packages, Sola equivalent, or equal.

6. Standard Pushbutton Colors and Inscriptions:

a. Use following color code and inscriptions for pushbuttons unless otherwise noted:

Tag Function	Inscription(s)	Color
OO	ON OFF	Red Green
OC	OPEN CLOSE	Red Green
OCA	OPEN CLOSE AUTO	Red Green White
OOA	ON OFF AUTO	Red Green White
MA	MANUAL AUTO	Yellow White
SS	START STOP	Red Green
RESET	RESET	Red
EMERGENCY STOP	EMERGENCY STOP	Red
LOCAL	LOCAL	White

b. Unused or Noninscribed Buttons: Black.

c. Lettering Color:

1) Black on white and yellow buttons.
2) White on black, red and green buttons.

7. Standard Light Colors and Inscriptions:

a. Use following color code and inscriptions for service legends and lens colors for indicating lights, unless otherwise noted in Instrument List:

Tag Function	Inscription(s)	Color

ON	ON	Red
OFF	OFF	Green
OPEN	OPEN	Red
CLOSED	CLOSED	Green
LOW	LOW	Green
FAIL	FAIL	Red
HIGH	HIGH	Red
AUTO	AUTO	White
MANUAL	MANUAL	Yellow
LOCAL	LOCAL	White
REMOTE	REMOTE	Yellow

b. Lettering Color:

1) Black on white lenses.
2) White on red and green lenses.

2.5 SOURCE QUALITY CONTROL

A. Factory Demonstration Tests: Demonstrate to Engineer that I&CS panel and assemblies included in these tests for conformance to related submittals and requirements specified.

2.6 REQUIRED INSTRUMENTS FURNISHED AND INSTALLED BY CONTRACTOR

2.6.1 LEVEL MEASUREMENT

Furnish and install level transmitter where shown on the drawings.

A. Level transmitter (Radar type)

1. Continuous level measurement by radar

2. Characteristics:

a. Radar remote probe/sensor with 350 feet cable length
b. Level transmitter with 4-20mADC output
c. Transmitter Power input 120VAC
d. Local level transmitter, keypad type with engineering unit.
e. HART protocol
f. Radar remote level sensor with narrow beam
f. Provided with required mounting hardware, brackets, and cables.

3. Manufacturer:

a. VEGA Vegapuls to match District's Standards.

Level Transmitter: Model Vegamet 841 Controller
Level sensor: Model C-21

PART 3 EXECUTION

3.1 GENERAL

A. Floor plan layout for I&CS components are diagrammatic and not intended to specifically define element locations or piping and tubing run lengths. Base materials and installations on field measurements.

B. Coordinate Work with Division 11, EQUIPMENT and Division 15, MECHANICAL.

C. Wiring: Refer to this Section and Division 16, ELECTRICAL.

3.2 FIELD QUALITY CONTROL

A. Perform functional tests to assure all devices are functional individually prior to system testing.

B. Perform final acceptance testing at the presence of the DISTRICT's representative, the Engineer.

3.3 TRAINING

A. Operation: For DISTRICT's operations personnel on operation of I&CS.

1. Training Session Duration: 1 instructor day.

2. Number of Training Sessions: 2

3. Location: Project site.

4. Content: Conduct training on loop-by-loop basis.

a. Loop Functions: Understanding of loop functions including interlocks for each loop.
b. Loop Operation: For example, adjusting process variable set points, AUTO/MANUAL control transfer, AUTO and MANUAL control, annunciator acknowledgement and resetting.
c. Interfaces with ICS Subsystems.

B. Maintenance Training:

1. Training Session Duration: 1 instructor day.

2. Number of Training Sessions: 2

3. Location: Project site.

4. Content: Provide training for each type of component and function provided.

   a. Loop Functions: Understanding details of each loop and how they function.
   b. Component calibration.
   c. Adjustments: For example, device setup parameters, controller tuning constants, current switch trip points, and similar items.
   d. Troubleshooting and diagnosis for and components.
   e. Replacing lamps, chart paper, fuses.
   f. AS components removal and replacement.
   g. Periodic maintenance.

END OF SECTION

SECTION 13110
CATHODIC PROTECTION AND JOINT BONDING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Contractor shall provide a fully functional cathodic protection system in conformance with the Contract Documents and standards referenced herein.

B. This section includes materials, testing and installation of corrosion protection and monitoring systems for metallic pipes, fittings, and appurtenances including insulating flange kits, test stations, copper/copper sulfate reference electrodes, sacrificial anodes, wiring, and exothermic welds.

C. Reference District Standard Procedures, Specifications, and Drawings for requirements not specified herein.

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.

1. AWWA C217 - Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines
2. ASTM D 1248 - Standard Specification for Polyethylene Plastics Molding and Extrusion Materials for Wire and Cable
3. NACE SP0286 - The Electrical Isolation of Cathodically Protected Pipelines
4. NACE RP0375 - Application and Handling of Wax-Type Protective Coatings and Wrapper Systems for Underground Pipelines
5. NACE SPO169 – Control of Exterior Corrosion on Underground or Submerged Metallic Piping Systems

1.03 SUBMITTALS

A. Submit manufacturer's catalog data on wire and cable, copper sulfate reference electrodes, test stations, conduit, exothermic weld molds and charges, pipe flange insulation kits, pipe flange internal coating, wax tape system, plastic warning tape, sacrificial anodes, and any other required materials.

1.04 PIPE JOINT BONDING CABLES

A. Electrical continuity bonding cables shall be installed across all buried or submerged metallic inline valves, flexible couplings, grooved couplings, pipe joints that are not circumferentially welded, and all other pipe joints except flange joints equipped with insulation gaskets. Where

shown on the drawings, bonding cables shall be installed in vaults. Bonding cables shall not be installed on the ductile iron pipe joints and fittings.

1.05 GALVANIC ISOLATION

A. All threaded outlets shall incorporate the use of an insulated ball valve for galvanic isolation of stray current.

B. Threaded outlets may incorporate the use of a nylon isolation bushing for galvanic isolation only with the approval of the District Engineer. Where the use of nylon bushings is required, the threaded outlet shall be increased in size to accept the bushing.

PART 2 - MATERIALS

2.01 GENERAL

A. Items in this section shall be selected from the Approved Materials List in accordance with the Standard Drawings.

2.02 PREPACKAGED MAGNESIUM ANODES

A. Prepackaged magnesium anodes shall be used in low current demand applications. The amount and size of magnesium anodes shall be as shown on the Approved Plans and shall be installed in accordance with the Standard Drawings.

B. Prepackaged magnesium anodes shall have galvanized steel rod cores encased in magnesium ingots. The ingot portion of anodes shall be of the weight as required on the Approved Plans.

C. Provide magnesium anodes with minimum No. 8 AWG HMW/PE (black) insulated wire. Each lead wire shall be long enough to extend to the corrosion monitoring test box plus 450mm (18") of slack without splices.

D. Magnesium anodes shall be prepackaged in a permeable cloth bag with low resistivity backfill mixture and shall be selected from the Approved Materials List.

2.03 SACRIFICIAL ANODES FOR COPPER TUBING

A. Prepackaged zinc sacrificial anodes shall be installed and connected to copper tubing where indicated on the Approved Plans. Anodes shall be selected from the Approved Materials List and shall be installed in accordance with the Standard Drawings.

B. Prepackaged zinc sacrificial anodes shall include a zinc-alloy ingot with galvanized steel core weighing not less than 6.8 kg (15 lbs.) and shall be packed in cloth bags filled with a mixture of gypsum and bentonite.

C. Prepackaged zinc sacrificial anodes shall include an integral anode lead connected to the galvanized steel core of the ingot consisting of No. 12 AWG stranded copper wire with (black) THW insulation. Anode lead wires shall be a minimum of 7.62 m (25') long.

2.04 TEST CABLE AND BONDING CABLE

A. All test cable and bonding cable shall be stranded copper wire with insulation rated at 600 volts. Cable with cut or damaged insulation is not acceptable. All cable shall be of sufficient length to extend from the point of connection to the appropriate corrosion monitoring test box without splices.

B. The cable shall have a 2.8mm (7/64") thick, high molecular weight polyethylene (HMW/PE) insulation specifically designed for cathodic protection service and suitable for direct burial in corrosive soil or water, conforming to ASTM D 1248, Type I, Class C, Category 5 (HMW/PE Type CP) Grade E-5 or J-1. Test cable shall have at least 450mm (18") of slack in the test box. Testing and/or bonding cable size and color shall be in accordance with the Standard Drawings.

2.05 PIPE FLANGE INSULATING KITS

A. INSULATING FLANGES

Insulating flange kits shall be installed to electrically isolate the water pipelines from existing pipelines and from new in-building piping. The insulating flange kit shall be for water service, and suitable for wet and dry locations.

a. Pipe flange insulating kit materials shall be of the type designated by the manufacturer as suitable for appropriate service at the operating temperatures and pressures specified for the pipe.

b. Flange insulating kits shall consist of a one piece full-face, insulating gasket, an insulating sleeve for each bolt, two insulating washers for each bolt, and a steel washer between each insulating washer and nut.

c. Insulating Gasket: Insulating gasket retainers shall be full-face, Type E, NEMA G-10 epoxy glass retainers with a nitrile (Buna-N) rectangular cross section O-ring sealing. Minimum total thickness shall not be less than 1/8-inch. Dielectric strength shall be not less than 550 volts per mil, and compressive strength of not less than 50,000 psi. Use PSI Linebacker, or equal.

i. Insulating Sleeves: Provide full length, one piece, insulating flange bolt sleeves for the appropriate bolt size. Insulating sleeves shall be NEMA G-10 epoxy glass. Dielectric strength shall be not less than 400 volts per mil.

ii. Insulating Washers: Insulating washers shall be NEMA G-10 epoxy glass with a minimum thickness of 1/8-inch. Dielectric strength shall not be less than 550 volts per mil, and compressive strength of not less than 50,000 psi.

iii. Provide cadmium plated steel flange bolt washers for placement over the insulating washers with a minimum thickness of 1/8 inch.

B. INSULATING FLANGED COUPLING ADAPTERS

a. Insulating elements shall be installed to electrically isolate the water pipeline from existing pipelines. The insulating elements shall consist of a full-face central gasket, two

sleeves for each end of the flange bolt, and two insulating washers with two steel washers for each bolt. The gaskets for potable water service shall be in compliance with NSF 61.

b. Pipe flange insulating kit materials shall be of the type designated by the manufacturer as suitable for appropriate service at the operating temperatures and pressures specified for the pipe.

c. Flange insulating kits shall consist of a one piece full-face, insulating gasket, two insulating sleeves for each end of the flange bolt, two insulating washers for each bolt, and a steel washer between each insulating washer and nut.

i. Insulating Gasket: Insulating gasket retainers shall be full-face, Type E, NEMA G-10 epoxy glass retainers with a nitrile (Buna-N) rectangular cross section O-ring sealing. Minimum total thickness shall not be less than 1/8-inch. Dielectric strength shall be not less than 550 volts per mil, and compressive strength of not less than 50,000 psi. Use PSI Linebacker, or equal.

ii. Insulating Sleeves: Provide two piece, insulating flange bolt sleeves for the appropriate bolt size. Insulating sleeves shall be NEMA G-10 epoxy glass. Dielectric strength shall be not less than 400 volts per mil.

iii. Insulating Washers: Insulating washers shall be NEMA G-10 epoxy glass with a minimum thickness of 1/8 inch. Dielectric strength shall not be less than 550 volts per mil, and compressive strength of not less than 50,000 psi.

iv. Provide cadmium plated steel flange bolt washers for placement over the insulating washers with a minimum thickness of 1/8 inch.

B. INSULATING FLEXIBLE COUPLINGS

1. A double boot assembly shall be installed on the flexible coupling to electrically isolate the water pipeline from existing pipelines.

2.06 WAX TAPE COATING FOR BURIED INSULATED PIPE FLANGES

A. All buried insulated pipe flanges shall be coated with a three-part, cold-applied wax tape coating system as described by NACE RPO375 and AWWA C217 in accordance with the Approved Materials List. Wax tape is also required where indicated on the Approved Plans.

2.07 EXOTHERMIC WELDS AND WELD CHARGES

A. Wire-to-pipe connections shall be made using exothermic welds. Weld charges and mold sizes for various surface configurations and materials shall be in accordance with the manufacturer's recommendations.

B. The cable connections to ductile iron and steel pipelines shall be accomplished utilizing an exothermic welding process as shown on the Drawings. Each cable shall be fitted with a copper sleeve for accomplishing the weld and cartridge, sleeves and molds for each weld shall be furnished by the same manufacturer. All materials for welding shall be sized and in accordance

with recommendations in manufacturers' literature. Where shown on the Drawings, the cable connections shall be made by welding a prefabricated rod& cable assembly to the pipeline.

PART 3 - EXECUTION

3.01 FIELD TESTING

A. The Contractor shall engage the services of a Cathodic Protection firm to test the cathodic protection installations in the presence of the District Engineer. For final acceptance, the official testing of the cathodic protection installations shall be completed by a Certified NACE CP-1 tester or higher, and approved by a Cathodic Protection Engineer and /or a NACE Certified CP Specialist, as deemed necessary by the District Engineer. The Contractor shall notify District Engineer of proposed test dates and times a minimum of 48 hours in advance. As a practical approach, the Contractor may choose to verify pipe continuity and flange isolation (described in Items A and B below) prior to backfilling as an unofficial test. Official testing shall occur after the backfilling and installation of the test boxes.

1. Pipeline Electrical Continuity Testing: Test the electrical continuity of all sections of pipe to be monitored between each pair of adjacent corrosion monitoring test stations or between the ends of pipe sections less than 152.4m (500') apart. Each pipe section shall be considered electrically continuous when the measured longitudinal resistance of each pipe section is no greater than 20% higher than the theoretical resistance of that section of pipe. If testing indicates inadequate electrical continuity, the Contractor shall excavate to investigate and locate improperly bonded pipe joints and make repairs until electrical continuity is accomplished to the satisfaction of the District Engineer**.**
2. Insulated Pipe Flange Testing: Each insulated pipe flange will be tested for effective electrical isolation of the two mating pipe flanges. The insulated pipe flange shall be judged for effectiveness in accordance with NACE SP0286, Section 9, Field Testing and Maintenance." The Contractor shall replace or repair any insulated pipe flange assembly until electrical discontinuity is accomplished.
3. Initial Reference CP Potential Measurements: The entire metallic piping system shall be tested to establish the base CP Potential measurement readings. The base data will be used for comparative purposes with future monitoring data. The baseline data shall include voltage measurements (+/- 1mV) between any permanent copper sulfate reference electrodes (+ voltmeter correction) and a reliable portable copper sulfate reference electrode (- voltmeter correction) placed directly in the CP test box.
4. Sacrificial Anode Connectivity Testing: After installation of sacrificial anodes for copper tubing, the copper tubing and sacrificial anode lead wire shall be tested for connectivity to ensure that the lead wire and the brass or copper clamp has been securely connected to the copper tubing. Test method shall be as directed by the District Engineer.
5. Cathodic Protection Report shall be prepared and stamped by a State of California registered professional corrosion engineer and/or certified NACE International CP-4 Specialist.

END OF SECTION

SECTION 13470
SCADA - PROGRAMMABLE LOGIC CONTROLLER SYSTEM

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope:

1. General:

a. The Contractor shall furnish, install and wire all SCADA system hardware required for this project. The Contractor shall also be responsible for proving standard software and application software for complete operating system.

b. The hardware and software specified in this project are District's Standards and shall not be substituted with other manufacturers which shall be rejected for non-conforming.

c. Prior to commencing the PLC programming, Contractor shall attend a meeting with the District and the District Representative to go through and to confirm the required programming standards.

2. Control System Responsibilities:

a. The Contractor shall be responsible for all control systems work described in these specifications and drawings, including PLCs, network/communication equipment, except for programming and configuration of the communication routers to be provided by the District. The Contractor shall be responsible for all submittals, purchasing, assembly, packing, shipping, installation, set up, startup, specified testing including factory tests, and as-built drawings for all control system equipment and purchased standard software.

b. The Contractor or subcontractor shall test the PLC/I/O system as specified herein to verify proper performance independent of the use of the PLC software provided by the District. Tests shall include factory tests (FT) and functional acceptance tests (FAT).

c. The Contractor shall provide the communications network hardware as specified herein and indicated on the Drawings and other sections of the specification.

d. Perform testing and training as described in this section.

3. Definitions:

a. Where a term is used in this section relating to instrumentation, and the meaning is not defined therein or elsewhere in the Contract Documents, the meaning of the term shall be as defined in ISA S51.1 Process Instrumentation Terminology, or if not contained in ISA 51.1, as defined in listed reference standards under "References".

b. CEET - Complete End to End Testing.

c. Where used, OIT/LOI- Operator Interface Terminal/Local Operator Interface.

d. Control Circuit: Any logical circuit (operating usually at 120VAC or less or DC) whose principal purpose is the conveyance of control and interlock/protection information and not the conveyance of energy for the operation of an electrically powered device.

e. HMI: Human Machine Interface.

f. LAN: Local Area Network e.g. Ethernet is a local area network based on IEEE standard 802.3 with TCP/IP protocol.

g. NAT - Network Acceptance Testing.

h. Panel: An instrument support system which may be either a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems. Unless otherwise specified or clearly indicated by the context, the term "panel" in these Contract Documents shall be interpreted as a general term, which includes flat panels, enclosures, cabinets and consoles.

i. PLC: Programmable Logic Controller.

j. Power Circuit: Any circuit operating at 120 VAC or more, whose principal purpose is the conveyance of power for motors, lighting and other power devices.

B. Test:

1. General:

a. Any testing or startup activity that requires the participation of the District shall be scheduled by the Contractor through written notification to the District. Contractor shall provide regularly updated testing and startup schedules to the District. In addition to any other form of notification, Contractor shall notify the District by email, or other mutually agreed upon means, five working days immediately prior to any testing or other activity requiring the participation of the District. Failure to properly notify District shall result in rescheduling of test activity, solely at Contractor expense and without an extension to the project completion schedule.

2. Operational Readiness Tests (ORT):

a. General: Prior to startup and the Functional Acceptance Test, the entire system shall be certified (inspected, tested and documented) that it is ready for operation.

b. Basic End-to-End Testing (BEET):

i. For each and every analog and discrete circuit, perform Basic End-to-End Testing (BEET). This includes, but is not limited to, all local control panels, MCCs, VFDs, and hardwired circuits in control panels.

ii. For each input, activate the signal at the primary field device, either by creating necessary process and equipment conditions or by disconnecting the wires at the field device and simulating the input signal. At the PLC, using the PLC programming software, verify proper receipt of the signal.

iii. For each output signal from the PLC, activate the PLC output signal using the PLC programming software, and verify proper receipt of the signal at the controlled device in the field, either by observing equipment operation or by disconnecting the wires at the equipment and verifying proper receipt of the signal.

iv. Verify proper signal receipt at all intermediate devices, such as indicators, signal trip and relay modules, etc.

v. The Loop/Component Inspections and Tests shall be implemented using District-approved forms and checklists.

vi. Each loop shall have a Loop Status Report to organize and track its inspection, adjustment and calibration. These reports shall include the following information and check off items with spaces for sign off by the system supplier:

a). Project Name.

b). Loop Number.

c). Tag Number for each component.

d). Check offs/signoffs for each component.

e). Tag/identification.

f). Installation.

g). Termination - wiring.

h). Termination - tubing.

i). Calibration/adjustment.

j). Signoffs/signoffs for the loop.

k). Panel interface terminations.

l). I/O interface terminations.

m). I/O signal operation.

n). Inputs/outputs operational: received/sent, processed, adjusted.

o). Total loop operation.

p). Space for comments.

q). Each active Analog Subsystem element and each I/O module shall have a Component Calibration Sheet. These sheets shall have the following information, spaces for data entry and a space for sign off by the system supplier:

1). Project Name.

2). Loop Number.

3). Component Tag Number of I/O Module Number.

4). Component Code Number Analog System.

5). Manufacturer (for Analog system element).

6). Model Number/Serial Number (for Analog system).

7). Summary of Functional Requirements. For example:

(a). For Indicators and Recorders: Scale and chart ranges

(b). For Transmitters/Converters: Scale and chart ranges

(c). For Computing Elements: Function

(d). For Controllers: Action (direct/reverse) control modes (PID)

(e). For Switching Elements: Unit range, differential (FIXED/ADJUSTABLE), reset (AUTO/MANUAL)

(f). For I/O Modules: Input or output

r). Calibrations; for example:

1). For Analog Devices: Required and actual inputs and outputs at 0, 25, 50, 75 and 100 percent of span, rising and falling.

2). For Discrete Devices: Required and actual trip points and reset points.

3). For Controllers: Mode settings (PID).

4). For I/O Modules: Required and actual inputs or outputs for 0, 10, 25, 50, 75 and 100 percent of span, rising and falling; 9 points calibration (5 points calibration will be rejected).

5). Space for comments.

6). Space for sign off by the ISS.

7). The ISS shall maintain the Loop Status Reports and Components Calibration sheets at the job site and make them available to the Construction Administrator/District at any time.

s). These inspections and tests do not require witnessing. However, the Construction Manager will review and initial all Loop Status Sheets and Component Calibration Sheets and spot-check their entries periodically and upon completion of the Operational Readiness Tests. Any deficiencies found shall be corrected.

c. Complete End-to-End Acceptance Tests (CEET):

i. For each PLC, CEET testing shall not commence until all Loop Acceptance Tests for the PLC have been satisfactorily completed, and all test results (including all forms signed off) have been submitted for review and accepted. For each and every analog and discrete circuit, perform an end-to-end test between the field device and the HMI computer operator station, and including all intermediate readouts. Also test each signal circuit transmitted over digital networks (i.e. ETHERNET, RS-422 links, etc.).

ii. In general, the end-to-end testing is a two or more person test. The Contractor shall provide personnel to operate equipment or simulate signals that are to be verified as part of this test.

iii. Check each loop from the field element to the respective computer control display. Include all intermediate field instruments, control devices, panels, indicators and other devices in the loop to ensure proper operation and linkage to computer control station displays.

iv. Analog signals shall be tested at 0, 50, and 100 percent of scale to verify the proper receipt on computer control displays.

v. Discrete input circuits shall be tested to verify proper state when the field device is switched between states. Discrete output circuits shall be tested to verify equipment responds properly (start, stop, etc.).

vi. Contractor shall provide adequate time in the Construction Schedule for CEET testing.

3. FUNCTIONAL ACCEPTANCE TEST (FAT)

   a. Prior to startup and the Functional Acceptance Test (FAT), the entire installed instrument and control system shall be certified that it is ready for operation. All preliminary testing, inspection, and calibration shall be complete as defined in the Operational Readiness Tests.

   b. Once the facility has been started up and is operating, a witnessed FAT shall be performed on the complete system to demonstrate that it is operating and in compliance with these Specifications. Each specified function shall be demonstrated on a paragraph-by-paragraph, loop-by-loop, and site-by-site basis.

   c. Strategy Field Testing (SFT):

      i. This test shall be performed by the Integrator with the assistance and cooperation of the Contractor. The Contractor shall provide a qualified start-up and testing representative on-site, assisting and participating in the testing full-time, for the duration of the SFT.

      ii. The Contractor shall include in the Construction Schedule at least two days of SFT testing work for each of the control strategies and shall provide staff for these periods, as required above for this work.

      iii. For each control strategy and for each electrical schematic diagram, demonstrate the proper operation of all hardware and software logic and control functions. Perform a step by step test of each function described in each control strategy.

      iv. Perform separate tests on each individual piece of equipment, and for each control loop.

      v. Perform the proper operation of each discrete control loop to ensure the proper operation of motors, hand switches, interlocks, solenoid valves, other auxiliary devices, status lights, computer control operator interfaces, and alarms.

      vi. Updated versions of the documentation specified to be provided for during the Factory Tests shall be made available at the job site both before and during the tests. In addition, one copy of all O&M Manuals shall be made available at the job site both before and during testing.

      vii. The system shall operate for a continuous 72 hours (3 days) without failure before this test will be considered successful.

1.2 QUALITY ASSURANCE

A. References:

1. Work specified in this Section shall follow the applicable code and standards: EIA, ANSI, IEEE, ISA and NFPA.

2. Where provisions of the pertinent codes and regulations, requirements of the referenced standards, or these specifications conflict, the more stringent of the requirements shall govern.

1.3 SUBMITTALS

A. General:

1. Make all submittals and resubmittals in strict accordance with the provisions of Division 1, Section 1A-7 - Submittals, Manuals, Operating Instructions, and Affidavits.

2. Make all submittals listed in Part 1.03-B, and any others required to fully describe what is to be furnished and/or installed under this Section.

B. Required Submittals:

1. Drawing index and detail part list.

2. System configuration diagrams

3. Hardware list and cutsheets.

4. Bill of materials.

5. Test plans consisting of Field Startup Functional Tests

PART 2 – PRODUCTS

2.1 MANUFACTURER AND SUPPLIER

A. The PLC shall be manufactured by Allen-Bradley CompactLogix series to match the District SCADA Standards. No other manufacturers are acceptable. The PLC and its auxiliaries shall be integrated in an empty section of a switchboard section. This integration shall be done and coordinated by a system integrator worked under the Contractor. Contractor shall provide complete wiring from the field to the I/O cards' terminals as detailed on the drawings. The PLC and its auxiliaries shall be as shown on the Drawings and as specified in this section:

B. Provide and install the following hardware to the PLC as shown on the drawings and as described in this section:

1. One 8-channel Analog Input cards model no. 1769-IF8

2. Two 16-point Digital Input cards model no. 1769-IQ16

3. One 16-channel Digital Output card model no. 1769-OW16

4. One 8-channel Analog Output card model 1769-OF8

5. Main CPU PLC model no. 1769-L33ER

6. Din-Rail supports

7. One industrial 12-port ETHERNET and two duplex LC fiber ports, switch Cisco Model# IE4000 Series and power supply Weidmuller 48VDC Model# 1469590000

8. UPS 1000VA, 120VAC input with 120VAC output, 4-hour batteries full load capacity manufactured by Best, Direct Automation, or Eaton.

9. Ethernet Radio made by Cambium Networks Model# PMP450i, 4.9GHz family of access points and Subscriber Module and yagi antenna as detailed on the drawings.

10. Security system controller Lenel model LNL-X2210

11. Card reader HID Model# RPK40/EM4102

12. Fiber-to-Copper media converter, din rail mounted or surface mounted, 48VDC, to convert fiber LC duplex signal to ETHERNET RJ45 communication port. The converters shall be manufactured by Moxa, Red Lion, or equal.

13. Din-rail mounted or surface mounted fiber patch panel with capacity to accommodate complete fiber wirings with LC connectors for a 12-strand fiber optic cable. The patch panels shall be manufactured by Leviton, Panduit, or equal.

14. Miscellaneous accessories such as fiber patch cables, ETHERNET patch cable, interposing 24VDC relays, DC Power supplies model PS24-150D, fuses, terminal strips, contact blocks, pulse converters, line surge protector, panel's security switch (GE Model 3025T-M, Interlogix, or equal), signal isolators, wire ducts, convenience outlet, wire troughs, UL-508A label with Short Circuit Current Rating of 22kA minimum, FLA.

C. Loose spare parts for no additional costs to the District:

1. One 8-channel Analog Input cards model no. 1769-IF8

2. One 16-point Digital Input cards model no. 1769-IQ16

3. One 16-channel Digital Output card model no. 1769-OW16

4. One 8-channel Analog Output card model no. 1769-OF8

PART 3 – EXECUTION

3.1 ACCEPTANCE TESTING

A. Perform final acceptance testing with the presence of the District and the District's representative. Demonstrate all correct signal wirings and control logics to the District's satisfaction. Retest shall be performed at no cost to the District if the first test is not satisfactory.

3.2 TRAINING

A. Provide two 4-hour training sessions for 2 plant personnel at the site. The training shall include classroom and hands-on practice of the system furnished.

B. Perform factory tests (FT) in the District's presence. Notify the District two weeks prior to actual scheduled factory test. See Part 1 for additional requirements.

END OF SECTION

ITEM No.	EQUIPTMENT DESCRIPTION	EQUIPT. NO.	FUNCTION NAME	LOOP NO.	SIGNAL FUNCTION	TYPE	DWG NO.	COMMENTS
1	Reservoir Hatch Intrusion	ZS-01	ZAH	01	Intrusion Alarm	DI		
2	Reservoir Level Transmitter	LT-1	LI	02	Level Ind.	AI		
3	Reservoir Level Switch	LS-02	LAH	02	Hi Hi Level Alarm	DI		
4	Switchboard Intrusion	ZS-03A ZS-03B	ZAH	03	Intrusion Alarm	DI		
5	Authorized Entry Acknowledge	ZS-03C	YL	03	Authorized Entry	DI		
6	Radio Enclosure Intrusion	ZS-04	ZAH	04	Intrusion Alarm	DI		
7	Altitude Valve Digital Link	ALT-1	ZIC	05	Valve Status/Control			
8	Control Power Status	MS	JA	06	Power Failure	DI		
9	UPS Status	UPS-1	YA	07	Low battery voltage	DI		
10	UPS Status	UPS-1	YA	07	Fail	DI		
11	UPS on Battery	UPS-1	YL	07	UPS on Battery	DI		
12	Future Mixer	MIX	HS	08	In Remote	DI		
13	Future Mixer	MIX	YL	08	Run	DI		
14	Future Mixer	MIX	YA	08	Fail	DI		
15	Future Mixer	MIX	SI	08	Speed Ind	AI		
16	Future Mixer	MIX	HS	08	Start/Stop Cmd	DO		
17	Future Mixer Speed Cmd	MIX	SIC	08	Speed Cmd	AO		

DI : Discrete Input
DO : Discrete Output
AI : Analog Input
AO : Analog Output

SECTION 13490

FIBER OPTIC SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section covers the requirements for providing all material, equipment fabrication, installation, calibration, testing, commissioning, and documentation of the Fiber Optic System.

1.02 SCOPE OF WORK

A. The Work of this Section includes providing a fiber optic conduit system, which includes the multimode fiber optic cable, connectors, splices, pull boxes, fiber accessories, and conduit.

1.03 CODES AND STANDARDS

A. All work performed and all material furnished shall conform to the applicable publications and standards of the organizations listed below. Latest edition and revisions shall be used as of the date of these Technical Specifications:

1. American Society for Testing and Materials (ASTM).

2. Electronic Industries Alliance/Telecommunications Industry Association (EIA/TIA).

3. National Electrical Manufacturer's Association (NEMA).

4. National Fire Protection Association (NFPA).

5. Underwriters' Laboratories (UL).

1.04 QUALIFICATIONS

A. All work specified under this Section shall be furnished and installed by a firm with at least ten successful installations of multimode fiber optic cable systems larger or comparable to this project.

B. The fiber optic cable installer shall be ETA Certified Fiber Optic Cable Technician (equivalent certification will be considered in a case by case basis, determined by the Owner) and shall be proficient in fiber optic splicing and termination and shall have a minimum of two years experience performing such work within the past three years.

C. The installation of the fiber optic system shall be under the supervision of a person having a minimum of 10 successful installation of multimode fiber optic cable, shall have construction experience, and testing fiber optic systems within the past 5 years.

1.05 RELATED SECTIONS

A. Section 13470 - SCADA PLC System.

1.06 SUBMITTALS

A. General:

1. Format: Orderly, indexed with labeled tab dividers.

2. In accordance with Section 01340 – Shop Drawings, Product Data and Samples.

B. Shop Drawings:

1. General:

a. Format: Orderly, indexed with labeled tab dividers.
b. Submittal Format and Requirements: In accordance with Section 01 34 00.
c. Shop drawings: Full scaled details, wiring diagrams, catalog cuts, and descriptive literature of all material to be provided.
d. Identify proposed items and options, installed spares, and other provisions for future work (e.g., reserved panel space; unused components, wiring and terminals).
e. Legends and abbreviation: Submit complete definitions of symbols and abbreviations used.
f. Drawings shall indicate exact conduit routings, indicating all pull boxes, conduit sizes, conduit bend radius and all necessary conduit related items.

C. Fiber Optic Cable Installer and Splicer Qualifications. Provide references and indicate that the installer meets all requirements indicated in Paragraph 1.04.

D. Fiber Optic Manufacturer Instructions.

E. Fiber Optic Field Test Plan.

1.07 QUALITY ASSURANCE

A. Fiber Optic System:

1. Provide drawings for the fiber optic cable and pathway system. Provide single line schematic details of the fiber optic and pathway media, and associated construction materials, including physical locations of all underground conduits, pull boxes, handholes, ductbanks, cable markers, and related hardware.

B. Fiber Optic Cable Installer and Splicer Qualifications:

1. Technicians installing FO media, splices and performing system tests shall be certified and trained as indicated in Paragraph 1.04. Submit Fiber Optic technician qualifications for approval 30 days before any work are to be made on the cable. Certification shall include, but not limited to, the training, and experience of the

individual on specific type and classification of fiber optic media to be provided under this contract.

C. Fiber Optic Field Tests Plan:

1. Prepare and provide technicians and test equipment for field tests of fiber optic media. Conduct OTDR reel tests at the job site prior to installation. Perform OTDR and end-to-end tests of all installed media. Conduct tests on multimode fiber in accordance with EIA TIA/EIA-526-14A for multi-mode fiber.

D. Manufacturer shall provide 25 years warranty on the fiber cables.

PART 2 - PRODUCTS

2.01 GENERAL

A. Materials and fiber optic system material shall be the standard products of a single manufacturer regularly engaged in the manufacturer of such products and shall be the manufacturer's standard commercially available product.

B. Fiber optic media shall meet all performance requirements of TIA-568-C.3, Optical Fiber Cabling Components Standard.

C. TIA-568.1-D, Commercial Building Telecommunications Cabling Standard

D. TIA-606-B, Administration Standard for Telecommunications Infrastructure

E. All transmission media, including but not limited to fiber optic cable, connectors, shall include a manufacturer’s 25-year extended product warranty.

2.02 FIBER OPTIC CABLE

A. Fiber Optic Media Type: Indoor/Outdoor Tight Buffered Plenum Rated Multimode.

B. Fiber Count: 12

C. Media Optic Characteristics:

1. Fiber core diameter: 62.5/125 micron

2. Wavelength (nm) 850/1310

3. Maximum Cabled Attenuation (dB/km) 3.5/1.5

4. Secondary Buffer Diameter (µm) 900

5. Max Tensile Load 2,700 N (600 lbs.) 900 N (200 lbs.)

6. Flame Retardancy UL Listed Type OFNP (ANSI/NFPA 262) and FT6 (CSA C22.2 No. 232)

7. Jacket Color Orange or Yellow

8. Impact Resistance, EIA/TIA-455-25A

9. Crush Resistance, TIA/EIA-455-41A

10. Operating Temperature -40°C to +85°C

11. Storage Temperature -40°C to +85°C

12. Installation Temperature (Actual temp. of cable) 0°C to +60°C

D. Fiber Optic Cable shall be Optical Cable Corp (OCC) Catalog No. DX012KWLS90P, Corning, Commscope, or equal.

2.03 FIBER-OPTIC CONNECTORS

A. Fiber-optic connectors shall be the LC Duplex type, push-pull hardware style, and field installable, self-aligning and centering. Fiber-optic connectors shall match the fiber core and cladding diameters. The connector shall have a short boot for strain relief. Fiber-optic equipment and cable shall use the same type connectors for correct mating. Connector insertion loss shall not exceed 0.2dB. Connectors must be capable of mounting on either 0.9 mm buffered fiber or 3.0 mm cordage. The connector shall be LC Duplex Mode Fiber-Optic Connector.

2.04 FIBER PATCH CORDS

A. Fiber patch cords shall consist of buffered, graded-index fiber with a 9 µm core and a 125 µm cladding consistent with all fiber properties required under Paragraph 2.02. The fiber cladding shall be covered by aramid yarn and a jacket of flame-retardant, low smoke material. Duplex fiber jumpers/patch cords with a factory installed connectors and a tension rating of 888 N (200-pound) on the cordage shall be provided. Cable retention shall be 220 N (50-pound) minimum, and connection repeatability shall yield 0.20 dB maximum change per 500 reconnects with connectors attached. Factory produced patch cords shall be of cordage sized at 3.0 mm and utilize connectors that provide a pull-proof non-optical disconnect feature. The patch cords shall be OCC Multimode to match with the specified cables.

2.05 FIBEROPTIC PATCH PANELS

A. The fiber optic enclosures shall be din-rail mounted or surface mounted with hinged door for multimode fiber cables for the PLC network shall be manufactured by OCC Catalog No. DCT2AP-6, LEVITON, PANDUIT, or equal.

PART 3 - EXECUTION

3.01 CONDUIT INSTALLATION

A. General

1. Conduit sections shall be installed in accordance with Section 16000. All joints shall be watertight.

2. All conduits shall be cleaned and tested prior to installation of cables.

3. Contractor shall install pull rope in the conduit.

4. Conduits entering pull boxes shall be sealed with Jackmoon Simplex duct plugs.

5. The conduit shall gradually and smoothly slope up to the elevation of the pull box entrance. Use of manufactured bends shall be limited to an absolute minimum. Factory bends, if required, shall be no more than 22½ degrees. Minimum radius for the conduit shall be 4 feet. No condulets are allowed.

6. Tags for the fiber cable shall be engraved stainless steel tag fastened to cable with non corrosive cable ties.

3.02 FIBER OPTIC CABLE INSTALLATION

A. General:

1. The Contractor shall determine a suitable cable installation method to ensure that all cable installation requirements shall be met in all conduit sections. All work shall be carried out in accordance and consistent with the highest standards of quality and craftsmanship in the communication industry with regard to the electrical and mechanical integrity of the connections; the finished appearance of the installation; as well as the accuracy and completeness of the documentation.

2. Fiber optic cables shall be installed from node to node i.e. PLC control panel to the next location in continuous lengths without intermediate splices throughout the project. Cable installation personnel shall be familiar with the manufacturer's recommended procedures including, but not limited to the following:

    a. Proper attachment to the cable strength elements for pulling during installation. Depending on cable design, this will involve direct attachment to internal strength members or attaching an external "Kellums" or split mesh grip using a 600 lb breakaway swivel.
    b. Cable tensile limitations and tension monitoring procedures.
    c. Cable bending radius limitations.
    d. Cable twisting limitations.
    e. It is preferred that all fiber cables be pulled with hand power only. Mechanical pull only allowed with consent of the Owner and the Engineer.

B. Cable Protection During Installation:

1. All fiber optic cables shall be pulled in conduit. Care shall be exercised during cable pulls through conduit bends and looping in pull boxes. For cable to be installed in occupied conduit, lubricated fish tape shall be used.

2. The Contractor shall comply with the cable manufacturer's recommended installation procedures at all times. Cable installation procedures shall conform to OCC MDIS Installation guidelines.

3. To reduce the possibility of damage to the outer jacket of the fiber optic cable, protective measures shall be used when the cable is installed. The requirements herein shall be followed, but does not limit the installation to only those identified. The purpose of the installation specifications is to ensure protection of the fiber optic cable when it is installed. Other protective measures not specified herein may be taken during installation if it will ensure protection of the cable.

4. Precautions shall be taken during installation to prevent the cable from being kinked, crushed or twisted. A pulling eye shall be attached to the cable end and be used to pull the cable through the duct and conduit system. As the cable is pulled off the reel and into the cable feeder guide, it shall be lubricated with a lubricant that shall be of the water- based type and approved by the cable manufacturer.

5. Crushed or kinked cable shall be replaced with new cable.

C. Lubrication: As the cable is pulled into the conduit system, it shall be sufficiently lubricated with a lubricant that shall be the water-based type and approved by the cable manufacturer. Lubricant shall be applied at a rate to provide a continuous 10-mil coating, as recommended by the manufacturer. Lubricant shall be Polywater F® manufactured by American Polywater.

D. To accommodate long continuous installation lengths, bi-directional "center pull" techniques for pulling of the fiber optic cable is acceptable and shall be implemented as follows:

1. From the midpoint, pull the fiber optic cable into the conduit from the shipping reel in accordance with the manufacturer's specifications.

2. When this portion of the pull is complete, the remainder of the cable must be removed from the reel to make the inside end available for pulling in the opposite direction.

3. This is accomplished by hand pulling the cable from the reel and laying into large "figure eight" loops on the ground cover with a plastic sheet.

4. The purpose of the figure eight pattern is to avoid cable tangling and kinking.

5. The loops shall be laid carefully one upon the other (to prevent subsequent tangling) and shall be in a protected area.

6. The inside reel end of the cable is then available for installation.

7. In some cases, it may be necessary to set up a winch at an intermediate cable vault. (If vaults are provided)

8. The required length of cable shall be pulled to that point, and brought out of the cable vault and coiled into a figure eight.

9. The figure eight is then turned over to gain access to the free cable end. This can then be reinserted into the duct system for installation into the next section.

E. Under no conditions shall the fiber optic cable be left exposed or unattended.

F. Repair of cable jacket shall not be permitted. Jacket damage shall require removal and re-installation of a new cable run at the Contractor's expense.

G. Splicing of fiber optic cable is not permitted. If cable is damaged, the cable shall be removed and new cable shall be installed at no cost to the Owner.

H. Minimum 5 service loops in manholes.

I. 25 feet of slack at cable terminations.

3.03 PULLBOXES

A. Field Location of Pull boxes

1. The drawings diagrammatically indicate the desired location of pull boxes, conduit runs and other items. Exact locations shall be determined by the Contractor based on physical size and arrangement of equipment, finished elevations, calculated cable pulling tensions, field obstructions.

2. Field verification of the conduit routings is required prior to execution of the work.

3.04 CONDUIT SYSTEM CLEANING AND TESTING

A. Conduit shall be tested for leakage by air testing at 5 psi, maintaining the pressure for one hour without showing any leakage.

B. The Contractor shall remove and replace conduit which fails either test and shall repeat the test.

3.05 FIBER OPTIC CABLE TESTING

A. General: The Contractor shall perform pre-installation and post-installation fiber optic cable tests. The Owner Representative shall be notified a minimum of 15 days in advance so that these tests are witnessed. All test equipment shall be traceable to NIST standards (National Institute of Standards and Technology).

B. Test equipment: The Contractor shall use the following to perform pre-installation and post-installation for the fiber optic cable tests:

1. Optical Time Domain Reflectometer (OTDR): The OTDR shall be laser precision, portable, latest model by Agilent Technologies.

C. Installation Tests: After fiber optic cable has been installed the following tests shall be performed:

1. A recording OTDR shall be used to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall be equipped with a 850 nm and 1300 nm light source for the multimode fiber (MM). The OTDR shall have an X-Y plotter to provide a hard copy record of each trace of each fiber. The OTDR shall be equipped with sufficient internal masking to allow the entire cable section to be tested. This may be achieved by using an optical fiber pigtail of 30 feet or more to display the required cable section.

2. The maximum permissible end-to-end loss shall be 0.5dB/km. The Contractor shall replace any cable in which any fiber does not meet this requirement.

3. The OTDR shall be calibrated for the correct index of refraction to provide proper length measurement for the known length of reference fiber.

4. A transmission test shall be performed with the use of a 850 and 1300 nm stabilized light sources and 1310 nm/1550 nm power meters for Single Mode. This test shall be conducted in both directions on each fiber of each cable.

5. Hard and electronic copy of test documentation shall be submitted to the Owner Representative. The documentation shall include the trace plot, index, dB/km loss, cable length, date and time of test, wavelength, pulse width, the test site, cable ID, fiber number and type, and operator's initials. The Contractor shall compare the pre-installation test results to the post-installation results. If a deviation of greater than one dB occurs, the Owner Representative shall be notified in writing by the Contractor, and the cable shall be removed and replaced at no additional cost to the Owner.

6. Upon completion of the previous tests all fiber optic cable coils shall be secured with ends capped to prevent intrusion of dirt and water.

3.06 RECORD DRAWINGS

A. In compliance with Division 1, the Contractor shall, upon completing the construction of the fiber optic system, submit to the Owner Record Drawings showing the following:

1. Horizontal alignment of fiber optic conduit

2. Location of all pull boxes using Station Number, and the exact Northing and Easting of each pull box using the North American Datum (NAD) 83 coordinate system.

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DIVISION 15 – MECHANICAL

SECTION 15000
GENERAL PIPING REQUIREMENTS AND APPURTENANCES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Contractor shall provide all piping systems indicated, complete and operable, in accordance with the Contract Documents.

B. The Drawings define the general layout, configuration, routing, method of support, pipe size, and pipe type. The Drawings are not pipe construction or fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, supports, anchors, and connectors for a complete and functional system.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01330, Submittals

B. Section 02200, Earthwork

C. Section 09610, Painting and Protective Coatings

D. Section 15040, PVC Pressure Pipe

E. Section 15076, Welded Steel Pipe

F. Section 15100, Valves, Gauges and Appurtenances

1.03 CONTRACTOR SUBMITTALS

A. General:

1. Submittals shall be furnished in accordance with Section 01330, Submittals.
2. Contractor shall incorporate pothole information into the pipe layout drawings, showing the size, depth and station of each utility potholed.

B. Shop Drawings: Shop drawings shall contain the following information:

1. Layout drawings including all necessary dimensions, stations and inverts, details, pipe joints, fittings, specials, valves, appurtenances, anchors, supports, guides, and material lists.
2. Fabrication drawings shall indicate all spool pieces, spacers, adapters, connectors, fittings, and supports to accommodate the equipment and valves in a complete and functional system.

C. Samples: All expenses incurred in making samples for certification of tests shall be borne by the Contractor at no increase in cost to the District.

D. Certifications

1. All necessary certificates, test reports, and affidavits of compliance shall be obtained by the Contractor and shall be submitted to the Engineer.
2. Fabricator Statement: A statement from the pipe fabricator certifying that all pipes will be fabricated subject to a recognized quality control program. An outline of the program shall be submitted to the Engineer for review prior to the fabrication of any pipe.

PART 2 - PRODUCTS

2.01 GENERAL

A. All products in contact with potable water shall be certified to NSF-61 and, where applicable, NSF-372 standards, per California Health and Safety Code Section 116875 (California AB-1953), unless otherwise exempt.

B. Extent of Work: All pipes, fittings, and appurtenances shall be provided in accordance with the requirements of the applicable sections of Division 15 and as indicated.

C. Pipe Supports: All pipes shall be adequately supported, restrained, and anchored in accordance with the requirements of the Contract Documents.

D. Pressure Rating: All piping systems shall be designed for the maximum expected test pressure.

E. Inspection: All pipe shall be subject to inspection at the place of manufacture. During the manufacture of the pipe, the Engineer shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with requirements.

F. Tests: Except where otherwise indicated, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable specifications and standards. The Contractor shall perform all tests at no additional cost to the District.

G. Welding Requirements: All welding procedures used to fabricate pipe shall be pre-qualified under the provisions of ANSI/AWS D1.1 - Structural Welding Code. 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.

2.02 POLYETHYLENE ENCASEMENT

A. Polyethylene encasement shall be used for all ferrous metal materials including those that are already protectively coated. This excludes welded steel pipe that has a tape wrap and cement mortar coating.

B. Polyethylene wrap or sleeves shall be used for the protection of buried ductile-iron pipe, appurtenances, and valves.

C. Polyethylene encasement shall be secured with 50mm (2”) wide polyethylene or vinyl adhesive tape or with plastic tie straps.

2.03 TRACER WIRE AND WARNING TAPE

A. Reference District Standard Specification II-B1-2.07. Warning tape is required on all underground utilities. Tracer wire is not required on the overflow piping.

B. Tracer wire for cathodic projection shall be printed with: "CAUTION CATHODIC PROTECTION CABLE BELOW".

2.04 GASKETS, BOLTS, AND NUTS

A. Gaskets, bolts, and nuts shall be as indicated in the District Standard Specifications (II-B1-2.09 and IIB1-2.11) and as described below.

B. Zinc-plated or fluoropolymer coated bolts and nuts shall be used for the installation of pipelines up to 500mm (20") diameter and shall be carbon steel. Bolts shall conform to ASTM A307, Grade A, and nuts shall conform to ASTM A563, Grade A, unless otherwise indicated on the approved drawings. Bolts and nuts shall have standard ANSI B1.1, Class 2A coarse threads.

C. Stainless steel bolts and nuts shall be used for the installation of pipelines 600mm (24") diameter and larger and for submerged flanges. Bolts and nuts shall be Type 316 stainless steel conforming to ASTM A193, Grade B8M for bolts, and Grade 8M for nuts.

D. All bolt heads and nuts shall be hexagonal, except where special shapes are required. Bolts shall be of such length that not less than 6.4mm (¼") or more than 12.7mm (½") shall project past the nut in tightened position.

E. All buried nuts and bolts shall be coated with a heavy coat of non-oxidizing grease.

2.05 TRANSITION AND FLEXIBLE COUPLINGS

A. Couplings shall be in accordance with the Approved Materials List and as described below:

1. Steel Couplings shall have middle rings made of steel conforming to ASTM A 36/A 36M, A 53 (Type E or S), or A 512 having a minimum yield strength of 207 MPa (30,000 psi). Follower rings shall be ductile-iron per ASTM A 536, or steel per ASTM A 108, Grade 1018 or ASTM A 510, Grade 1018. Minimum middle ring length shall be 175 mm (7") for pipe sized 150 mm (6") through 600 mm (24").
2. Sleeve bolts shall be made of stainless steel per ASTM A193 and shall have a minimum yield strength of 276 MPa (40,000 psi), an ultimate yield strength of 414 MPa (60,000 psi), and shall conform to AWWA C111.

B. All flexible couplings shall be fusion-bonded epoxy lined and coated in accordance with AWWA C213.

C. All flanged coupling adapters shall be fusion-bonded epoxy lined and coated in accordance with AWWA C213. Fasteners, nuts, and bolts shall be Type 316 stainless steel.

2.06 FLEXIBLE EXPANSION JOINTS

A. Flexible expansion joints shall be installed in the locations indicated on the drawings and shall be manufactured of ductile iron conforming to the material requirements of ASTM A536 and ANSI/AWWA C153/A21.53.

B. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 350 psi. A minimum 2:1 safety factor, determined from the published pressure rating shall apply. Factory Mutual Approval for the 3 inch through 12 inch sizes is required.

C. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 20°, 2”-12”; 15°, 14”-36”.

D. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating shall meet ANSI/NSF-61.

E. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.

F. Appropriately sized polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be included for direct buried applications.

G. Bedding for flexible expansion joints shall be installed per manufacturer’s recommendations.

H. Flexible expansion joints shall be FLEX-TEND as manufactured by EBAA Iron or approved equal.

2.07 GROVED-END OR SHOULDERED COUPLINGS FOR DUCTILE IRON OR STEEL PIPE

A. Grooved-end or shouldered couplings shall be as described below:

1. Use square-cut shouldered or grooved ends per AWWA C606. Grooved-end couplings shall be malleable iron per ASTM A 47, or ductile iron per ASTM A 536. Gaskets shall be per ASTM D 2000.
2. Bolts for exposed service shall conform to ASTM A 183, 69 MPa (10,000 psi) tensile strength.

2.08 JOINT RESTRAINT

A. Welded steel pipe shall have fully welded joints to provide a fully restrained piping system.

B. PVC and connection to existing PVC piping systems shall have restraint systems consisting of mechanical restraining systems and/or gravity concrete thrust blocks.

C. Thrust blocks shall be per District Standard Drawings W-2 and W-3.

D. Joint Restraint Systems shall be selected from the Approved Materials List.

1. A minimum pressure rating of 250psi of pipe is required for all engineered restraint systems. All approved restrain system products must meet a 2:1 safety factor.
2. Split ring style joint restraint rods and nuts shall be 304 stainless steel for all applications in accordance with AWWA/ANSI C111/A21.11 and provide a minimum 45,000 psi yield and 60,000 psi tensile strength or as approved by the District Engineer. Unless otherwise approved, all parts and hardware for the joint restraint systems are to be supplied by the restraint manufacturer. Clamping ring shall be manufactured of high strength ductile iron in accordance with ASTM A536, grade 65-45-12.

3. Gland style joint restraint rings and its wedging components shall be constructed of ductile iron conforming to ASTM A 536, Grade 65-45-12. The wedges shall be ductile iron, heat-treated to a minimum hardness of 370 - 470 BHN. Dimensions of the gland shall be such that it can be used with mechanical joint bells conforming to AWWA C111 and AWWA C153. The design shall use torque limiting twist-off nuts to provide actuation of the restraining wedges.

2.09 COPPER PIPE

A. Copper pipe shall be Type K soft copper tubing with solder fittings. Solder fittings shall be lead-free. Solder shall be of the type certified for use in potable water applications as specified in AWWA Standard C800.

2.10 SERVICE SADDLES

A. Service saddles shall be either doublewide strap type made of bronze with bronze nuts, or stainless steel double steel strap type. The thread shall be female iron pipe.

B. Acceptable manufactures are as listed in the District's Approved Materials List.

2.11 CORPORATION (CORP) STOPS

A. Corp stops shall be bronze with a male iron pipe thread on the inlet side. 1-inch and 2-inch Corp stops shall be of the ball valve type.

B. Acceptable manufactures are as listed in the District's Approved Materials List.

2.12 ANGLE METER BALL VALVE STOP

A. Standard angle meter ball valve stops shall be bronze and 1-inch in size, in the 2-inch size they shall be flange angle meter ball valve.

B. Acceptable manufactures are as listed in the District's Approved Materials List.

2.13 LUBRICATION FOR STAINLESS STEEL NUTS AND BOLTS

A. Apply a liberal coat of an anti-seizing compound to the threads of all stainless steel nuts and bolts, and to the face of all washers.

2.14 DIELECTRIC NIPPLES

A. Dielectric nipples shall create a dielectric waterway to inhibit galvanic corrosion between two dissimilar metals. Dielectric nipples shall be Schedule 40 carbon steel with plastic lining confirming to the requirements of ASTM A53 and ASTM F1545. Dielectric nipples shall be Victaulic Dielectric Waterway, or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

A. All pipes, fittings, and appurtenances shall be installed in accordance with the requirements of AWWA and the applicable sections herein.

3.02 MATERIAL DELIVERY, STORAGE, AND PROTECTION

A. Delivery: All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition. All defective or damaged materials shall be replaced with new materials.

B. Onsite Storage Limitation: Onsite storage shall be limited to working areas unless exception is approved by the District.

C. Care of Pipe: Care shall be taken to avoid cracking of the cement mortar coating and/or lining on steel pipe. Plastic sheet caps shall be used to close pipe ends and keep coating and linings moist.

D. Stored pipe shall at all times be supported on sawdust bags, sand bags, or other suitable support. Bags shall be of sufficient size to prevent contact of the pipe coating with the ground or any other obstruction. Rolling the pipe on the ground will not be permitted.

3.03 HANDLING OF PIPE AND FITTINGS

A. Pipe shall be transported from the plant to the job site on padded bunks with nylon tie-down straps or padded banding to adequately protect the pipe and coating.

B. Each section of pipe 16 inches in diameter and larger, including bends and special fittings, shall be protected from undue deformation during handling, transportation and installation by proper internal bracing. The bracing shall be placed near each end of the pipe and at suitable intervals between the end bracings, as required to prevent the pipe from exceeding 1.0 percent deformation measured on the pipe diameter. Such 1.0 percent deformation shall be a total combination of pipe deflection and the pipe manufacturer's tolerances, in accordance with AWWA C200, AWWA C205, AWWA C151, and AWWA C110, as applicable.

C. Bracing shall have a minimum of six points of bearing on the pipe and shall be fitted to the curvature of the interior pipe surface and shall be wedged against the mortar lining in a manner that will secure the bracing during handling, installation and backfilling and shall also prevent damage of the interior lining. All internal bracing shall remain in place until the pipe has been installed and backfilled, or until its removal is otherwise authorized by the District.

D. Pipe shall be handled, stored and shipped in a manner that will prevent damage to the coating and lining. Pipe shall be handled with wide belt slings or rubber padded forklifts. Chains, cables or other equipment likely to cause damage to the pipe or coating shall not be used.

E. No metal tools or heavy objects shall be permitted to come into contact unnecessarily with the finished coatings and linings. Workmen will be permitted to walk upon the coating only when necessary, in which case they shall wear shoes with rubber or composition soles and heels. All pipe and fittings, specials and couplings shall be examined before laying and no piece shall be installed that is found to be defective. Any damage to the coatings and linings shall be repaired as acceptable to the District.

F. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner by the Contractor, at his own expense.

G. Fittings shall be lowered into trench by means of rope, sling, or other acceptable means without damage to the fittings. Rope, sling or other devices used for lowering fitting into trench shall be attached around exterior of fitting for handling. Under no circumstances shall the lifting device be attached through the fittings interior for handling. Fittings shall be carefully connected to pipe or other facility, and joints shall be checked to ensure a sound and proper joint.

3.04 PLACEMENT OF PIPE IN TRENCH

A. General: Dewatering, excavation, shoring, sheeting, bracing, backfilling material placement, material compaction, compaction testing, and pipe laying requirements and limitations shall be in accordance with Section 02200, Earthwork.

B. Sanitation of Pipe Interior: During laying operations, tools, clothing, or other materials shall not be placed in or allowed in the pipe.

C. Prevention of Entry into Pipe: When pipe laying is not in progress, including lunch-hour, the ends of the pipe shall be closed using vermin-proof plugs constructed in a manner to also prevent entry by children.

D. Laying Pipe on Grades over 10 Percent: Pipes shall be laid in an upgradient direction whenever the grade exceeds 10 percent.

E. Depressions at Joints and Pipe Sling Points: Depressions shall be dug into pipe base material to accommodate the pipe bell and external joint filler form, and to permit removal of the pipe handling slings.

F. Placement of Pipe on Pipe Base: Pipe shall be lowered onto the bedding and installed to line and grade its full length on firm bearing except at the bell and at sling depressions. Unless specified otherwise, the tolerance on grade shall be 1/4 inch; the tolerance on line shall be 1 inch. Grade shall be measured along the pipe invert.

G. Pipe Installation: Pipe shall be installed without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Precaution shall be taken to prevent pipe from being displaced by water entering trench. Damaged or displaced pipe shall be replaced or returned to specified condition and grade.

H. Pipe Deflection: The deflection at any flexible joint shall not exceed that prescribed by the manufacturer of the pipe. The manufacturer's printed installation guide outlining the radius of curvature that can be negotiated with pipe sections of various lengths shall be followed.

I. Equipment for Installation of Pipe: Proper implements, tools, and facilities as recommended by the pipe manufacturer's standard printed installation instructions shall be provided and used by the Contractor for safe and efficient execution of the work. All pipe, fittings, valves, and accessories shall be carefully lowered into the trench using suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

J. Cutting and Machining Pipe: Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, or any other method that may fracture the pipe or produce ragged, uneven edges.

3.05 FLANGED CONNECTIONS

A. Bolthole Alignment: Pipe shall be set with flange boltholes straddling the pipe horizontal and vertical centerlines.

3.06 BLOW-OFF ASSEMBLIES

A. General: In-line type or end-of-line type blow-off assemblies shall be installed in accordance with the Drawings at the locations noted.

B. Location: The assembly shall be installed in a level section of pipe. The tap for blow-off in the line shall be no closer than 12 inches to a valve, coupling, joint, or fitting unless it is at the end of the main.

3.07 FIELD REPAIR OF DAMAGED COATINGS

A. All surfaces of metallic appurtenances in contact with potable water and not protected from corrosion by another system shall be shop-coated by the manufacturer. Appurtenances with damaged coatings shall be repaired or replaced as directed by the District Engineer. Touch-up of damaged surfaces, when allowed by the District Engineer, shall be performed in accordance with the manufacturer’s recommendations.

3.08 CLEANUP

A. After completion of the work, all remaining pipe cuttings, joining and wrapping materials, and other scattered debris shall be removed from the site. The entire piping system shall be handed over in a clean and functional condition.

END OF SECTION

SECTION 15035
PVC GRAVITY PIPE (SDR-35)

PART 1 - GENERAL

1.01 Description

A. Furnish all labor, materials, equipment, and incidentals required, and install polyvinyl chloride (PVC) gravity pipe and appurtenances as shown on the Drawings and as specified herein.

1.02 Related Work Specified Elsewhere

A. Section 01340, Shop Drawings, Product Data and Samples

B. Section 02223, Trenching, Excavation, Backfill and Compaction

C. Section 15000, General Piping Requirements and Appurtenances

1.03 INSPECTION AND TESTS

A. All pipe and accessories to be installed under this Contract shall be inspected and tested at the place of manufacture by the manufacturer as required by the Standard Specifications to which the material is manufactured.

B. In the event that any of the test specimens fail to meet the applicable standards, all pipe presented by such tests shall be subject to rejections. The Contractor may furnish two additional test specimens from the same shipment or delivery for each specimen that failed and the pipe will be considered acceptable if all of these additional specimens meet the requirements of the applicable standards.

C. Pipe which has been rejected by the Engineer shall be removed from the site of the work by the Contractor and replaced with pipe which meets these specifications.

PART 2 - PRODUCTS

2.01 GENERAL

A. All products in contact with potable water shall be certified to NSF-61, per California Health and Safety Code Section 116875 (California AB-1953).

2.02 PVC Gravity Pipe (Gasketed)

A. PVC gravity pipe and fittings 4-inch through 15-inch diameter shall be as noted on the Approved Plans.

1. SDR 35 conforming to ASTM D3034 - Standard Specification for Type PSM PVC Sewer Pipe and Fittings. Each length of pipe and fitting shall be marked with the nominal size, the SDR designation, the name of the manufacturer or trademark, and the date of manufacture.

a. The pipe shall be joined with an integral bell and spigot type rubber gasketed joints. Each integral bell joint shall consist of a formed bell with a rubber gasket. Flexible gasketed joints shall be elastomeric compression types conforming to ASTM F 1336, ASTM D 3201 and ASTM F 477. Joints shall permit contraction, expansion and settlement, and yet maintain a watertight connection. Joints shall be tested in accordance with ASTM D 3212. Rubber gaskets shall be marked with manufacturer's identification sizes and proper insertion direction.

b. Pipe shall be furnished in standard laying lengths not exceeding 20 feet and shall be colored green in accordance with the Utility Location and Coordination Council Uniform Color Guide.

c. All fittings and accessories shall be furnished by the pipe supplier and shall have bell and/or spigot configurations compatible with the pipe.

B. PVC gravity pipe shall include the installation of Warning/Identification Tape in accordance with Section 15000.

PART 3 - EXECUTION

3.01 Delivery and Temporary Storage

A. Storage of pipe on the job site shall be done in accordance with the pipe manufacturer's recommendation and with approval of the Engineer.

B. At times when pipe laying is not in progress, the pipe shall be closed with a tight fitting cap or plug to prevent the entrance of foreign matter into the pipe.

3.02 Laying Gravity PVC Pipe and Fittings

A. PVC gravity pipe shall be laid in accordance with the instructions of the manufacturer and ASTM D2321, "Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe." Pipe shall be laid upgrade without a break from structure to structure, with bell ends of the pipe upgrade. Bell holes shall be excavated so that after installation only the pipe barrel shall bear upon the trench bottom. No blocking under the pipe will be permitted.

B. For pipelines less than 12 inches in diameter, a single laser level beam shall be utilized and centered inside the pipe.

C. Use care in handling and installing pipe and fittings. Pipes shall be lifted with handling beams or wide belt slings as recommended by the pipe manufacturer. Under no circumstances shall pipe or fittings be dropped either into the trench or during unloading. The interior of the pipe shall be kept clean of oil, dirt, and foreign matter, and the machined ends and couplings shall be wiped clean immediately prior to jointing.

D. Use a PVC pipe cutter where necessary to cut and machine all PVC pipe in the field. A "full insertion mark" shall be provided on each field cut pipe end. Field-cut pipe shall be

beveled with a beveling tool made especially for plastic pipe. Bevels shall be in accordance with the manufacturer's requirements.

E. Pipe stubs for all manhole connections shall not exceed 3 feet in length unless otherwise shown on the drawings. Install caps where required.

3.03 Lateral Connections Utilizing Gravity PVC Pipe

A. All connections into existing gravity PVC pipe shall be made with a PVC solvent welded wye saddle. Where PVC pipe joins alternate materials a PVC wye with coupling adaptors shall be used to join the pipes.

B. The pipe to be saddled shall be scored to the approximate shape of wye and shall be cut with a hole cutter. The tap holes shall be cleanly machined and may be further worked by hand to provide a true neat opening for the collar wye saddle. Pipe damaged during this operation shall be repaired or replaced. The District's Representative shall be the sole judge as to the method of repair or replacement.

C. After the connection has been made, the Contractor shall encase the fitting with concrete per City of Simi Valley Standard Plan No SV 40-190.

3.04 Tests for Gravity Pipe

A. Gravity pipe shall be required to pass a leakage test before acceptance. Leakage tests shall be as described in Section III-B3 for the District Standard Specifications.

END OF SECTION

SECTION 15045
PVC SCHEDULE 80 PLASTIC PIPE

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Materials, testing, and installation of PVC Schedule 80 plastic pipe for drain pipes, 6" or less in diameter.

1.02 RELATED WORK

A. Section 01340, Shop Drawings, Product Data and Samples

B. Section 01660, Testing and Training

C. Section 02223, Trenching, Excavation, Backfill and Compaction

D. Section 15000, General Piping Requirements and Appurtenances

1.03 SYSTEM DESCRIPTION

A. Furnish and install complete operating piping system including appurtenant mechanical connections required for compliance with Manufacturer's installation requirements and compliance with applicable building codes and standards.

B. Pipes and fittings in contact with potable water shall be ANSI/NSF 61 certified.

1.04 QUALITY ASSURANCE

A. Pipe, tubing and fittings shall bear NSF seal except for drainage piping.

B. Pipe and fittings shall be produced by same Manufacturer

C. Mark pipe with nominal size, type, class, schedule or pressure rating, and Manufacturer.

D. Factory testing shall include PVC Piping, Schedule, Type. Mark pipe and fittings in accordance with ASTM D1785

1.05 REFERENCES

A. Reference publications below form part of this specification to extent referenced and are referred to within text by basic designation only.

1. ASME/ANSI B1.20.1 (ANSI B2.1) Pipe Threads – NPT National Pipe Thread Taper
2. ASME/ANSI B16.5 Steel Pipe Flanges and Flanged Fittings (Including ratings for Class 150, 300, 400, 600, 900, 1500, and 2500)
3. ASTM D656 Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
4. ASTM D1599 Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings
5. ASTM D1784 Rigid Poly(Vinyl-Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl-Chloride) (PVC) Compounds
6. ASTM D1785 Poly(Vinyl-Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
7. ASTM D2241 Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
8. ASTM D2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
9. ASTM D2466 Poly(Vinyl-Chloride) (PVC) Plastic Pipe Fittings, Schedules 40, 80 and 120
10. ASTM D2467 Socket-Type Poly(Vinyl-Chloride) (PVC) Plastic Pipe Fittings Schedule 80

11. ASTM D2485 Recommended Practice for Making Solvent-Cemented Joints with Poly(Vinyl-ASTM D2564 Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Pipe and Fittings
12. Chloride) (PVC) Plastic Pipe and Fittings
13. ASTM D2774 Underground Installation of Thermosetting Pressure Piping
14. ASTM D2855 Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
15. ASTM F402 Safe Handling of Solvent Cements, Primers and Cleaners Used for Joining Thermoplastic Pipe and Fittings
16. ASTM F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe
17. ASTM F645 Selection, Design and Installation of Thermoplastic Water Pressure Piping Systems
18. ASTM F656 Primers for Use in Solvent Cement Joints of Poly(Vinyl-Chloride) (PVC) Plastic Pipe and Fittings
19. ASTM F1498 Taper Pipe Threads 60° for Thermoplastic Pipe and Fittings
20. ASTM F1970 Special Engineered Fittings, Appurtenances or Valves for use in Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Systems
21. California Green Building Standards Code (CALGreen Code)
22. Code of Federal Regulations Title 49
23. NSF/ANSI 14 Plastics Piping System Components and Related Materials
24. Plastic Pipe Institute PE 3408

1.06 SUBMITTALS

A. Shop drawing submittals for piping under this section shall include all data and information required for the complete piping systems. All dimensions shall be based on the actual equipment to be furnished.

B. The Contractor shall submit shop drawings and catalog cuts for the pipe and any other equipment supplied under this section, in accordance with the Specifications.

C. Submit the pipe manufacturer's recommendations for handling, storing, and installing pipe.

D. Furnish one -year warranty from date of final acceptance

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect piping materials from sunlight, scoring and distortion.

B. Do not allow surface temperatures on pipe and fittings to exceed 120°F.

C. Strictly follow Manufacturer’s instructions and warranty requirements for delivery, storage, and handling of PVC plastic pipe and fittings.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Acceptable Manufacturers include:

ITEM	MANUFACTURER	MANUFACTURER LOCATION
PVC Pipe and Fittings		
PVC Plastic Pipe and Fittings ⅜”-24”	GF Harvel Plastics, Inc.	Irvine, CA (800) 854-4090
	Harrington Industrial Plastics, Inc.	Chino, CA (909) 597-8641
	J.M. Eagle, Inc.	Los Angeles, CA (800) 621-4404
	North American Pipe Corporation / Westlake Chemical	Janesville, WI (608) 754-2710
	Pacific Plastics	Brea, CA (714) 990-9050
	Spears Manufacturing Company	Sylmar, CA (818) 364-1611
	Accepted equal	

ITEM	MANUFACTURER	MANUFACTURER LOCATION
Solvent Cement PVC	T Christy Enterprises, Inc. Red Hot Blue Glue, Low VOC	Anaheim, CA (714) 507-3300
	IPS Corporation Weld-On 705 or 711	Gardena, CA (310) 516-0108
	Spears Manufacturing Company PVC 05 or PVC 11	Sylmar, CA (818) 364-1611
	Accepted equal compatible with pipe material, and CALGreen Code and SCAQMD requirements	
Double-Containment Pipe		
Double-Containment Pipe, Fittings and Appurtenances	NOV Ameron Bondstrand (FRP)	Blackburnett, TX
	Flo Safe / Orion / Watts Water Technologies (PVC/PP)	Waukesha, WI (913) 342-1653
	George Fischer, Inc. (PVC)	Irvine, CA (800) 854-4090
	Encase Div IPEX (PP)	Pineville, NC (704) 889-2431
	Guardian Div IPEX (PVC/CPVC/FRP)	Pineville, NC (704) 889-2431
	Spears Manufacturing Company (PVC/CPVC)	Sylmar, CA (818) 364-1611
	Accepted equal	

A. Materials for PVC pipe used for temperatures to 90°F, shall conform to Conform to ASTM D1785

B. Materials for PVC pipe joints shall be:

   a. Joints

      i. Restrained Style

      ii. Solvent-welded socket joints except at valve connections

      iii. Provide threaded or flanged adaptors as required for valve connections

   b. Solvent Cement:

      i. ASTM D656 primer

      ii. ASTM D2564 solvent cement

C. Refer to Section 15000 for requirements for identification, identification tape and warning tape for buried pipe.

PART 3 - EXECUTION

3.01 PREPARATION

A. Make field measurements needed to install PVC plastic pipe before submitting shop drawings or ordering. Make minor changes in dimensions and alignments as needed to avoid utilities or structural conflicts.

B. Clean dirt and moisture from pipe and fittings. Bevel pipe ends per Manufacturer's instructions with chamfering tool or file. Remove burrs.

3.02 INSTALLATION

A. Provide molded transition fittings for transitions from plastic to metal or IPS pipe. Do not thread plastic pipe.

B. Locate unions where shown and where needed for easy access and assembly of piping system.

C. For pipe used as sleeves, bends shall be accommodated with the use of wyes rather than 90-degree elbows for ease of pulling tubing through the conduit run.

D. Install solvent-welded PVC pipe as follows:

1. Do not solvent weld joints when ambient temperatures are below 40°F or above 90°F unless solvents specifically formulated for these conditions are used.
2. De-burr and bevel pipe surfaces to be solvent-welded.
3. Clean and dry pipe surfaces to be solvent-welded.
4. Use only solvent recommended by Manufacturers of pipe and fittings.
5. Apply solvent with non-synthetic bristle brush no less than ½ nominal size of pipe diameter.
6. Follow proper primer and cement application sequence as described in ASTM D2855.
7. Apply even coat of solvent to inside of fitting and to outside of pipe on full area to be inserted into fitting socket.
8. Insert pipe into fitting to full depth immediately after coating, and then rotate pipe 90 degrees to distribute solvent and remove air bubbles.
9. Remove excess solvent from outside of joint.
10. Each joint shall remain undisturbed for at least 30 minutes to develop handling strength.
11. Allow 24 hours drying time before pressure testing.

A. Refer variances between Manufacturer's installation instructions and Contract Documents to Owner's Representative.

3.03 FIELD QUALITY CONTROL

A. Field testing shall include hydrostatic testing per Section 01660
B. For double containment piping:
   a. Hydrostatic Test or Air Test
   b. Sensing System - Verify operation by filling with water and then draining

3.04 PROTECTION

A. When pipe laying is not in progress, and during noon hour and overnight, close open end of pipe with tight-fitting cap or plug to prevent entrance of foreign matter into pipe.

B. Do not use pipeline to drain water that has infiltrated into trench.

C. Maintain inside of pipe free from foreign materials and in clean and sanitary condition until acceptance by Owner.

END OF SECTION

SECTION 15056
DUCTILE IRON PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes materials and installation procedures for ductile iron pipe and fittings for potable systems.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 01330, Submittals

B. Section 02200, Earthwork

C. Section 15000, General Piping Requirements and Appurtenances

D. Section 15030, Pressure Testing and Disinfection

1.03 REFERENCES

ASTM C 150	-	Standard Specification for Portland Cement
AWWA C104	-	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
AWWA C110	-	Ductile-Iron and Gray-Iron Fittings
AWWA C111	-	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C150	-	Thickness Design of Ductile Iron Pipe
AWWA C151	-	Ductile-Iron Pipe, Centrifugally Cast
AWWA C153	-	Ductile-Iron Compact Fittings
AWWA C217	-	Cold-Applied Petroleum Wax Tape Coatings
AWWA C600	-	Installation of Ductile-Iron Mains and Their Appurtenances

1.04 SUBMITTALS

A. Shop drawing submittals shall include all data and information required for the complete piping systems. All dimensions shall be based on the actual equipment to be furnished.

B. The Contractor shall submit shop drawings and catalog cuts for the fittings and any other equipment supplied under this section, in accordance with the Specifications.

C. Submit the manufacturer's recommendations for handling, storing, and installing fittings.

1.05 QUALITY ASSURANCE

A. Ductile iron fittings shall carry a current certification of the National Sanitation Foundation (NSF) as acceptable to use in the transport of potable water.

B. The manufacturer of each shipment of ductile-iron fittings shall be required to supply a statement certifying that each lot or load of fittings has been subjected to and met the tests specified for ductile-iron fittings per AWWA C110 and C153, as applicable.

PART 2 - MATERIALS

2.01 DUCTILE IRON PIPE

A. Pipe shall be ductile iron conforming to AWWA C151. Provide pipe in pressure classes at locations and in lengths as shown on the drawings. Where not shown in the drawings, use pressure class 250. The minimum wall thickness for DIP shall be as specified in AWWA C150 for the design pressure class, and thickness Class 53 for flanged or grooved end spools.

2.02 DUCTILE IRON FITTINGS

A. General:

1. Ductile-iron fittings shall be manufactured per AWWA C110 and C153. Gray-iron or cast-iron fittings shall not be used. Gray iron or cast-iron flanges shall not be used.
2. Ductile-iron fittings shall be mechanical, flanged, or push-on joints in accordance with AWWA C110, and C153. Pipe shall be manufactured in accordance with AWWA C900, cast iron outside diameter, Class 305 (DR 14), unless otherwise indicated on the Drawings. The pipe shall have integral bell joints, complete with a gasket installed by the manufacturer. All joints shall be restrained.
3. Except as amended herein, or otherwise shown on the Approved Plans, joints for ductile-iron fittings shall have a pressure rating equal to or greater than the adjacent piping.

B. Unless otherwise specified, ductile-iron flanged fittings shall be integrally cast in accordance with AWWA C110, rated at a working pressure of 1,724 KPa (250 psi). Gray-iron or cast-iron flanged fittings are not permitted.

C. Ductile-iron fittings and appurtenant components and materials shall be selected from the Approved Materials List and in accordance with the Standard Drawings.

2.03 OUTLETS

A. For outlets 3 inches and smaller, use a ductile iron tapping saddle.

B. For outlets 4 inches and larger, use a tee with a flanged outlet.

2.04 GASKETS

A. Mechanical-joint rubber gasket configuration and materials shall comply with AWWA C111 and shall be in accordance with the applicable joint type and pressure rating of the piping system.

B. Flange gaskets shall be 3.2mm (1/8") thick aramid fiber bound with nitrile for all sizes of pipe. Gaskets shall be full-face type with pre-punched holes or ring-type extending to the inner edge of the bolt circumference of the flange. Ring-type gaskets may only be used as directed by the District Engineer.

C. Push-on joint rubber gaskets shall be per AWWA C111.

D. If soil contaminated with organic solvents or petroleum products are encountered during the course of the work, alternate gasket materials or joint treatment may be required by the District Engineer.

2.05 LINING

A. The interior of pipe and fittings shall be cement-mortar lined in accordance with AWWA C104. Unless otherwise noted on Plans, lining thickness shall be the minimum thickness listed in AWWA C104, Section 4.8. Cement-mortar shall be in accordance with ASTM C 150, Type II or Type V. A seal coat shall be provided.

B. Where specifically called for in the plans, pipe and fittings shall be fusion-bonded epoxy lined and coated (FBEL&C) in accordance with ANSI/AWWA C116. The lining and coating material shall be 100 percent powder epoxy, certified as compliant with NSF Standard 61. Coating and lining shall be Scotchkote 134, 206N, or approved equal, applied to a minimum dry film thickness of 14 mils.

2.06 COATINGS

A. The exterior surfaces of pipe and fittings located indoors, in vaults and structures, and above ground shall be as follows:

1. Exposed Metal, Atmospheric Weathering Environment

Type: High build epoxy and Polyurethane.

Service Conditions: Use on metal structures, steel and ductile iron piping, pumps, valves, fittings, and appurtenances subject to sunlight or atmospheric weathering.

Surface Preparation: As required by Manufacturer's published recommendations.

Prime Coat: Shall be shop-applied. One coat of 6-8 mils dry-film thickness or as recommended by Manufacturer. Coating shall be Tnemec 'Hi-Build Epoxoline II Series L69", Devoe Bar-Rust 231LV, or approved equal.

Finish Coat: Two coats of 2-3 mil dry-film thickness each coat. Coating shall be Tnemec "Endura Shield Series 1080", Devoe "Devthane 379H", or approved equal.

B. The exterior surfaces of all buried pipe and fittings shall be factory coated with a zinc inner layer per ISO 8179-1 as well as a minimum one (1) mil thick petroleum asphaltic material per AWWA C110, C151, and C153, unless otherwise noted on Plans.

C. Materials for coating buried mechanical joints and hardware shall be in accordance with Section 15000.

2.07 POLYETHYLENE ENCASEMENT

A. Polyethylene encasement shall be in accordance with Section 15000 and selected from the Approved Materials List.

B. Wrap all buried ductile iron piping, valves, fittings, and specials, etc. in two (2) layers of 8 mil polyethylene film per ANSI A21.5/AWWA C-105. Valves shall be covered with Trenton primer and wax tape followed by polywrap. Use only tube type for pipe. Complete the wrap prior to placing concrete anchors, collars, supports or thrust blocks. Repair polyethylene if damaged during installation.

C. V-BIO Enhanced Polywrap, no equal.

2.08 JOINT RESTRAINTS

A. Install joint restraints and/or thrust blocks as indicated on the Drawings and per Section 15000.

PART 3 - EXECUTION

3.01 GENERAL

A. At all times when the work of installing pipe is not in progress, including worker break times, the ends of the pipe shall be closed with tight-fitting, vermin-proof and child-proof caps or plugs. Do not permit trench water to enter the pipe. Do not place tools, clothing, or other materials in the pipe. The Contractor shall maintain the interior of the pipe in a sanitary condition free from foreign materials at all times.

B. Proper care shall be used to prevent damage in handling, moving and placing the pipe. All pipe, fittings, valves, and other pipeline materials shall be lowered into the trench in a manner that prevents damage. The pipe shall not be dropped, dragged or handled in a manner that will cause bruises, cracks, or other damage. PVC pipe that has been gouged, scratched, or otherwise damaged shall be subject to rejection at the discretion of the District Engineer.

C. Where pipe lengths less than the standard 20 feet are required, the pipe sections shall be installed in accordance with the manufacturer's installation guide and shall only be used as specified herein or with the approval of the District Engineer.

3.02 TRENCHING, BACKFILLING AND COMPACTION

A. See section 02200.

3.03 FLANGED FITTINGS

A. Flanged fittings shall be installed where indicated on the Approved Drawings.

1. Bolt holes shall straddle the vertical centerline.
2. The bolts, nuts and flange faces shall be thoroughly cleaned by wire brush prior to assembly.
3. Bolts and nuts shall be lubricated with a District-approved anti-seize compound.
4. Nuts shall be tightened in an alternating "star" pattern to the manufacturer's recommended torque.
5. Coat the exterior of exposed flanges, bolts and nuts located aboveground or within vaults in accordance with Section 09910.

3.04 FLANGED CROSSES AND TEES

A. Flanged ductile-iron crosses shall be installed with flanged ductile-iron pipe spools between the crosses and adjacent gate valves or butterfly valves.

B. Flanged tees shall be installed with flanged ductile-iron pipe spools between the tees and adjacent butterfly valves.

C. Spools are required to position valves a sufficient distance from crosses and tees to allow for the installation of thrust blocks without conflicting with valve actuators. Spools shall be 450mm (18”) long for pipe sizes 200mm (8”) through 300mm (12”), and 600mm (24”) long for pipe sizes 350mm (14”) and larger.

D. The pressure class of the spools shall be equal to or greater than that of adjacent piping.

3.05 MECHANICAL-JOINT FITTINGS

A. Install mechanical-joint fittings per AWWA C600 and the manufacturer's recommendations.

B. Prior to installation of the mechanical joint, clean the socket and plain end of the pipe. Lubricate both the gasket and plain end of the pipe with an approved lubricant per AWWA C111 immediately prior to slipping the gasket onto the plain end of the pipe.

C. Tighten the bolts to the normal range of bolt torque per the manufacturer's recommendations and AWWA C600, Table 3:

D. Joint deflection of piping is permitted to attain a curve. Deflection at a joint shall not be greater than 3° total at a joint.

3.06 SUPPORT FOR DUCTILE–IRON FITTINGS

A. All ductile-iron fittings require concrete support blocks to prevent the fitting’s weight from being carried by the adjacent pipe.

END OF SECTION

SECTION 15061
CEMENT-MORTAR LINED AND TAPE COATED STEEL PIPE AND SPECIALS

PART 1 - GENERAL

1.1 WORK OF THIS SECTION

The Work of this Section shall include, but not be limited to, furnishing all labor, materials, tools and equipment and performing all Work required for materials, design, fabrication, and installation of cement-mortar lined and tape coated with a mortar over-coat steel pipe and specials as shown in the Approved Plans and described in the Contract Documents.

1.2 REFERENCES, SPECIFICATIONS, CODES AND 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 – 150mm ((6”) and Larger
AWWA C205	-	Cement-Mortar Lining and Coating for Steel Water Pipe 100mm (4”) and larger Shop Applied
AWWA C206	-	Field Welding of Steel Water Pipe
AWWA C207	-	Steel Pipe Flanges for Waterworks Service 100mm (4”) and larger
AWWA C208	-	Dimensions for Fabricated Steel Pipe Fittings
AWWA 214	-	Tape Coating Systems for the Exterior of Steel Water Pipelines
AWWA 216	-	Heat Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
AWWA C217	-	Cold-applied Petroleum Tape Coatings
AWWA C606	-	Grooved and Shouldered Joints
AWWA M11	-	Steel Pipe-Guide for Design and Installation
ASTM A 47/A 47M	-	Standard Specification for Ferritic Malleable Iron Castings
ASTM A 36/A 36M	-	Standard Specification for Carbon Structural Steel
ASTM A 53	-	Standard Specification for Pipe, Steel, Black & Hot Dipped, Zinc-Coated, Welded, and Seamless
ASTM A 105	-	Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A1011/A101M		Standard Specification for Steel, Sheet, and Strip, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy and High Strength Low Alloy with improved formability
ASTM A 183	-	Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A 216	-	Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding for High Temperature Service
ASTM A 283/A 283M	-	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 307	-	Standard Specification for Carbon Steel Bolts and Studs
ASTM A 536	-	Standard Specification for Ductile Iron Castings

ASTM A 568/A 568M	-	Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality and Cold Rolled
ASTM D 2000	-	Standard Classification System for Rubber Products
ANSI Bl.1	-	Unified Inch Screw Threads
ANSI Bl.2	-	Gages and Gaging for Unified Inch Screw Threads
ANSI Bl.20.1	-	Pipe Threads, General Purpose (inch)

1.3 RELATED WORK SPECIFIED ELSEWHERE

Sections 02223, 09910, 13110, and 15000.

1.4 QUALIFICATION OF MANUFACTURERS

Factory applied pipe lining and coating (tape wrap, mortar, etc.) is an element of the completed pipe. Only manufacturers who provide a completed lined and coated pipe can be qualified for this work. The Work requires that one pipe manufacturer accept responsibility for furnishing the complete coated and lined pipe without altering or modifying the Contractor's responsibilities under the Contract Documents. All pipe components, including but not limited to, manufacturing of steel cylinders, fittings, and applying the linings and coatings (tape wrap, mortar, etc.) for the main pipeline shall be the product of one manufacturer that has been manufacturing steel pipe for municipal water pipelines for at least five years and has completed at least three similar projects of 12" diameter or larger.

1.5 SPECIALS

A special is defined as any piece of pipe other than a normal full length of straight pipe. This includes, but is not limited to, elbows, short pieces, reducers, tees, crosses, spools, sections with outlets, beveled sections and manholes.

1.6 DESIGN REQUIREMENTS

A. All steel used for pipe or specials shall have a 36,000 psi minimum yield point unless otherwise shown on the Approved Plans or as directed by the District's Representative. See material information concerning steel designation below.

B. Design stress in steel cylinders shall not exceed 50% of the specified minimum yield strength of the steel used. The internal operating pressure used for design shall be a minimum of 150 psi or as shown on the Approved Plans, whichever is greater. No allowance shall be made for the tensile strength of the cement mortar lining and coating.

C. Specials shall be designed per AWWA M11 and as a minimum shall conform to the pressure rating, grade of steel and cylinder thickness of the adjoining standard pipe sections. Fitting dimensions shall conform to AWWA C208. Reinforcing collars, wrappers, crotch plates, and anchor rings shall be designed and fabricated per AWWA M11.

1. Outlets may be built into the wall of the pipe or may be fabricated as steel plate specials. Outlets of size 2" and smaller in piping 4" and larger shall be of the threadolet type or shall be extra-heavy half couplings to fit the pipe in accordance

with AWWA M11. Outlets shall be 3,000 lb WOG forged steel per ASTM A105. Threads shall comply with ANSI B1.20.1. Outlets larger than 2" shall use a tee or nozzle with a flanged outlet. All outlets larger than 2" in diameter shall be provided with steel reinforcing collars, wrapper plates, or crotch plates per AWWA M11. At the option of the manufacturer, wrappers may be used in place of collars, and crotch plates may be used in place of collars or wrappers. Pipe couplings shall not be used for outlets.

2. On 2" and smaller outlets where nylon insulation bushings are to be used, the outlet shall be increased in size to accept the bushing.

3. Tees, wyes, and crosses shall be dimensioned in accordance with AWWA C208, Table 1, or as modified on the Approved Plans.

4. Bends shall have a minimum centerline radius of not less than 2.5 times the pipe diameter and provide the number of pieces as tabulated below, unless otherwise shown on the Approved Plans:

Deflection Angle	Number of Pieces
0 to 22 ½ degrees	2
Greater than 22 ½ to 45 degrees	3
Greater than 45 to 67 ½ degrees	4
Greater than 67 ½ to 90 degrees	5

5. All specials shall be marked at both ends of the fitting with "Field Top" indicators.

D. Minimum cylinder thickness for pipe shall be 0.188" or 3/16" or as directed by the District Engineer.

The wall thickness tolerances for steel pipe 300mm (12") diameter and larger shall be governed by the requirements of the ASTM specifications to which the plates or sheets are ordered, but in no case shall the thickness be less than 0.188" or 3/16" or as directed by the District Engineer.

E. Standard pipe sections shall not be less than 20' nor more than 40' in length, except where shorter lengths are required to fit horizontal and vertical alignment or are otherwise shown on the Approved Plans.

F. Pipe ends shall be as follows:

1. Lap Welded Joints: Use expanded bell with matching spigot end.

2. Flanges: Flanges for use in construction of Steel Pipe shall be as described below.

a. AWWA C207, Class E flanges (matching ANSI/ASME B16.1, Class 125 flanges for bolt hole size and drilling) shall be used for pressures between 1.03 MPa and 1.72 MPa (150 psi and 250 psi).

b. Flanges shall be flat-faced type only. Segmented flanges shall not be used.

3. Butt Straps: Use two-piece rolled steel straps with a minimum thickness of 6.35mm (1/4"), and a minimum width of 250mm (10"). Straps shall be fabricated to snugly fit over the plain pipe ends and shall be centered over the ends of the pipe sections to be joined. Weld one or more standard 125mm (5"), 1361kg (3000 lb.) half-couplings to the butt strap section as shown on the Approved Plans. Butt straps are shown on Plans at major tie in points only. Contractor shall include butt straps as needed to execute the Work at no additional cost.

4. Grooved-End or Shouldered Couplings: Use square-cut shouldered or grooved ends per AWWA C606. Grooved-end couplings shall be malleable iron per ASTM A 47, or ductile-iron per ASTM A 536. Gaskets shall be per ASTM D 2000. Nuts and bolts in exposed service shall conform to ASTM A 183, 758.43 MPa (110,000 psi) tensile strength.

5. Flexible Pipe Couplings: Use plain-end pipe with flexible pipe couplings per AWWA C200. Provide joint harnesses per AWWA M11 where indicated on the Approved Plans.

6. Bell ends shall be formed by an expanding press or by the pipe being moved axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape. **The ends shall not be rolled.** No welded rings will be allowed as substitution for expanded bells. Faying surfaces of the bell and spigot shall be essentially parallel, but in so case shall be bell slope vary more than 2 degrees from the longitudinal axis of the pipe.

G. Angles or Curves in Alignment: Minor changes of direction in the grade or alignment may be made by a deflection in the joint up to a maximum of 3/4-inch on one side of the joint. For greater angular deflections, pipe with ends beveled up to a maximum of 5 degrees measured from a plane perpendicular to the pipe's axis may be used. The short point on the bevel shall be so marked on the pipe. Pipe length shorter than 20' may be used on curves. Where curves that have a shorter radius than can be accommodated by beveled pipe is required, or where indicated on the Approved Plans, special short-radius bends shall be provided.

H. Interior Lining of Pipe

1. Cement Mortar Lining: Use linings conforming to AWWA C205, except as noted below. All interior metal surfaces shall be lined. Minimum Lining Thickness shall be as follows:

i. Pipelines 16” and smaller:

Lining Thickness	Tolerance
5/16”	-3/16", +3/16”

ii. Pipelines 18” through 36”:

Lining Thickness	Tolerance
3/4”	-3/16", +3/16”

I. Exterior Coating of Pipe:

1. The exterior coating of the buried steel piping shall be polyethylene tape-coat with a ¾” mortar overcoat in accordance with AWWA C205, C209, and C214. The minimum mortar coating thickness shall be a ¾” thickness, with a tolerance of plus 25 percent.

2. Exterior Coating of Exposed Piping: The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer and then finish coated in conformance to the requirements of Section 09910.

3. Prefabricated polyethylene tape coating shall be in conformance with Section 09810 and shall include a cement mortar over-coat. Except as otherwise required, exterior surfaces of all steel pipe, fittings, and specials shall be cleaned and coated over the polyethylene wrap in the shop with reinforced cement-mortar coating applied in conformity with ANSI/AWWA C205. During the operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The coating machines shall be of a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the coating. If coating is damaged or found faulty at delivery site, the damaged or unsatisfactory portions shall be replaced with coating conforming to these Specifications at no additional cost of the Owner.

a. The pipe shall be left with a three-inch holdback from the end of the plastic tape to the cement mortar coating at each pipe end or where field joints occur. Ends of the coating shall be left square and uniform. Feathered or uneven edges will not be permitted.

b. Defective coatings, as determined by the Construction Manager, shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective coatings shall be cut back to a square shoulder in order to avoid feather-edged joints.

c. The progress of the application of mortar coatings shall be regulated in order that all hand work, including the repair of defective areas is cured in accordance with the provisions of ANSI/AWWA C205. Cement-mortar for patching shall be the same materials as the mortar for machine coating, except that a finer grading of sand and mortar richer in cement shall be used with field inspection indicates that such mix will improve the finished coating of the pipe.

J. The exterior surfaces of areas of exposed pipes and fittings that are not polyethylene tape coated with a mortar over coat, such as flanges, grooved ends, or plain ends for butt-straps or flexible couplings, shall be sandblasted in accordance with SSPC-SP10 - Near White Blast Cleaning, and coated in accordance with Specification Sections 09910 and 15000.

K. The exterior surfaces of areas of buried pipes and fittings that are not polyethylene tape coated with a mortar over coat, such as flanges, grooved ends, or plain ends for butt-straps or flexible couplings, shall be wax tape coated in accordance with Specification Section 13110.

L. The term "diameter of pipe" as used in these specifications or as shown on, the Approved Plans shall mean the net inside diameter of the mortar lining.

1.7 QUALITY ASSURANCE

A. Cement-mortar lined and tape coated with mortar overcoat steel pipe shall be inspected at the supplier's manufacturing plant by the District's Representative. The Contractor shall be responsible for District Representative's expenses, including travel, time, meals and overnight accommodations. Overnight accommodations and air travel may be required, at the discretion of the District's Representative, if the manufacturing plant is more than 200-miles from the District Representative's office.

B. In addition to the shop hydrostatic testing performed on pipe cylinders required per AWWA C200, all welds of specials and attachments (i.e. **joint rings and nozzles**) shall be tested by a dye-penetrant process. Certification of such testing shall be submitted to the District's Representative.

C. Field welders shall be certified under Section IX, Part A of the ASME Boiler and Pressure Vessel Code or in accordance with AWWA C206, Section 3. Welders shall present a copy of their certification to the District's Representative prior to performing any field welding. Certifications shall be dated within three (3) years of the job to be performed.

D. Plainly mark each length of straight pipe and each special at the bell end to identify the proper location of the pipe item by reference to the layout schedule.

E. The top of all pipe and specials shall be clearly identified by marking the top with "TOP." for easy identification in the field.

F. Closed-Circuit Television Inspection: A closed-circuit television (CCTV) inspection shall be performed by Contractor on all steel pipe 36” and smaller in accordance with Section 15045.

1.8 DELIVERY, STORAGE, AND HANDLING

Delivery, storage, and handling of the pipe and specials shall be as follows:

A. Pipe and fittings shall be carefully handled and shall be protected against damage to linings and coatings due to impact shocks. Pipe shall not be placed directly on rough ground but shall be supported in a manner which will protect the pipe against damage whenever stored at the site or elsewhere. Pipe shall be handled and stored per these requirements and in accordance with the manufacturer's recommendations.

B. Temporary internal bracing shall be installed in all pipe 16” and larger prior to shipment to the job site. Temporary internal bracing shall be 2" x 4” wooden struts installed in both the horizontal and vertical directions. Each set of struts shall be nailed together as a unit. Wooden wedges may be used to maintain the proper tight fit of the internal bracing. The bracing shall be located 12” in from each end of the pipe section for all pipe, and additionally at the mid-point for piping 24” and larger. Maintain internal bracing as specified under Pipe Installation.

C. Transport pipe to the job site on padded bunks with nylon tie-down straps or padded bonding to protect the pipe.

D. Pipes and specials shall only be handled with appropriate spreader bars and wide nylon slings. Chains or wire rope slings shall not be used. Under no circumstances shall pipe or specials be pushed or dragged along the ground. All pipe sections over 20' in length shall be lifted at the quarter points from each end.

E. Store pipe on earth berms or timber cradles adjacent to the trench in the numerical order of installation. Place the supports at about the one-quarter point from the pipe ends.

F. Maintain plastic end caps on all pipe and specials in good condition until the pipe is ready to be installed in the trench. Periodically open the plastic end caps and spray potable water inside the pipe for moisture control.

1.9 CONTRACTOR SUBMITTALS

The following shall be submitted in compliance with Section 01300 –Submittals:

A. An affidavit of compliance with AWWA C200 and C205.

B. Certificate stating that all materials in contact with potable water system are NSF approved for use with potable water.

C. Submit detailed shop drawings for the pipe and specials showing:

1. Order of installation and closures with designation by piece number for each steel pipe and fabricated special to be furnished and installed.

2. Pipe station and invert elevation (IE) at each change of grade and horizontal alignment.

3. Elements of curves and bends, both in horizontal and vertical alignment including elements of the resultant true angular deflections in case of combined curvature.

4. Pipe outside and internal diameter, wall thickness, location of welded seams, and internal design pressure.

5. Locations of bulkheads for field hydrostatic testing of pipeline. **Hydrostatic testing against valves shall not be permitted.**

6. Locations of closures, including cut-to-fit allowances, for length adjustment and for construction convenience.

7. Locations of valves, flanges, manholes, appurtenances and other mechanical equipment.

8. Limits of concrete encasement.

9. Call out weld sizes and dimensions of thrust ring collars, grooved end collars, flanges, reinforcing collars, wrapper plates, and crotch plates.

D. Submit joint details.

E. Details of all specials and of the pipe lining and coating.

F. Calculations supporting the sizing of reinforcing collar plates, wrapper plates or crotch plates.

G. Calculations supporting selected wall thickness of pipe and specials.

H. Calculations supporting welded joint design and joint welding details.

I. Current shop welder and field welder certifications. Submit welding procedure specifications (WPS) and procedure qualification records (PQR) for each welding process.

J. Certification of dye-penetrant shop-weld testing.

K. Cathodic Protection design and installation details.

L. Drawings of butt straps, couplings, and flanges.

M. Details of bulkheads and of their method of attachment to the pipeline.

N. Certificate that cement complies with ASTM C150, designating type.

O. Shop drawings of all pipes and specials shall be submitted for review. Shop drawings shall be complete in all respects. If the shop drawings show any deviations from the requirements of the Approved Drawings and Specifications due to standard shop practices or other reasons, the deviations shall be noted along with the reason for the deviation in the Shop Drawing Submittal Form.

P. Submit fabricator's quality control program results in one complete binder including all inspection reports, tests conducted, certified mill tests reports, weld test coupon reports, welder qualification records, hydrostatic testing reports, shop testing reports, final fabrication checklists for each special, and affidavit of compliance. The quality control program results shall document all phases of the fabrication process and be delivered prior to substantial completion of the project.

1.10 WAX TAPE

Wax tape shall be installed in accordance with Section 13110 and as shown on the Drawings or as directed by the District's Representative.

1.11 TRACER WIRE

Tracer wire shall be installed on all potable and recycled water mains in accordance with Section 15000.

1.12 WARNING/IDENTIFICATION TAPE

Warning/Identification Tape shall be installed on all potable and recycled water mains in accordance with Section 15000.

PART 2 MATERIALS

2.1 STEEL PIPE AND SPECIALS

Steel pipe and specials shall conform to the requirements of the AWWA C200 and C205, and AWWA M11, except as modified herein.

A. Steel for fabricated cylinders shall conform to ASTM A36/A36M, ASTM A1011/A1011M, Grade 36, or ASTM A1018/A1018M, Grade 36. Other steel grades may be used only upon approval of the District's Representative.

2.2 POLYETHYLENE TAPE COATING WITH MORTAR OVERCOAT (ROCK SHIELD)

Polyethylene tape coating with mortar overcoat shall be in accordance with Section 09810. Cement mortar over-coating shall be reinforced in accordance with AWWA C205. Holiday testing shall be calculated from:

$$V = 1250\ T^{1/2}$$

where:

V = Test voltage, volts
T = Total tape coating system thickness, mils

2.3 MORTAR LINING AND OVER-COAT

A. Cement used in mortar lining and over-coating shall be Portland cement per ASTM C 150, Type V for coating and Type II or Type V for lining.

B. Cement-mortar over-coating shall be reinforced in accordance with AWWA C205.

C. Cement mortar grout for field joints shall consist of a mixture of 1 1/2 to 2 parts sand to 1 part Type II or Type V Portland Cement with enough clean, potable water to permit packing and troweling without crumbling. The sand shall be washed, well-graded sand such that all will pass a No. 8 sieve. The quantity of water to be used in the preparation of grout shall be the minimum required to produce a mixture sufficiently workable for the purpose intended. Grout shall attain a minimum compressive strength of 12.4 MPa (1,800 psi) in 28 days.

D. In certain circumstances, rapid-setting mortar may be required. Acceleration admixtures may be used in the mix as permitted by the District Engineer. Calcium chloride shall not be used in the mix.

2.4 PAINTING AND COATING

A. Paint and coating products for exterior surfaces of all pipe and appurtenances not otherwise coated shall be in accordance with Section 09910 and the Approved Materials List.

B. Paint and coating products for areas in contact with potable water such plain ends of pipe, grooved and shouldered ends of pipe and exposed inside surfaces of threaded outlets and blind flanges shall be in accordance with Section 15000 and selected from the Approved Materials List.

2.5 BOLTS AND NUTS FOR FLANGES

Bolts and nuts shall be in accordance with W.A.S. Specification Section 15000 and the Approved Materials List.

2.6 GASKETS

A. Flange gaskets shall comply with AWWA C207. Flange gaskets shall be 1/8” thick acrylic or aramid fibers bound with nitrile for all sizes of pipe. Gaskets shall be full-face type with pre-punched holes or ring-type extending to the inner edge of the bolt circumference of the flange.

B. In the event of encountering organic solvents or petroleum products during the course of the work, alternate gasket materials or joint treatment will be required as directed by the District's Representative.

2.7 JOINT BONDING AND CATHODIC PROTECTION

Joint bonding, flange insulation kits, internal epoxy linings, and cathodic protection materials shall be provided as indicated on the Approved Plans and in accordance with Section 13110 and the Approved Materials List.

2.8 TRENCHING, EXCAVATION, BACKFILLING AND COMPACTION

Trenching, excavation, backfilling, and compaction shall be performed in accordance with Section 02223.

2.9 CONCRETE

Concrete used for thrust and anchor blocks shall be in accordance with Section 03000.

2.10 WAX TAPE

Wax tape materials shall be in accordance with Section 13110 and the Approved Materials List.

2.11 CLOSED-CIRCUIT TELEVISION INSPECTIONS

The Contractor shall furnish all equipment and materials required for CCTV inspections in accordance with Section 15045

2.12 POLYETHYLENE TAPE COATING

Tape coatings shall be in accordance with Section 09810.

2.13 TRACER WIRE

Tracer wire materials shall be in accordance with Section 15000 and the Approved Materials List.

2.14 WARNING/IDENTIFICATION TAPE

Warning/identification Tape materials shall be in accordance with Section 15000 and the Approved Materials List.

PART 3 EXECUTION

3.1 GENERAL

A. At all times when the work of installing pipe is not in progress, including worker break times, the ends of the pipe shall be closed with a vermin-proof and child-proof cap or plug. Do not permit trench water to enter the pipe. Do not place tools, clothing, or other

materials in the pipe. The Contractor shall maintain the interior of the pipe in a sanitary condition free from foreign materials.

B. There shall be absolutely no backfilling, excavation, or compaction activities being performed during welding, inspection, or while anyone is inside the pipe or in the pipe trench. The Contractor is fully responsible for safety during the entire project duration.

3.2 TRENCHING, EXCAVATION, BACKFILLING AND COMPACTION

A. Trenching, backfilling and compaction shall be performed in accordance with Section 02223.

3.3 DEWATERING

The Contractor shall provide, and maintain at all times during construction, ample means and devices to promptly remove and dispose of all water from any source entering trench excavations or other parts of the work. Any damage caused by flooding of the trench shall be the Contractors responsibility.

Dewatering shall be performed by methods that will maintain a dry excavation, preservation of the final lines and grades and protection of all utilities. If flooding of the trench does occur, the Contractor shall immediately dewater and restore the trench. Damaged or altered pipeline appurtenances shall be repaired or replaced as directed by the District's Representative.

3.4 PIPE INSTALLATION

When the work requires and the size of the pipe allows entry of personnel into the pipe, the Contractor shall comply with all Federal and State regulations for confined space entry Work inside pipelines shall not be undertaken until all the tests and safety provisions of the Code of Federal Regulations 1910.146, and the General Industry Safety Orders of the California Code of Regulations, Title 8, Section 5159 for confined space entry have been performed and the area is verified as safe, to enter. Generally, the aforementioned safety, provisions apply to pipe 24" and larger. Note that for pipe less than 24" diameter, more stringent safety procedures apply.

The Contractor shall furnish and install all pipe, specials, fittings, closure pieces, valves, supports, bolts, nuts, gaskets, jointing materials, and all other appurtenances as shown on the Approved Plans and as required to provide a complete and workable installation.

Pipe installation shall be as shown on the Approved Plans and Shop Drawings in accordance with the following:

A. No pipe shall be installed where the linings or coatings show cracks detrimental to the pipe coating system in accordance with AWWA C200, and as determined by the District's Representative. Such damaged linings and coatings shall be repaired, or new, undamaged pipe sections shall be provided at no additional cost to the District.

B. Pipe damaged prior to Substantial Completion shall be repaired or replaced by the Contractor.

C. The Contractor shall inspect each pipe and fitting to ensure that there are no damaged portions of the pipe. The Contractor shall remove or smooth out any burrs, gouges, weld splatter, or other small defects prior to laying the pipe. The District's Representative shall determine if pipe to be installed is acceptable.

D. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of all pipes and fittings in the trench shall be closed during any interruption to the work as noted above.

E. Pipe shall be laid directly on the bedding material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings and to permit visual inspection of the joint. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coatings on field joints.

F. Installation Tolerances: Each section of pipe shall be laid in the order and position shown on the approved layout schedule to the proper lines and grades in accordance with the following:

1. Each section of pipe having a nominal diameter less than 48" shall be laid not to vary more than 2" horizontally or 1" vertically from the alignment and elevations shown on the Approved Plans.

2. Each section of pipe having nominal diameter 48" and larger shall be laid not to vary more than five percent (5%) of the pipe diameter horizontally or two and one half percent (2.5%) of the pipe diameter vertically.

3. In addition to the horizontal and vertical tolerances above, lay the pipe so that no high or low points occur along the pipeline other than those shown on the approved layout schedule.

G. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the District's Representative may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed seventy five percent (75%), of the maximum deflection recommended, by the pipe manufacturer. No joint shall be deflected any amount that will be detrimental to the strength and water tightness of the finished joint. In all cases the joint opening, before finishing with the protective mortar inside the pipe, shall be the controlling factor.

H. Pipes shall be laid uphill on grades exceeding 10 percent. Pipe that is laid on a downhill grade shall be blocked and held in place until the following pipe section has been installed to provide sufficient support to prevent movement.

I. Temporary internal pipe bracing shall be left in place in pipe sizes larger than 24" until pipe zone compaction has have been completed. Bracing in pipe smaller than 24" may be removed immediately after the pipe has been laid into the trench. The Contractor shall employ a laboratory to monitor pipe deflection by measuring pipe inside diameter before bracing is removed and 24 hours after struts are removed. Pipe deflection shall not exceed 3 percent in 24 hours after the bracing has been removed. After the backfill has been placed, the struts shall be removed.

J. Cold Weather Protection: No pipe shall be installed upon a foundation onto which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation. No pipe shall be laid unless it can be established that the trench will be backfilled prior to formation of ice and frost.

K. Pipe and Specials Protection: The openings of all pipe and specials where the pipe and specials have been mortar-lined in the shop shall be protected with suitable bulkheads to maintain a moist atmosphere and to prevent unauthorized access by persons, animals, water, or any undesirable substance. The bulkheads shall be designed to prevent drying out of the interior of the pipe. The Contractor shall introduce water into the pipe to keep the mortar moist where moisture has been lost due to damaged bulkheads.

3.5 FIELD WELDED JOINTS

A. Welded joints shall be completed in the trench per AWWA C206.

B. Both the bell and spigot ends shall be cleaned of foreign matter prior to welding.

C. For pipe diameters less than 24" the exterior of the joint shall be welded. For pipe diameter 24" and larger, the joint shall be welded in accordance with the approved submittal. All welded joints shall remain exposed until inspection has been performed.

D. Welding electrodes shall be as recommended by the pipe manufacturer. Typically, electrodes shall be E6010 for root passes and E7018 for additional passes. Do not deposit more than 1/8" of throat thickness per pass.

E. Weld material shall be deposited in successive layers. Complete and clean each pass around the entire circumference of the pipe before commencing the next pass.

F. The minimum number of passes in the completed weld shall be as follows:

Steel Cylinder Thickness (inches)	Fillet Weld Minimum Number of Passes
0.2500 or 1/4" or less	2
Greater than 0.2500 or 1/4"	3

G. To minimize longitudinal stresses due to temperature variations, it is necessary to leave unwelded one joint per each 400' of pipeline. This joint shall be left unwelded until all the joints on both sides of it are welded, and it shall be welded at the coolest time of the

working day. The District's Representative shall decide if and when this procedure is warranted.

H. Tack-welding the joint may be permitted to hold the pipe in place. If the joint is to be circumferentially welded, sufficient time shall elapse to allow for an initial set of interior joint lining prior to proceeding with joint welding. Rapid-setting mortar may be used in accordance with this Section. In some cases, the District's Representative may require hand holes.

I. Field welders shall be certified in accordance with ASME Section 9 (pipe welders) or AWS D1.1 (plate welders). Welders shall present a copy of their certification to the District's Representative prior to performing any field welding.

J. Prior to butt-strap welding, the pipe and pipe joint shall be properly positioned in the trench using line-up damps so that, in the finished joint, the abutting pipe sections shall not be misaligned by more than 1/16".

K. The pipe ends shall be cut straight on joints where butt straps are used for realignment, adjustment, or deflection, and fillet welds shall be made as indicated.

L. Inspection of Field Welded Joints:

1. The Contractor shall retain and pay for the services of a weld inspection firm to perform weld inspection on all welded joints. Inspection of welds shall take place as soon as possible following the completion of the welds, and in no case shall welding proceed further than 100 feet in front of the inspection. All welds shall be visually inspected by an AWS QC1 Certified Inspector. Nondestructive testing, such as liquid dye penetrate testing, shall only be performed by individuals qualified per AWS D1.1 as a NDT Level II or greater. The Contractor shall test 50 percent of all field lap welds by the Standard Method for Liquid Penetrant Examination in accordance with ASTM E 165-02, unless otherwise directed by the District Engineer. The Contractor shall perform visual inspection and dye-penetrant inspection on all welds appurtenance connections. The Contractor and their testing firm shall provide reports of welding inspections to the District's Representative for approval.

2. The Contractor shall coordinate and supply ventilation, lighting, and other equipment deemed necessary for inspection. The Contractor shall be responsible for providing safe entry into and out of the trench, safety of inspection personal, traffic control and other safety precautions deemed necessary for the inspections.

3.6 INTERIOR JOINT FINISH – PIPE LESS THAN 24"

Complete interior mortar joints for pipe sizes less than 24" by drawing through a tight fitting swab or squeegee. Coat the face of the cement mortar lining at the bell with a sufficient amount of stiff cement mortar to fill the gap. Immediately after joining the pipes, draw the swab through the pipe to remove all excess mortar and expel it from the open pipe end. Do not move the pipe after

the swab has been pulled past the joint. See requirements under "Field Welded Joints" for these joints requiring welding.

3.7 INTERIOR JOINT FINISH - PIPE 24" AND LARGER

A. Complete interior mortar joints for pipe sizes 24" and larger by the trowel method. Prior to applying interior mortar at the joints all backfill in the area shall be completed. After cleaning the interior joint, pack cement mortar into each joint. Finish the surface with a steel trowel to a smooth finish and equal thickness to match the adjoining pipe mortar.

B. Where more than a 4" joint strip of mortar is required, place galvanized welded wire mesh reinforcement in 2" x 4" pattern of No. 13 gauge over the exposed steel. Install the mesh so that the wires on the 2" spacing, direction run circumferentially around the pipe. Crimp the wires on the 4" spacing to support the mesh 3/8" from the metal surface. Steel-trowel finish the interior mortar to match adjoining mortar-lined pipe sections.

3.8 EXTERIOR JOINT FINISH

A. Tape wrapped mortar over coat steel pipe field joints shall be coated with polyethylene tape or heat shrinkable sleeves and mortar over-coat and shall conform to the requirements of Section 09810.

B. The outside annular space between pipe sections shall be completely filled with grout formed by the use of polyethylene foam-lined fabric bands after the joint is coated with polyethylene tape or heat shrinkable sleeves. The grout space shall be flushed with water prior to filling so that the surfaces of the joint to be in contact with the grout will be thoroughly moistened when the grout is poured. The joint shall be filled with grout by pouring from one side only. Grout shall be rodded with a wire or other flexible rod or vibrated so that the grout completely fills the joint recess by moving down one side of the pipe, around the bottom of the pipe and up the opposite side. Pouring and rodding the grout shall be continued to allow completion of the filling of the entire joint recess in one operation. Care shall be taken to leave no unfilled space. Grouting of the outside joint spaces shall be kept as close behind the laying of the pipe as possible except that in no case shall grouting be closer than three joints of the pipe being laid.

C. The grout bands or heavy-duty diapers shall be polyethylene foam-lined fabric with steel strapping of sufficient strength to hold the fresh mortar, resist rodding of the mortar, and allow excess water to escape. The foam plastic shall be 100 percent closed cell, chemically inert, insoluble in water and resistant to acids, alkalis and solvents. Foam Plastic shall be Dow Chemical Company, Ethafoam 222, or District approved equal.

The fabric backing shall be cut and sewn into 9" wide strips with slots for the steel strapping on the outer edges. The polyethylene foam shall be cut into strips 16" wide and slit to a thickness of 1/4" that will expose a hollow or open-cell surface on one side. The foam liner shall be attached to the fabric backing with the open or hollow cells facing towards the pipe. The foam strip shall cover the full interior circumference of the grout band with sufficient length to permit an 8" overlap of the foam at or near the top of the

pipe joint. Splices to provide continuity of the material will be permitted. The polyethylene foam material shall be protected from direct sunlight.

The polyethylene foam-lined grout band shall be centered over the joint space with approximately equal widths extending over each pipe end and securely attached to the pipe with the steel straps. After filling the exterior joint space with grout, the flaps shall be closed and overlapped in a manner that fully encloses the grout with polyethylene foam. The grout band shall remain in position on the pipe joint.

3.9 COATING REPAIRS

A. Coating repair for polyethylene tape coated and mortar over-coated pipe shall conform to the requirements of Section 09810 and this Section. When visual inspection shows, or seems to indicate that a portion of the coating system has sustained physical damage, as determined by the Construction Manager, the damaged area shall be subjected to an electrical holiday test of 6,000 to 7,000 volts. If the holiday test indicates failure of the coating system, the coating shall be repaired and re-tested at the option of the Construction Manager.

B. Following repair of the damaged area if the holiday test indicates a holiday still exists, the inner wrap of the taped joint shall be exposed and the exposed area shall be wiped clean with xylol solvent, or equal, and the area coated with tape primer. A patch of 35-mil thick cold-applied tape of sufficient size to cover the damaged area, plus a minimum lap of 2 inches in all directions, shall then be applied. The patched area shall again be tested for holidays. If none are detected, a second layer of 35-mil thick tape shall then be applied over the first patch. The second layer of tape shall overlap the first layer a minimum of 23 inches in all directions. For polyurethane coated joints, the joint repair process shall be repeated.

C. When the area tests show no holiday, a notation shall be applied to the area indicating the test is satisfactory.

3.10 BUTT STRAP JOINTS

Butt strap closure joints shall be installed where shown on the Approved Plans in accordance with AWWA C206.

A. Butt straps shall be field welded to the outside plain end of the pipe along both edges with a full circumferential weld. A minimum of two weld passes shall be used.

B. The interior of the joints shall be filled with a rapid-set mortar and finished off smoothly to match the pipe interior diameter.

C. Clean the butt strap with wire brush and apply a cement and water wash coat prior to applying cement mortar,

D. Galvanized wire mesh, 2”x4” x No. 13 gauge shall be installed to the exterior of the joint prior to applying the mortar coating.

E. Coat the exterior of the closure assemblies with tape coating in accordance to Section 09810.

F. Seal weld the steel plug to the hand hole after the interior of the joint has been inspected and approved by the District's Representative.

3.11 FLANGED CONNECTIONS

Flanged connections shall be installed where indicated on the Approved Plans.

A. Bolt holes shall straddle the horizontal and vertical centerlines.

B. The bolts, nuts and flange faces shall be thoroughly cleaned by wire brush prior to assembly.

C. Bolts and nuts shall be lubricated with a District-approved anti-seize compound.

D. Nuts shall be tightened in an alternating "star' pattern to the manufacturer's recommended torque.

E. Slip-on type flanges intended for field fit-up and welding shall be welded inside and outside in accordance with AWWA C207.

F. Coat the exterior of exposed flanges, bolts and nuts in accordance with Section 09910.

3.12 FLANGED COUPLING ADAPTERS

Flanged coupling adapters shall be installed in accordance with the manufacturer's recommendations. Bolts shall be tightened with a torque wrench in the presence of the District's Representative to the torque recommended by the manufacturer.

3.13 JOINT BONDING/CATHODIC PROTECTION INSULATION

Bonding of joints to provide continuity, flange insulation kits, internal epoxy linings, and other cathodic protection items and materials shall be installed where shown on the Approved Plans in accordance with the Standard Drawings and Section 13110.

3.14 WAX TAPE

Wax tape shall be installed as shown on the Drawings or as directed by the District's Representative in accordance with Section 13110 and the Standard Drawings.

3.15 CONCRETE

Where required, concrete thrust and anchor blocks shall be installed in accordance with Section 03000 and as shown on the Approved Plans. Prior to filling the pipeline with water, refer to Section 03000 for the minimum concrete curing time required.

3.16 TRACER WIRE

Tracer Wire shall be installed in accordance with Section 15000 and the Standard Drawings.

3.17 WARNING/IDENTIFICATION TAPE

Warning/Identification Tape shall be installed in accordance with Section 15000 and the Standard Drawings.

3.18 DISINFECTION AND BACTERIOLOGICAL TESTING

Disinfection, bacteriological testing, and flushing of potable water lines shall be performed in accordance with Section 15041.

3.19 HYDROSTATIC TESTING

A. All piping, valves, fire hydrants, services, and related appurtenances shall be installed.

B. The pipe trench shall have trench zone backfill placed and compacted with a minimum of 24” of material over the pipe.

C. All concrete thrust block and anchor blocks shall be allowed to cure in accordance with Section 03000.

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 until factory-applied mortar linings and coatings on all pipe lengths have been in place for a minimum of fourteen (14) days. Steel pipelines with cement mortar field-applied to the interior of the pipeline shall not be filled with water until a minimum of eight (8) hours has elapsed after the final placement of cement mortar, unless otherwise approved by the District Engineer. Pipelines with cement-mortar lining shall be filled with water and placed under a minimum pressure of 172 KPa (25 psi) for at least forty-eight (48) hours prior to hydrostatic testing.

F. The Contractor is required to pre-test all pipelines before requesting a hydrostatic testing.

G. 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.

H. 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. The hydrostatic test pressure shall be 150 psi at the lowest point in the section of pipe being tested. The hydrostatic test pressure at the highest point in the section of pipe being tested shall be within 50 psi of the hydrostatic test pressure at the lowest point in the section of pipe being tested.

I. 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 at not less than ninety-five percent (95%) of the specified test pressure at all times.

J. At the end of the fourth (4th) hour, the pressure shall meet the requirements stated above. Pumping shall then be discontinued for one hour. The pipeline is required to hold the specified test pressure with zero loss for one hour. Any pressure loss from the initial starting pressure will result in a failed test.

K. If pressure loss exists, the cause of the loss shall be located and repaired as required by the District Engineer. All defective pipe, fittings, valves and other appurtenances discovered shall be removed and replaced with sound material. The hydrostatic test shall be repeated until pressure loss does not occur. All visible leaks shall be similarly repaired.

L. For testing information not contained herein, refer to Section 01660.

3.20 FIELD PAINTING AND COATING

A. Exterior surfaces of all exposed pipe and appurtenances not otherwise polyethylene tape coated with a mortar over-coat shall be field painted in accordance with Section 09910.

B. The exterior surfaces of areas of buried pipes and fittings that are not polyethylene tape coated with a mortar over coat, such as flanges, grooved ends, or plain ends for butt-straps or flexible couplings, shall be wax tape coated in accordance with Specification Section 13110. Areas in contact with potable water such plain ends of pipe, grooved and shouldered ends of pipe and exposed inside surfaces of threaded outlets and blind flanges shall be coated in accordance with Section 15000.

END OF SECTION

SECTION 15100
VALVES, GAUGES, AND APPURTENANCES

PART 1 - GENERAL

1.01 DESCRIPTION

Furnish all labor, materials, equipment, and incidentals required, and install complete and ready for operation all valves and appurtenances as shown on the Drawings and specified herein.

1.02 REFERENCES

A. All valves and appurtenances shall be furnished, installed, tested and disinfected per Section 01660

B. Section 15000, General Piping Requirements and Appurtenances

1.03 SUBMITTALS

A. Submit data to show that the following items conform to the Specification requirements:

   1. Pipe couplings, flexible pipe pieces

B. Valves, and accessories

   1. The valve manufacturer's catalog data showing the size to be used, valve dimensions, pressure rating and materials of construction.

C. Fittings and Coupling Compatibility: To assure uniformity and compatibility of piping components, fittings and couplings shall be furnished by the same manufacturers.

1.04 QUALITY ASSURANCE

Field Quality Control: The Contractor shall be responsible for the costs of additional inspection, retesting or repair incurred by the District resulting from non-compliance of defective materials provided by the Contractor.

1.05 APPURTENANCES

Furnish and install all necessary guides, inserts, anchors and assembly bolts, washers and nuts, hangers, supports, gaskets, couplings and flanges; all other appurtenant items shown on the Drawings; devices included in or on the piping equipment; and piping accessories.

PART 2 - PRODUCTS

2.01 GENERAL

A. Acceptable material manufacturers shall be per the Approved Material List. Reference the District Standard Specification Section II-B1-2.

B. Valve sizes are nominal inside diameter unless otherwise noted.

C. All valves shall be lead free and NSF 61 certified.

2.02 VALVES

A. General:

1. All buried valves shall include a valve extension if the top of the operating nut is five (5) feet deep or greater. All valve extensions shall be pinned to the operating nut.
2. Valve Ends
   a. Valve ends shall be compatible with the piping system in which they are being installed in accordance with the Approved Plans or directed by the District Engineer.
3. Ductile-iron flanges shall generally be in accordance with AWWA C115, rated at a working pressure of 1,724 kPa (250 psi). When Class 250 butterfly valves are shown on the Approved Plans or are otherwise required, ductile-iron flanges shall be compatible with AWWA C207, Class "F". Maximum working pressure of the flange shall as specified in AWWA or ASME/ANSI. Flanges shall be integrally cast per AWWA C110.

B. Testing: All valves shall be hydrostatic and leak tested in accordance with ANSI/AWWA C504 and Section 15030.

C. Proof of Design: The Contractor shall provide an Affidavit of Compliance certifying all valves from the manufacturer to the District. This Affidavit of Compliance shall serve as proof of compliance with ANSI/AWWA C504.

D. Marking: The manufacturer shall show the valve size, manufacturer, class, and year of manufacture on each valve.

E. All above ground valves shall be equipped with a handwheel operator.

F. End Types: Shall be as shown on the Drawings.

G. All buried valves shall be covered with a Trenton primer, wax tape, and polywrap.

2.03 BUTTERFLY VALVES

A. All butterfly valves shall be of the tight-closing, rubber-seat type conforming to AWWA C504. Butterfly valves shall be minimum Class 150B.

2.04 RESILIENT-SEATED GATE VALVES:

A. Resilient-seated gate valves shall meet the requirements of AWWA C509.

2.05 MUD VALVES

A. Mud valves shall be stainless steel and mounted to a ANSI Class 125-lb flange.

B. Valve shall be operated using a 2" square nut extended using 316 stainless steel stem extensions supported by stem guides and brackets.

C. Mud valve shall be manufactured by MPI Mcwane, model NRS Stainless Steel or approved equal.

2.06 STEM GUIDES AND BRACKETS

A. Stem guide shall be 316 stainless steel for corrosion resistance.

B. Stem guide shall consist of a guide and bracket assembly. The guide shall be attached to the bracket by a minimum of four bolts to ensure stability.

C. Stem guide shall have the capability to adjust from 2” to 39”.

D. The bracket and guides shall be slotted to allow for adjustment in two directions for proper alignment at installation.

E. Stem guide and accessories shall be manufactured by Troy Valve or approved equal.

2.07 VALVE STACKS AND COVERS

A. The valve stack shall be SDR 35 PVC pipe 8-inches in diameter. Refer to District Standard Drawing W-1.

2.08 COMBINATION AIR RELEASE AND VACUUM ASSEMBLIES:

A. Mechanical Assembly: The mechanical assembly shall have both the features of an air release valve and an air vacuum valve. The assembly shall be housed in a cast iron body and all internal parts such as the float, bushing, level pins, seat, and baffle shall be either stainless steel or brass as furnished by the manufacturer.

B. The inlet threads shall be iron pipe threads of the same size as the valve.

2.09 BLOW-OFF ASSEMBLIES

A. Refer to District Standard Drawing W-9 with the exceptions of the following:

1. Spools shall be 4-inch PVC.
2. Vertical spool shall be flanged ductile iron pipe.

2.10 SWING CHECK VALVES

A. Swing check valves shall conform to AWWA C508, and shall have the following materials of construction:

Component	Material	Specification
Disc ring and seat ring	Bronze or Stainless Steel	ASTM B62, B16, or B584; ASTM B148 or ASTM A276
Body, cover, and disc	Cast iron or Ductile Iron	ASTM A126, Class B or ASTM A536 Grade 65-45-12
Disc arm	Ductile Iron	ASTM A536 Grade 65-45-12
Hinge pin	Stainless steel	ASTM A276, Type 304
Cover bolts and nuts	Stainless steel	ASTM A193, Grade B8M; ASTM A194, Grade 8M
Internal fasteners and accessories	Bronze or Type 304 or 316 stainless steel	

B. Ends shall be flanged, Class 125, ANSI B16.1. Valves shall be designed for a minimum working pressure of 150 psi. Equip valve with outside lever and weight. Valves shall be Dezurik/APCO CVS 6000 Series, Val-Matic 7800 Series, or approved equal.

C. The check valve shall be capable of accepting air cushion, lever and weight or lever and spring.

2.11 GAUGES

A. Each pressure gauge shall be direct mounted with a 4.5-inch diameter dial, stainless steel case and ring, Type 316 stainless steel tube and socket, ASME Grade 1A, ±1 percent span accuracy, furnished with a clear glass crystal window, and a Type 316 stainless steel pressure snubber or diaphragm seal. Provide diaphragm seals on all lines transporting non-clear matter in suspension of solution (includes well discharge lines). All gauges shall be weatherproofed. The face dial shall be white finished aluminum with jet black graduations and figures. The face dial shall indicate the units of pressure being measured in psi.

B. Gauges shall have a range of 0-300 psi

C. Gauge shall be Ashcroft Type 1009 Duralife, or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. All valves, gauges, and appurtenances shall be installed in accordance with the requirements of AWWA, manufacturer's recommendations and the applicable sections herein.

3.02 MATERIAL DELIVERY, STORAGE AND PROTECTION

A. Delivery: All valves, gauges and accessories shall be delivered in a clean and undamaged condition. All defective or damaged materials shall be replaced with new materials.

B. Onsite Storage Limitation: Onsite storage shall be limited to working areas unless exception is approved by the District.

3.03 INSTALLATION

A. Buried valves shall be installed as follows:

B. Install and connect valve according to Manufacturer's installation and warranty requirements.

C. Wrap with two (2) layers of wax tape and two (2) layers of 8-mil V-Biocide polyethylene encasement around valve and flanges and secure with plastic adhesive tape wrapped around valve stem below operating nut to prevent entrance of soil. Fold overlaps twice and tape. Backfill with care to protect polyethylene.

D. Place and compact backfill to height of valve stem.

E. Place block pads under extension pipe to maintain valve box in vertical position during backfilling and repaving and to prevent extension pipe from contacting valve bonnet.

F. Mount upper slip pipe of extension in mid-position and secure with backfill around extension pipe.

G. Pour concrete ring allowing a depression so valve box cap will be flush with finished surface.

H. Valves shall be tested at same time connecting pipelines are pressure tested and in accordance with Contract Document sections covering testing. During pressure testing, protect or isolate valves, operators, or control and instrumentation elements whose pressure rating is less than test pressure.

3.04 CLEANUP

A. After completion of the work, all remaining materials and other scattered debris shall be removed from the site.

END OF SECTION

SECTION 15120
ALTITUDE CONTROL VALVE

PART 1 - GENERAL

1.01 REQUIREMENT

A. Under this specification, the Contractor shall furnish, deliver, and install the altitude valves (Electronic Control Valves) as specified on the Drawings and hereinafter described in these Specifications.

B. The valve manufacturer shall be able to supply a complete line of equipment from 2-inch through 36-inch sizes. The valve manufacturer shall also provide a computerized cavitation chart which shows flow rate, differential pressure, percentage of valve opening, Cv factor, system velocity, and if there will be cavitation damage.

C. A direct factory representation shall be made available for start-up service, inspection and necessary adjustments. The factory representative shall be made available for the duration of time necessary to correctly install and provide a complete and functioning system package for the item; a minimum of 2 days is required.

D. Wetted surfaces of valves, trim, accessories, coatings, etc. intended for use on potable and domestic water systems shall be NSF-61 and NSF-372 certified.

1.02 SUBMITTALS

A. Submit to Engineer for approval: shop drawings, technical information on completed valve assembly including all options, appurtenances and cavitation report in accordance with Section 01300.

B. Submit factory test reports in accordance with Section 01300.

PART 2 - PRODUCTS

2.01 GENERAL

A. Contractor shall not “tie” together equipment from other manufacturers to develop a system with similar functions as specified herein. This will be considered non-compliance with these specifications.

B. Refer to attached VC-22D ValvApp Worksheet (ClaVal) for valve configuration.

2.02 FUNCTION

A. The Electronic Control Valve shall be capable of controlling downstream pressure, rate of flow, upstream pressure sustaining, tank level control (altitude and modulating), valve position, blending, pressure management or select combinations of any of these applications. Solenoid pilot controls equipped onto the electronic control valve are actuated by electrical signals received from SCADA and/or a local VC-22D electronic valve

controller. The solenoid pilots either add or relieve line pressure from the cover chamber of the control valve, causing it to open or close, ensuring the process variable signal follows the set-point command signal. This enables remote control over the electronic control valve operations. The process variable signal would come from a flow meter, pressure sensor or other rapid fluctuating process. The electric solenoid pilot controls can also be combined with hydraulic or electronic motorized pilot controls to create dual function, or fail-safe capability. Upon receiving the remote setpoint command from SCADA or a local command from the electronic valve controller, the electron valve shall modulate and maintain the desired setpoint value. When the feedback signal deviates from the setpoint, the appropriate opening or closing solenoid on the valve will pulse. As the feedback signal approaches the setpoint, this on/off pulse time will gradually decrease to smoothly modulate the valve to setpoint. When the feedback signal is within a programmable dead band, the opening and closing solenoids will lock the cover and the electronic valve will maintain position.

B. In normal operation, the valve will be under command of the two solenoids maintaining the desired flow or position set point. The solenoids will be under command of the VC-22D electronic valve controller. The CDS6A will control the high level shut off of the reservoir. The CDS6A shall always be active. In the event of a power failure, the valve will be allowed to go to the full open position until the high level shut off set point of the pilot is reached which will hydraulically close the valve.

2.03 MAIN VALVE

A. The main valve shall be hydraulically operated, single diaphragm actuated, globe pattern. The valve shall consist of three major components; the body with seat installed, the cover with bearing installed and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating the operating pressure from line pressure. Packing glands, stuffing boxes and/or rolling diaphragm technology will not be permitted and there shall be no pistons operating the main valve or pilot controls. No fabrication or welding shall be used in the manufacturing process. Y-pattern valves shall not be permitted. Main valve shall be certified by NSF/ANSI Standard 61 as a safe drinking water system component.

2.04 END CONNECTIONS

A. End Connections for control valve shall be flanged per ASME/ANSI B16.42, Class 150 (1-1/2” thru 36”).

2.05 MAIN VALVE BODY

A. No separate chamber(s) below the diaphragm shall be allowed between the main valve cover and body. No fabrication or welding shall be used in the manufacturing process.

B. The valve shall contain a resilient, synthetic rubber disc with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to

permit smooth transition of flow and shall hold the disc firmly in place. The disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing shocks. It must have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hourglass-shaped disc retainers shall be permitted and no V-type or slotted type disc guides shall be used.

C. The diaphragm assembly containing a non-magnetic stainless steel stem of sufficient diameter to withstand high hydraulic pressures shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. The seat shall be a solid, one-piece design and shall have a minimum of a five-degree taper on the seating surface for a positive, drip-tight shut off. No center guides shall be permitted. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve separating operating pressure from line pressure. No bolts or cap screws shall be permitted for use in the construction of the diaphragm assembly.

D. The flexible, non-wicking, FDA approved diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a Mullins Burst Test of a minimum of 600 psi per layer of nylon fabric and shall be cycle tested 100,000 times to insure longevity. The diaphragm shall not be used as the seating surface. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully open or fully closed position. Bellofram type rolling diaphragms shall not be permitted.

E. The main valve seat and the stem bearing in the valve cover shall be removable. The cover bearing and seat in 6" and smaller size valves shall be threaded into the cover and body. Valve seat in 8" and larger size valves shall be retained by flat head machine screws for ease of maintenance. The lower bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To insure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No "pinned" covers to the valve body shall be permitted. Cover bearing, disc retainer, and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline. The valve shall be designed such that both the cover assembly and internal diaphragm assembly can be disassembled and lifted vertically straight up from the top of a narrow opening/vault. Y-pattern valves shall not be permitted. The seat shall be of the solid one piece design. Two piece seats or seat inserts shall not be permitted. Packing glands and/or stuffing boxes shall not be permitted.

2.06 PILOT CONTROL SYSTEM

A. The pilot control shall be through two direct acting two-way solenoid pilot valves controlled by an external power source. The pilot control system shall include strainers and solenoid manual by-pass valves. The pilot control system shall utilize copper control tubing and brass fittings. The solenoid pilot valves either add or relieve line pressure from the cover chamber of the main valve, causing it to open or close as directed by the electronic controller. Solenoids shall have NEMA IV enclosures.

B. A direct factory representative shall be made available for start-up service, inspection and necessary adjustments.

2.07 MATERIALS

A. Material Specification for the Electronic Altitude Control Valves shall be as follows:

Component	**Material**
Main Valve	
Body & Cover	Ductile Iron-ASTM A536
Main Valve Trim	Bronze, Stainless Steel
Seat	Bronze, Stainless Steel
Stem, Nut and Spring	Stainless Steel
Seal Disc	Buna-N® Rubber
Diaphragm	Nylon Reinforced Buna-N® Rubber
Internal Trim Parts	Stainless Steel: Bronze; Brass
End Detail	Flanged
Pressure Rating	Class 150 lb. (250psi Max.)
Temperature Range	Water to 180°F
Any other wetted metallic parts	Stainless Steel; Bronze; Brass
Coating	Fusion Bonded Epoxy Coating (Interior and Exterior); ANSI / NSF 61 Approved / AWWA C116-03
Optional Accessories	Position Indicator, Position Transmitter, Limit Switch, Opening and Closing Speed Controls, Isolation Valves, Gauges. **Reference VC-22D ValvApp Worksheet within this Specification**
Solenoid Pilot Control System	
Pilots Body & Cover	Bronze B283
Pilot Trim	Brass & 303 Stainless Steel
Seals & Disc	NBR

Core & Plugnut	430F Stainless Steel
Core Springs	302 Stainless Steel
Shading Coil	Copper
Disc-Holder	CA
Core Guide	CA
Connections	FNPT
Power Supply	120VAC/60Hz
Enclosure	NEMA Type 1
Pressure rating	400 psi Max.
Control Tubing	Copper
Control Fittings	Brass

2.08 FACTORY ASSEMBLY:

A. Each valve assembly shall be factory assembled.

B. The Quality Management System of the factory shall be certified in accordance with ISO 9001: 2008.

C. For all control valves, the factory assembly shall include the complete main valve, pilot valve(s), and all associated accessories and control equipment.

D. During factory assembly the control valve manufacture shall make all necessary adjustments and correct any defects. 3

2.09 NAMEPLATES:

A. Each Control Valve and associated pilot(s) shall be provided with an identifying nameplate.

B. Nameplates, depending on type and size of control valve, shall be mounted in the most practical position possible, typically on the inlet side of the valve body.

C. Nameplates shall be brass and a minimum of 3/32” thick, ¾” high and 2-3/4” long.

D. Pertinent control valve data shall be etched or stamped into the nameplate. Data shall include control valve Catalog number, function, size, material, pressure rating, end-connection details, type of pilot controls used and control adjustment range.

2.10 FACTORY TESTING

A. Each control valve shall be factory tested.

B. The Quality Management System of the factory shall be certified in accordance with ISO 9001: 2008

C. Tests shall conform to approved test procedures.

D. The standard factory tests shall include a valve body and cover leakage test, seat leakage test and a stroke test. Control valves and pilot valves, in the partially open position, with both ends closed off with blind flanges (valves) and pipe plugs (pilots), shall be subject to an air test. The applied air pressure shall be 90 psi minimum. All air pressure tests shall be applied for a minimum of 15 minutes. No visible leakage is permitted through the valve seat, the pressure boundary walls of the valve body, valve cover, pilot body, pilot cover or the body-cover joint.

E. Control valve manufacturer shall, upon request, offer additional testing, such as high-pressure hydrostatic testing, positive material inspection testing, ferrite testing, liquid penetration inspection testing, magnetic particle examination testing and radiographic examination testing.

F. The Altitude Control Valve (Electronic Control Valve) shall be Cla-Val Model 131-EF.

2.11 FIELD TESTING

A. Each control valve shall be field tested according to manufacturer's installation manual 'Test Procedure after Valve Assembly'.

B. A manufacturer representative shall be available during system start up and field testing of the control valve.

C. The closing and opening speed of the valve shall be adjusted once installed and testing. The closing and opening time shall be 20 seconds minimum.

PART 3 - EXECUTION

3.01 GENERAL

A. All valves shall be installed in accordance with the manufacturer's recommendation. Appropriate galvanized steel supports shall be provided to support the valve.

3.02 TRAINING

A. Contractor shall provide the services of a factory trained and field experienced representative of the manufacturer to conduct group training of the Owner's designated personnel in the operation of the valves. Include instruction covering basic system theory, operating principles and adjustments, routine maintenance and repair, and "hands on" operation. The text for this training shall be the operation and maintenance manuals. The training time period shall not exceed 8 hours.

3.03 WARRANTY

A. The valve manufacturer shall warrant the valve to be free of defects in material and workmanship for a period of 3 years from date of shipment, provided the valve is installed

and used in accordance with all applicable instructions. Electrical components shall have a 1-year warranty.

END OF SECTION

VC-22D ValvApp™ Worksheet

This worksheet is intended for the configuration of ValvApps™ used in the VC-22D Valve Controller. From the information provided below, Cla-Val will determine whether a standard ValvApp™ should be used or if a custom ValvApp™ is required. Additionally, this worksheet acts as a check list during commissioning to verify all parameters have been correctly configured in the VC-22D Valve Controller. Once this worksheet is completed, please return to your Cla-Val representative for approval. If a custom ValvApp is required and approved, a custom wiring diagram and ValvApp™ will be created and emailed to you. Please verify all *Required fields have been filled out prior to submittal.

Information **Configuration:** VC-22D

*Project Name: DSRSD | Reservoir 20B
*Today's Date: 6/6/25
*Cla-Val Representive: TBD
*Project Completion Date: TBD
Control Valve Model Number (if known): 131-EF
*Customer Approval Signature:

Valve Regulation *(If more than 2 PID's are required, specify in logic on page 2)*

☐ *PID 1 - Valve Regulation* *Solenoid Config.: NC / NO (P.F. Open)
*Control Type: Level - Altitude | Signal Loss: Hydraulic
Deadband (+/-): | Ramping:

☐ *PID 2 - Valve Regulation* Solenoid Config.: NC / NO (P.F. Open)
Control Type: Level - Altitude | Signal Loss: Hydraulic
Deadband (+/-): | Ramping:

DP Metering (133 Valve)

☐ *DP Metering* Pressure Measurement: ◉ P1+P2 ○ DPT ☐ LFS Output:
Size: 8" | Body Style: 100-01 Globe | Seat: Standard | Units: gpm | Output Scaling:

Totalizer

☐ *Totalizer* Reset: Units: Ouput: Output Scaling:

Analog Inputs (4-20mA) *6 Available*

☐ *Analog Input #1 (Typically reserved for control setpoint signal)*
Name: Units: Scaling ☐ Signal Powered by Controller
4mA = 20mA = Decimal:

☐ *Analog Input #2 (Typically reserved for control feedback signal)*
Name: Units: Scaling ☐ Signal Powered by Controller
4mA = 20mA = Decimal:

☐ *Analog Input #3*
Name: Units: Scaling ☐ Signal Powered by Controller
4mA = 20mA = Decimal:

☐ *Analog Input #4*
Name: Units: Scaling ☐ Signal Powered by Controller
4mA = 20mA = Decimal:

☐ *Analog Input #5*
Name: Units: Scaling ☐ Signal Powered by Controller
4mA = 20mA = Decimal:

☐ *Analog Input #6*
Name: Units: Scaling ☐ Signal Powered by Controller
4mA = 20mA = Decimal:

Digital Inputs *6 Available*

☐ *Digital Input 1* Name: Purpose:
☐ *Digital Input 2* Name: Purpose:
☐ *Digital Input 3* Name: Purpose:
☐ *Digital Input 4* Name: Purpose:
☐ *Digital Input 5* Name: Purpose:
☐ *Digital Input 6* Name: Purpose:

Analog Outputs (4-20mA) *Note: Analog Outputs are sourced with controller power.*

☐ *Analog Output #1*
Name **Units** **Scaling** **4mA =** **20mA =** **Decimal**

☐ *Analog Output #2*
Name **Units** **Scaling** **4mA =** **20mA =** **Decimal**

☐ *Analog Output #3*
Name **Units** **Scaling** **4mA =** **20mA =** **Decimal**

☐ *Analog Output #4*
Name **Units** **Scaling** **4mA =** **20mA =** **Decimal**

Solenoid Outputs

☐ *Solenoid Output #1 (SO1)*
Name
Default: Closing Solenoid

☐ *Solenoid Output #2 (SO2)*
Name
Default: Opening Solenoid

Note: *SO1 and SO2 are a powered solid state output typically reserved for solenoids used on a 131 or 133 series valve. The output can be configured as PWM (default) or Discrete ON/OFF. If configured as discrete, a value of 0 represents an open circuit, and 1 a closed circuit.*

Relay Output

☐ *Relay Output #1 (RO1)*
Name

☐ *Relay Output #2 (RO2)*
Name

Note: *RO1 and RO2 are configured as dry contact mechanical relays typically used for alarms. These outputs are configured as Discrete ON/OFF, a value of 0 represents an open circuit, and 1 a closed circuit.*

Actions/Alarms

☐ *Action #1*
Name **Describe**
Additional Comments

☐ *Action #2*
Name **Describe**
Additional Comments

☐ *Action #3*
Name **Describe**
Additional Comments

☐ *Action #4*
Name **Describe**
Additional Comments

Communication

☐ **GSM/GPRS** ☐ **Modbus TCP/IP** ☐ **Modbus RTU (RS485/RS232)**

Note: *See ModBus specification page for register mapping and implementation. Refer to manual for more details.*

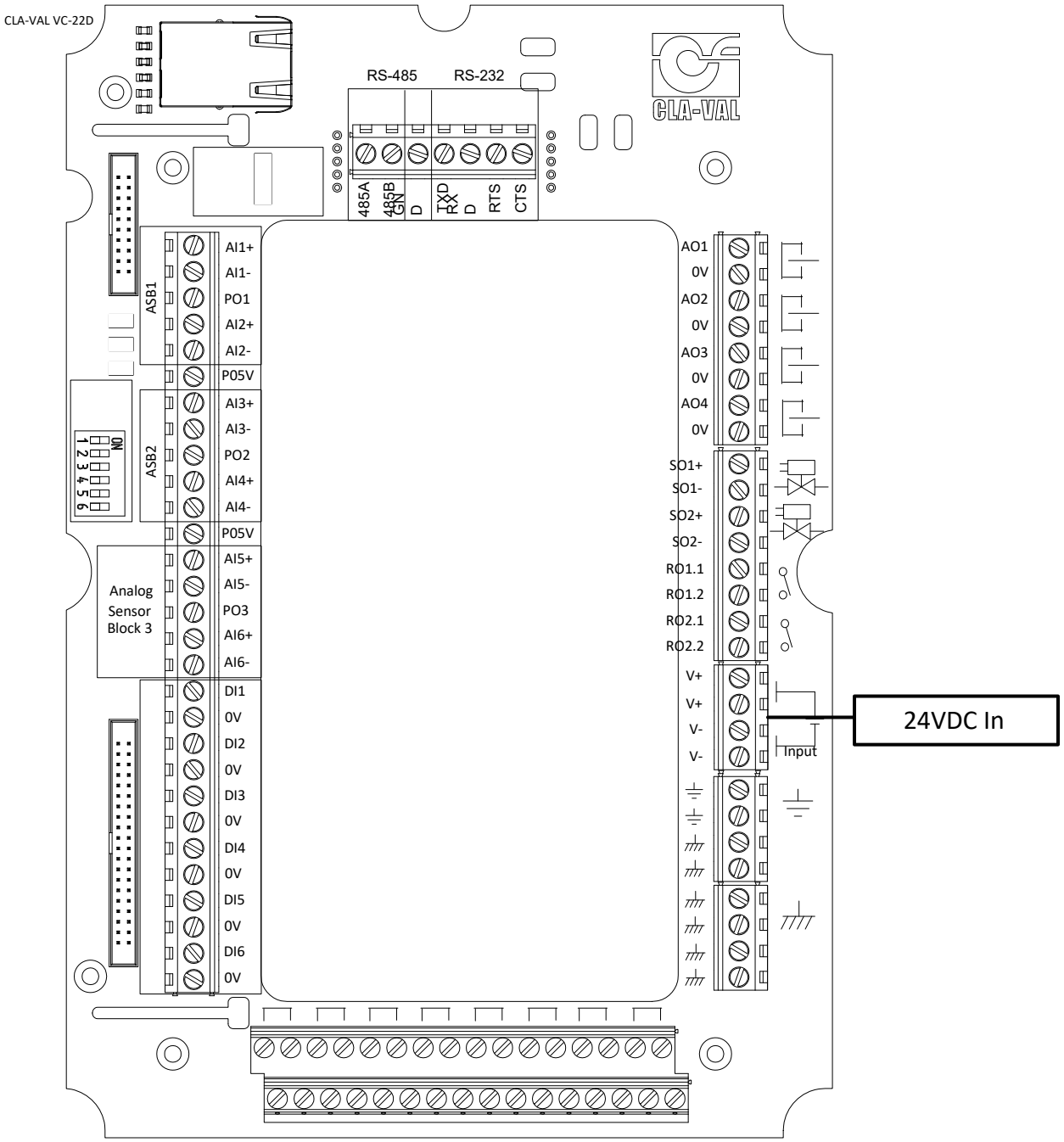
Control Logic (Please specify all control logic using sketches, diagrams, etc. Attach additional sheets if necessary)*

The following remote monitoring will be provided to the project site PLC via Modbus communication:
. Valve flow rate (gpm)
. Valve position (%)
. Valve/Valve Controller Fail

The following remote control will be performed from the project site PLC via Modbus communication:
. Operator adjustable valve position setpoint (%)

In the event there is a power failure the valve will operate as a hydraulic altitude valve (i.e.; go to full open until the high level shut off setpoint of the CDS6A pilot and hydraulically close the valve).

* Please refer to individual I/O sensor documents for correct wiring. This is only to give an idea of where wires will be landed. Does not account for number of wires and Loop or Field powered.



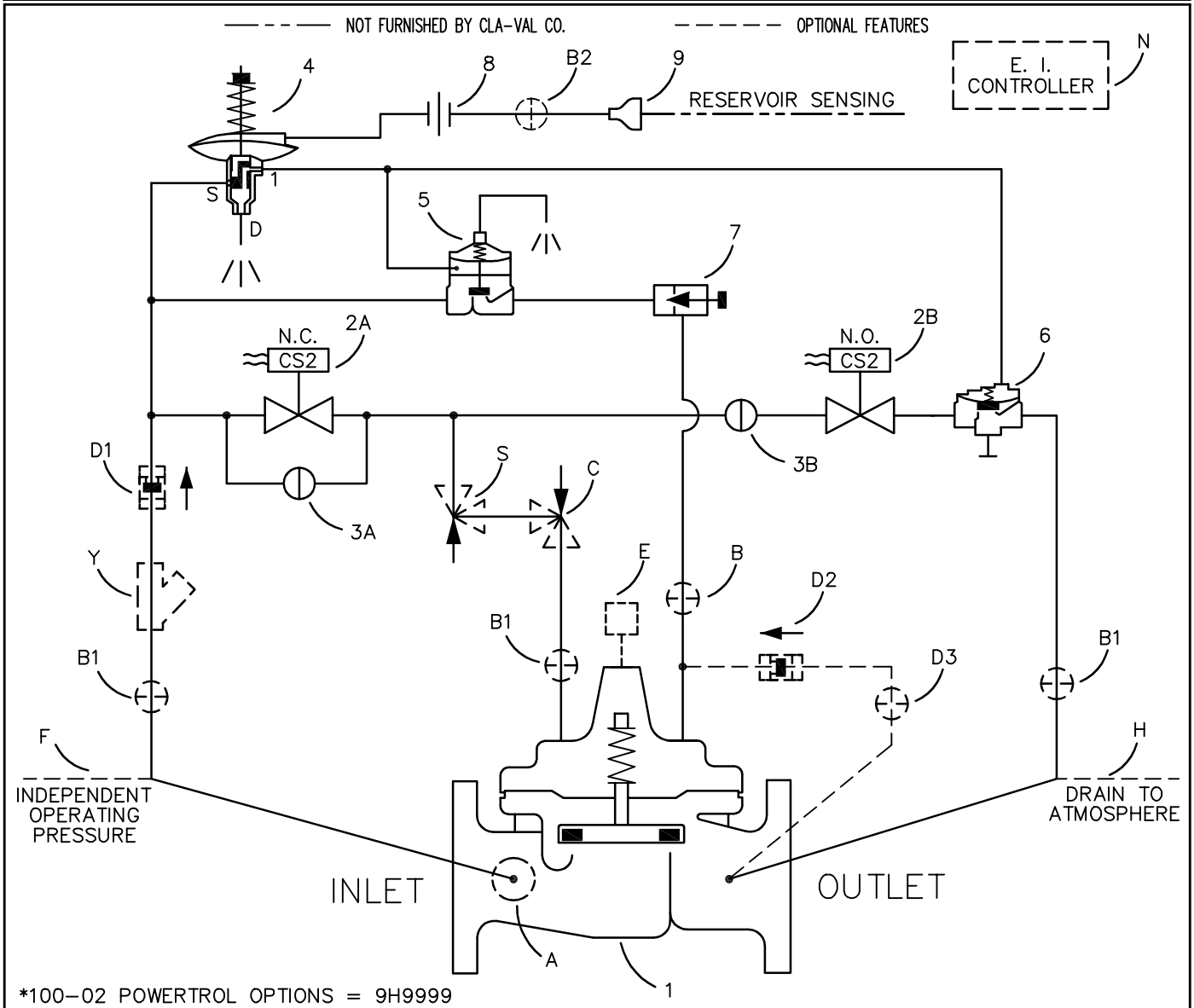
CLA-VAL CO. NEWPORT BEACH, CALIFORNIA

CATALOG NO.	DRAWING NO.	REV
131-EF/631-EF	208047	–

TYPE OF VALVE AND MAIN FEATURES

ELECTRONIC INTERFACE VALVE WITH ALTITUDE OVERRIDE (POWER FAIL OPEN)

DESIGN		
DRAWN	AK	4-15-10
CHK'D	VL	4-16-10
APV'D	CH	4-19-10



*100-02 POWERTROL OPTIONS = 9H9999

ITEM NO.	BASIC COMPONENTS	QTY
1	100-01 HYTROL (131-EF) MAIN VALVE 100-20 HYTROL (631-EF) MAIN VALVE	1
2	CS2 SOLENOID CONTROL	2
3	CK2 COCK (SOLENOID BYPASS)	2
4	CDS6A ALTITUDE CONTROL	1
5	*100-02 POWERTROL (REVERSE FLOW)	1
6	100-01 HYTROL (REVERSE FLOW)	1
7	CNA NEEDLE VALVE (CLOSING)	1
8	UNION	1
9	BELL REDUCER	1

OPTIONAL FEATURE SUFFIX		ADDED TO CATALOG NUMBER
A	X46A FLOW CLEAN STRAINER	1
B	CK2 COCK (ISOLATION VALVE)	5
C	CV FLOW CONTROL (CLOSING)	1
D	CHECK VALVES WITH COCK	1
E	X117D POSITION TRANSMITTER	1
F	INDEPENDENT OPERATING PRESSURE	
H	ATMOSPHERIC DRAIN	
N	ELECTRONIC CONTROLLER (SINGLE)	1
S	CV FLOW CONTROL (OPENING)	1
Y	X43 "Y" STRAINER	1

CAD REVISION RECORD - DO NOT REVISE MANUALLY

LTR	DESCRIPTION	BY	DATE
–	RELEASED FOR PRODUCTION (NED 64412)	AK	4-15-10

CLA-VAL CO. NEWPORT BEACH, CALIFORNIA

CATALOG NO.	DRAWING NO.	REV
131-EF/631-EF	208047	–

TYPE OF VALVE AND MAIN FEATURES

ELECTRONIC INTERFACE VALVE WITH ALTITUDE OVERRIDE (POWER FAIL OPEN)

DESIGN		
DRAWN	AK	4-15-10
CHK'D	VL	4-16-10
APV'D	CH	4-19-10

CAD REVISION RECORD - DO NOT REVISE MANUALLY

LTR	DESCRIPTION	BY	DATE
	SEE SHEET 1.		

OPERATING DATA

I. ALTITUDE VALVE FEATURE:

ALTITUDE CONTROL (4) IS A SPRING LOADED, 3-WAY, DIAPHRAGM ACTUATED CONTROL THAT SENSES PRESSURE IN THE RESERVOIR. WHEN RESERVOIR PRESSURE (LIQUID LEVEL) IS LOWER THAN THE SET POINT OF CONTROL (4), PORTS 1 AND D ARE INTERCONNECTED. THIS RELIEVES PRESSURE FROM THE POWERUNIT CHAMBER OF POWERTROL (5) AND FROM THE COVER CHAMBER OF AUXILIARY HYTROL (6). THIS CLOSES POWERTROL (5) AND OPENS AUXILIARY HYTROL (6), OPENING THE MAIN VALVE (1) UNDER COMMAND OF THE ELECTRONIC INTERFACE FEATURE. RESERVOIR SENSING PRESSURE INCREASES AS THE LIQUID LEVEL RISES IN THE RESERVOIR. WHEN RESERVOIR SENSING PRESSURE INCREASES TO THE SET POINT OF CONTROL (4), CONTROL (4) SHIFTS, INTERCONNECTING PORTS S AND 1. THIS APPLIES PRESSURE TO THE POWERUNIT CHAMBER OF POWERTROL (5) AND TO THE COVER CHAMBER OF AUXILIARY HYTROL (6). THIS OPENS POWERTROL (5) AND CLOSES AUXILIARY HYTROL (6), CLOSING THE MAIN VALVE (1).

ALTITUDE CONTROL (5) ADJUSTMENT:

TURN THE SPRING ADJUSTING NUT CLOCKWISE TO INCREASE THE SETTING; COUNTERCLOCKWISE TO DECREASE THE SETTING

II. ELECTRONIC INTERFACE FEATURE:

SOLENOID CONTROLS (2A) AND (2B) ARE DIRECT ACTING, 2-WAY SOLENOID CONTROLS THAT CHANGE POSITION WHEN THE COILS ARE ENERGIZED OR DE-ENERGIZED BY THE ELECTRONIC INTERFACE CONTROLLER (N). FOLLOWING PARAGRAPHS DESCRIBE THE OPENING AND CLOSING CYCLES OF MAIN VALVE (1).

OPENING: [AUXILIARY HYTROL (6) MUST BE OPEN]

WHEN THE ELECTRONIC INTERFACE CONTROLLER (N) DE-ENERGIZES SOLENOID CONTROLS (2A) AND (2B), THE N.C. SOLENOID CONTROL (2A) CLOSES AND THE N.O. SOLENOID CONTROL (2B) OPENS. THIS RELIEVES MAIN VALVE (1) COVER PRESSURE TO OUTLET AND THE MAIN VALVE (1) STARTS TO OPEN UNTIL THE ELECTRONIC INTERFACE CONTROLLER (N) ENERGIZES SOLENOID CONTROL (2B), CLOSING SOLENOID CONTROL (2B), LOCKING THE MAIN VALVE (1) IN THE DESIRED POSITION.

CLOSING:

WHEN THE ELECTRONIC INTERFACE CONTROLLER (N) ENERGIZES SOLENOID CONTROLS (2A) & (2B), THE N.C. SOLENOID CONTROL (2A) OPENS AND THE N.O. SOLENOID CONTROL (2B) CLOSE. THIS APPLIES PRESSURE TO THE MAIN VALVE COVER AND THE MAIN VALVE (1) CLOSES.

CLA-VAL CO. NEWPORT BEACH, CALIFORNIA

CATALOG NO.	DRAWING NO.	REV
131-EF/631-EF	208047	–

TYPE OF VALVE AND MAIN FEATURES

ELECTRONIC INTERFACE VALVE WITH ALTITUDE OVERRIDE (POWER FAIL OPEN)

DESIGN		
DRAWN	AK	4-15-10
CHK'D	VL	4-16-10
APV'D	CH	4-19-10

OPERATING DATA-CONTINUED

III. MANUAL BYPASS FEATURE:

OPENING: [AUXILIARY CONTROL (6) MUST BE OPEN]
MANUALLY OPEN CK2 COCK (3B) AND CLOSE CK2 COCK (3A). THIS RELIEVES COVER PRESSURE FROM THE MAIN VALVE, OPENING THE MAIN VALVE (1).

CLOSING:
MANUALLY OPEN CK2 COCK (3A) AND CLOSE CK2 COCK (3B). THIS BYPASSES SOLENOID CONTROL (2A) CLOSING THE MAIN VALVE (1).

IV. POWER FAIL OPEN FEATURE:

DURING A POWER FAILURE SOLENOID CONTROLS (2A) AND (2B) ARE DE-ENERGIZED. SOLENOID CONTROL (2A) CLOSES AND SOLENOID CONTROL (2B) OPENS. THIS RELIEVES COVER PRESSURE OF THE MAIN VALVE AND THE MAIN VALVE (1) OPENS.

V. CLOSING SPEED CONTROL:
NEEDLE VALVE (7) CONTROLS THE CLOSING SPEED OF THE MAIN VALVE. TURN THE ADJUSTING STEM CLOCKWISE TO MAKE THE MAIN VALVE CLOSE SLOWER. DO NOT CLOSE VALVE (7) COMPLETELY OR THE MAIN VALVE WILL NOT CLOSE. (SUGGESTED INITIAL SETTING OF NEEDLE VALVE IS 1/4 TO 1/2 TURN OPEN).

VI. OPTIONAL FEATURE OPERATING DATA:

SUFFIX A (FLOW CLEAN STRAINER)
A SELF-CLEANING STRAINER IS INSTALLED IN THE MAIN VALVE INLET BODY BOSS WHICH PROTECTS THE PILOT SYSTEM FROM FOREIGN PARTICLES.

SUFFIX B (ISOLATION VALVES)
CK2 COCKS (B) & (D3) ARE USED TO ISOLATE THE PILOT SYSTEM FROM MAIN LINE PRESSURE. THESE VALVES MUST BE OPEN DURING NORMAL OPERATION.

SUFFIX C (CLOSING SPEED CONTROL)
FLOW CONTROL (C) CONTROLS THE CLOSING SPEED OF THE MAIN VALVE. TURN THE ADJUSTING STEM CLOCKWISE TO MAKE THE MAIN VALVE CLOSE SLOWER.

SUFFIX D (CHECK VALVES WITH COCK)
WHEN OUTLET PRESSURE IS HIGHER THAN INLET PRESSURE, CHECK VALVE (D2) OPENS AND (D1) CLOSES. THIS DIRECTS THE HIGHER OUTLET PRESSURE INTO THE MAIN VALVE COVER AND THE MAIN VALVE CLOSES.

SUFFIX E (POSITION TRANSMITTER)
POSITION TRANSMITTER (E) TRANSMITS A POSITIONAL SIGNAL FROM THE MAIN VALVE TO THE ELECTRONIC INTERFACE CONTROLLER.

CAD REVISION RECORD - DO NOT REVISE MANUALLY

LTR	DESCRIPTION	BY	DATE
	SEE SHEET 1.		

CLA-VAL CO. NEWPORT BEACH, CALIFORNIA

CATALOG NO.	DRAWING NO.	REV
131-EF/631-EF	208047	–

TYPE OF VALVE AND MAIN FEATURES

ELECTRONIC INTERFACE VALVE WITH ALTITUDE OVERRIDE (POWER FAIL OPEN)

DESIGN		
DRAWN	AK	4-15-10
CHK'D	VL	4-16-10
APV'D	CH	4-19-10

OPERATING DATA-CONTINUED

SUFFIX F (INDEPENDENT OPERATING PRESSURE)
PILOT SUPPLY PRESSURE IS OBTAINED FROM AN INDEPENDENT SOURCE. (PILOT SUPPLY PRESSURE IS OBTAINED FROM THE MAIN VALVE INLET IF SUFFIX (F) IS NOT SPECIFIED.) NOTE: INDEPENDENT OPERATING PRESSURE MUST BE EQUAL TO OR GREATER THAN PRESSURE AT THE MAIN VALVE INLET AT ALL TIMES.

SUFFIX H (ATMOSPHERIC DRAIN)
PILOT SYSTEM DRAIN LINE IS DISCHARGED TO ATMOSPHERE. [PILOT SYSTEM DRAIN LINE IS CONNECTED TO THE MAIN VALVE OUTLET BOSS IF SUFFIX (H) IS NOT SPECIFIED.]

SUFFIX N (ELECTRONIC INTERFACE CONTROLLER)
ELECTRONIC INTERFACE CONTROLLER (N) ENERGIZES OR DE-ENERGIZES THE SOLENOID CONTROLS, OPENING, CLOSING OR LOCKING THE MAIN VALVE (1) IN THE DESIRE POSITION.

SUFFIX S (OPENING SPEED CONTROL)
FLOW CONTROL (S) CONTROLS THE OPENING SPEED OF THE MAIN VALVE. TURN THE ADJUSTING STEM CLOCKWISE TO MAKE THE MAIN VALVE OPEN SLOWER.

SUFFIX Y (Y-STRAINER)
A Y-PATTERN STRAINER IS INSTALLED IN THE PILOT SUPPLY LINE TO PROTECT THE PILOT SYSTEM FROM FOREIGN PARTICLES. THE STRAINER SCREEN MUST BE CLEANED PERIODICALLY.

VII. CHECK LIST FOR PROPER OPERATION:

( ) SYSTEM VALVES OPEN UPSTREAM AND DOWNSTREAM.
( ) AIR REMOVED FROM THE MAIN VALVE COVER AND PILOT SYSTEM AT ALL HIGH POINTS.
( ) CK2 COCKS (B1), (B2) & (D3) OPEN DURING NORMAL OPERATION (OPTIONAL FEATURE).
( ) PERIODIC CLEANING OF STRAINER (Y) IS RECOMMENDED (OPTIONAL FEATURE).
( ) CV FLOW CONTROLS (C) AND (S) OPEN AT LEAST 4 TURNS (OPTIONAL FEATURE).
( ) CNA NEEDLE VALVE (7) OPEN AT LEAST 1/4 TURN.
( ) CORRECT VOLTAGE TO SOLENOID CONTROLS (2A) & (2B).
( ) CK2 COCK (3A) CLOSED DURING NORMAL OPERATION.
( ) CK2 COCK (3B) OPEN DURING NORMAL OPERATION.
( ) RESERVOIR SENSING LINE PROPERLY CONNECTED.
( ) INDEPENDENT OPERATING PRESSURE CONNECTION PROPERLY CONNECTED. (OPTIONAL FEATURE)

CAD REVISION RECORD - DO NOT REVISE MANUALLY

LTR	DESCRIPTION	BY	DATE
	SEE SHEET 1.		

DIVISION 16 – ELECTRICAL

SECTION 16000
REQUIREMENTS FOR ELECTRICAL WORK

PART 1 GENERAL

1.1 DESCRIPTION

A. This section specifies electrical work including labor, electrical material, equipment, and installation and testing requirements for complete operating system. All equipment requiring power and or control shall include equipment furnished under this section and other sections of the specifications. The electrical drawings included in this project document are diagrammatic only and functional in nature and do not specify exact locations of equipment or equipment terminations.

1.2 QUALITY ASSURANCE

A. References: This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ANSI A58.1	Minimum Design Loads for Building and Other Structures
IEEE 81	Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE C57.12.01	General Requirements for Dry-Type Distribution and Power Transformers
NEMA 250	Enclosures for Electrical Equipment (1000 Volt Maximum)
NEMA ICS 1	General Standards for Industrial Controls and Systems
NEMA ICS 2	Industrial Control Devices, Controllers, and Assemblies
NEMA ICS 6	Enclosures for Industrial Controls and Systems

Reference	Title
NEMA ST20	Dry-Type Transformers for General Application
NEMA WD 1	General Requirements for Wiring Devices
NFPA 70	National Electrical Code (NEC)
CBC	California Building Code
UL 50	Enclosures for Electrical Equipment
UL 62	Flexible Cords and Cables
UL 67	Panelboards
UL 489	Molded-Case Circuit Breakers and Circuit Breaker Enclosures
UL 506	Specialty Transformers
Ul 508A	Standard for Industrial Control Panel

C. Identification of Listed Products: Electrical equipment and materials shall be listed by an independent testing laboratory for the purpose for which they are to be used. Three such organizations are Underwriters Laboratories, Inc. (UL), Canadian Standards Association (CSA), and Electrical Testing Laboratories (ETL). The independent testing laboratory shall be acceptable to the inspection authority having jurisdiction.

1.3 SUBMITTALS

A. The following specific submittal requirements for the switchgear, switchboard, motors, transformers, power distribution panels and starters or VFD's shall be followed:

1. Contractor shall formally place an order with equipment manufacturer within thirty days of the award of the contract. The order shall include all relevant drawings and specs including any addendum items associated with the equipment.

2. Contractor shall submit shop drawings to the District as soon as possible or within 6 weeks of the order being placed for long lead items such as standby generator.

3. Contractor shall forward review comments to equipment manufacturer within two days after receipt of the comments by the District.

4. Contractor shall provide the release for manufacturing to equipment manufacturer within 3 business days of receiving a favorably reviewed submittal and shall provide the District with the shipping date.

5. Prior to shipment, a factory test of the equipment witnessed by the District shall occur.

B. The following information shall be provided for all electrical equipment and materials in accordance with Section 01340:

1. Verification of fault withstands and interrupting ratings of all applicable power equipment and devices.

2. Interconnection diagrams -The Contractor shall prepare interconnection diagrams depicting all cable requirements together with their actual terminations as specified below.

   Interconnection diagrams shall be drawn to reflect actual, physical relationship between equipment and or components as shown on the drawings. The interconnection diagram shall indicate wiring between panels, terminal boxes, remotely mounted devices, and motor starters. The diagrams shall interface with the manufacturer's internal connection diagrams for panels. The diagrams shall indicate the terminations to terminal blocks of field devices at each end of the cable, the number of conductors in the cable, the size of wire, and the number of spare conductors. For each termination, the diagrams shall indicate the terminal number, wire color, and wire number as it appears on the wire marker. All terminal blocks, including spares, shall be indicated on the diagrams. Interconnection diagrams shall be provided for review and approval prior to installation of equipment.

3. Catalog-cuts including technical specifications, application information, ratings, and other information required to verify the equipment and/or material meets the requirements of this specification.

4. A copy of this specification section with addenda updates, and all referenced sections with addenda updates, with each paragraph check marked to show specification compliance or marked to show deviations.

1.4 PROJECT/SITE CONDITIONS

A. General: Unless otherwise specified, equipment and material shall be sized and rated for an ambient temperature of 40 degrees C at an elevation ranging from sea level to 100 feet without exceeding the manufacturer's stated ratings. All outdoor locations shall be considered as corrosive areas. Enclosures for outdoors, unless otherwise noted, shall be NEMA 4X or 3RX, 316 stainless steel.

B. Seismic: All electrical equipment and supports shall be braced in accordance with latest California Building Code.

C. Classified Hazardous locations: None in this project.

1.5 ELECTRIC SERVICE

Electric service for this facility is new and provided by Pacific Gas and Electric Company. A new service request and application has been submitted to PG&E. Contractor, however, shall be

responsible for coordinating this work with PG&E and the DISTRICT to ensure a timely installation of the service. Contractor shall be responsible for trenching, furnishing and installation of underground service conduits as detailed on the drawings. Coordination with the District's staff and with PG&E is required.

PART 2 PRODUCTS

2.1 GENERAL

Equipment and materials shall be new and free from defects. All equipment of the same or similar type shall be of the same manufacturer throughout the work. Standard production materials shall be used wherever possible.

2.2 RACEWAY, FITTINGS, AND SUPPORTS

A. General: Conduit shall be provided for power, control, instrumentation, grounding, lighting, receptacles, and signaling systems.

B. Raceway:

1. All exposed conduit, indoor and outdoor, shall be threaded, rigid galvanized steel (RGS) conduit. All conduit accessories such as couplings, elbows, junction boxes etc. shall also be galvanized steel. Minimum size of conduit shall be 3/4 inch. Bushings shall be galvanized, malleable iron with insulating collars. Grounding bushings shall be locking type with a feed through compression lug. Unions shall be galvanized, ferrous alloy type. Threadless fittings are not acceptable. Running threads shall not be used in lieu of conduit nipples. Threaded hubs shall be used to terminate conduits entering boxes. RGS conduit shall be manufactured by Allied Tube and Conduit, Appleton, PWC Inc. or equal.

2. Liquidtight, flexible steel conduit shall be formed from spirally wound, galvanized steel strip with successive convolutions securely interlocked and jacketed with liquidtight, plastic cover. Minimum size shall be 3/4 inch. Fittings for liquidtight conduit shall have cadmium-plated, malleable iron body and gland nut with cast-in lug, brass grounding ferrule threaded to engage conduit spiral and O-ring seals around the conduit and box connection and insulated throat. Forty-five and 90-degree fittings shall be used where applicable.

3. Embedded or encased underground conduit shall be Schedule 40, high impact, polyvinyl chloride (PVC). Minimum size shall be 1 inch.

4. Fittings for PVC conduit shall be solvent welded type.

C. Boxes:

1. Boxes for use outdoors and in process areas shall be hot-dip, galvanized cast ferrous alloy type FD with integrally cast-threaded hubs for conduit entry. Boxes larger than FD boxes shall be welded steel and hot-dip galvanized after fabrication.

2. Conduit bodies shall be ferrous alloy type with screw taps for fastening covers. Gaskets shall be made of neoprene.

D. Raceway Supports: Stainless steel framing channels shall be used to support groups of conduit. Individual conduit supports shall be one-hole stainless steel malleable iron pipe straps with stainless steel clamp backs and nesting backs where required. Ceiling hangers shall be adjustable, stainless steel rod hangers. Straps or plumbers tape are not acceptable. Hanger rods shall be 1/2-inch all thread stainless steel rod.

E. Concrete Pull Boxes: Provide and install pre-cast concrete pull boxes in locations indicated on the Drawings and as required by NEC. Pull boxes shall be:

1. Designed for heavy traffic conditions, with pull box and cover designed for heavy traffic bridge loading H-20

2. Minimum 2 feet by 3 feet by 3 feet depth with ¾ inch diameter pulling irons located at each end. Concrete material shall be reinforced Class A.

3. Provided with engraved “Electrical” or “Instrumentation” or “Telephone” as applicable on the top side of the covers.

F. Pull Boxes: Provide and install pre-cast concrete pull boxes in locations indicated on the Drawings and as required by NEC. Pull boxes shall be:

1. Designed for heavy traffic conditions, with pull box and cover designed for heavy traffic bridge loading H-20

2.3 CONDUCTORS, WIRE, AND CABLE

A. General: Conductors, wires, and cable shall be provided for power, control, lighting, receptacles, instrumentation, grounding and signal circuits. The quantity and size of conductors shall be as specified.

B. Power and Control Conductors: Power and control conductors shall be single conductor, stranded, annealed copper with 600-volt THWN/THHN polyvinyl chloride (PVC) insulation, Okonite, Okoseal-N; CABLEC; or equal.

C. Lighting and Receptacle Circuit Conductors: Conductors for lighting and receptacle circuits shall be single conductor, annealed copper with 600-volt THWN/THHN PVC insulation. Conductor sizes No. 10 AWG and larger shall be stranded. No. 12 AWG shall be solid conductor. Minimum conductor size shall be No. 12 AWG. Conductors shall be Okonite, Okoseal-N; CABLEC; or equal.

D. Grounding Conductors: Grounding conductors shall be as specified in paragraph 16000-2.7 A.

E. Instrumentation and Signal Cable: Cable for instrumentation and signal circuit shall be twisted shielded pair or triad as specified, No. 16 AWG 7-strand copper with 600-volt PVC insulation, 100 percent aluminum-Mylar tape shield, No. 18 AWG tinned copper drain wire and overall PVC jacket, Okonite, Okoseal-N type P-OS, CABLEC, or equal.

F. Splicing and Terminating Materials:

1. Connectors: Connectors for stranded conductors shall be tool applied tin-plated copper, compression type of the correct size and UL approved for the application.

   Connectors for wire sizes No. 10 AWG and smaller shall be nylon self-insulated, ring tongue or locking-spade terminals. Connectors for wire sizes No. 8 AWG and larger shall be one-hole lugs up to size No. 3/0 AWG and two-hole or four-hole for size 4/0 AWG and larger. Mechanical clamp, dimple, or screw-type connectors are not acceptable.

   480-volt and 240-volt motor terminations shall be made using bolt connected lugged connectors and factory engineered kits consisting of heat shrinkable, polymeric insulating material with high dielectric strength mastic sealant.

   Termination of solenoid valves, 120-volt motors, and other devices furnished with pigtail leads shall be made using self-insulating, tubular compression connectors.

2. Terminal Blocks: Terminal blocks shall be provided for external control and power wires size 10 AWG and smaller. Terminal blocks shall be 600 volts, heavy-duty, rated 20 amperes for control and 30 amperes for power.

G. Wire Markers: Wire markers shall be yellow or white shrink tubing, Thermofit Marker System (TMS) by Raychem Co., Thomas and Betts equivalent, or equal for conductors No. 10 AWG and smaller and locking tab cable markers, W.H. Brady Co., Thomas and Betts, or equal, for conductors No. 8 and larger. Letters and numbers identifying each conductor shall be machine printed in permanent black ink.

H. Conduit tags: Conduit tags shall be 315 stainless steel imprinted with conduit designation as per conduit schedule shown on the drawings. Each tag shall be 0.5” by 2”with 0.25” high letters.

2.4 WIRING DEVICES

A. General: Receptacles, plugs, switches, and appurtenances shall be provided as specified on the drawings. Wiring devices shall be UL approved for the current and voltage specified and shall comply with NEMA WD-1. Receptacles and switches shall be premium, specification grade. GFI type in weather proof cover/box shall be provided for all outdoor receptacles.

B. Receptacles: Receptacles shall be 20A, 120V, and grounding type. Receptacles for use outdoors and in wet process areas shall be corrosion resistant, GFI type, marine duty with polycarbonate weatherproof lift covers, Hubbell 53CM62/ 53CM21, General Electric, or equal.

C. Switches: Switches for use outdoors and in wet process areas shall be 20 amp, press-switch type with weatherproof, corrosion-resistant neoprene plate, Hubbell, Arrow-Hart, or equal. Switches located in classified hazardous locations shall be suitable for installation in such locations. They shall be made by Killard Hazloc Series, Appleton, Crouse-Hinds , or equal.

2.5 INDIVIDUAL MOTOR STARTERS

A. General: Unless otherwise specified, where shown on the plans, individual motor starters shall be combination type with molded case motor circuit protector, 3-pole, 600-volt AC contactor, and three overload relays, NEMA size 1 minimum. Each motor starter shall be individually enclosed. Starters shall be manufactured by Cutler-Hammer, Allen-Bradley, General Electric, or equal.

B. Enclosures: The door of the motor starter enclosure shall be interlocked with an externally operated disconnect handle, lockable in the open position. Enclosures shall be NEMA 12 for dry indoor areas and NEMA 4X 316 SS for outdoor and wet process areas.

C. Motor Branch Circuit Protection: Molded case motor circuit protectors shall be magnetic only with trip settings adjustable over a range of 700 to 1300 percent of the full load current of the motor served. The motor circuit protector, in conjunction with the starter, shall be rated to interrupt 42,000 amperes (symmetrical) unless otherwise specified.

D. Overload Relay: Overload relays shall be bimetallic type with separate heaters for each of the three poles. Reset shall be accomplished with a reset pushbutton located on the unit door exterior. Trip setting shall be adjustable from 85 to 115 percent of the motor full load rating.

E. Control Circuits: Control power transformers, fuses, and control devices shall be provided as specified. Two control transformer primary fuses, rated to interrupt 100,000 amperes at 600 volts, shall be provided on all motor starters. Each motor starter shall be provided with one control circuit secondary fuse rated to interrupt 10,000 amperes at 250 volts and sized at 125 percent of the control circuit full load current. Control circuit shall be 120 V with grounded leg.

F. Wiring: Conductors shall be switchboard type and rated 90 degrees C above ambient temperature. Conductor shall be identified with tag numbers as specified.

G. Manual Starters: Where required, manual starters shall be provided as indicated on the drawings. Manual starters shall consist of a horsepower rated quick-make, quick-break toggle mechanism together with one or two overloads as specified. Voltage shall be as specified. Indoor and dry location shall be NEMA 12. For outdoor and wet process area, they shall be NEMA 4X corrosive resistant. For classified hazardous locations, they shall be rated for such locations and shall be manufactured by Square D, General Electric, or equal.

2.6 ELECTRICAL CONTROL DEVICES

A. Control Devices:

1. PUSHBUTTONS: Pushbuttons shall be flush head, 20mm, heavy-duty, 600 volts, 10 amperes continuous with NEMA rating to match enclosure types. Pushbutton operators

shall be red for stop functions and black for all other functions. Escutcheon plates shall be as specified on the drawings. For field mounted pushbuttons, each stop pushbutton shall be provided with a galvanized steel padlockable mechanism. For hazardous locations, the control stations shall be rated as explosion proof suitable for such locations. They shall be Killark Hazloc Series, Appleton, Crouse-Hinds or equal.

2. Selector Switches: Selector switches shall be heavy-duty, 20mm with NEMA rating to match enclosure type, rated 600-volt, 10-ampere, continuous. Switches shall be provided with contact blocks and number of positions as required performing the specified operations. The escutcheon legend shall be as specified on the drawings.

3. Indicating Lights: Indicating lights shall be heavy-duty, 20mm, push-to-test, transformer type with 6.3-volt lamps. Indicating lights shall be NEMA rated to match enclosure type.

4. Control Stations: Unless otherwise specified, control stations shall be NEMA 12 or 13 for dry, indoor locations and NEMA 4X for process areas and outdoor locations, Allen Bradley Bulletin 800H, Crouse-Hinds NCS series, or equal.

5. Security (limit switches). Security switches shall be heavy duty, industrial type with adjustable arm, lever made of stainless steel material. Each switch shall have one normally open and one normally closed contact rated for at least 5A at 120VAC. The switches shall be NEMA 4X, and shall be as manufactured by General Electric, Square D, or equal.

B. Control Relays:

1. Load-Switching Control Relays: Control relays used for switching loads (solenoids, actuators, contactors, motor starter coils, etc.) shall be heavy-duty, machine tool type. Relays that have contacts used for remote interlocking or for which the switching load is not shown shall also be heavy-duty machine tool type.

   Contacts shall, as a minimum, be 4-pole and be field interchangeable to either normally open or normally closed. Relay shall be capable of accepting a 4-pole adder.

   AC relays shall have NEMA A600 contact ratings and electrical clearances for up to 600 volts. DC relays shall have NEMA P300 contact ratings and electrical clearances of up to 250 volts.

   Relays shall be Allen Bradley Bulletin-700, Square D Class 8501, or equal.

2. Logic Level Switching Control Relays: Control relays used for switching solid-state logic and signal circuits shall be Potter Brumfield series KUP, Schrack Series RA, or equal. Relays shall have a minimum of three SPDT, gold-flashed, fine silver contacts rated 3 amps resistive at 120 volts AC or 28 volts DC. Relay shall be plug-in type with heavy-duty, barrier-protected screw terminal sockets and clear polycarbonate dust cover with clip fastener. AC models shall have neon lamp indicator wired in parallel with coil.

3. Timing Relays: Solid state timing relays shall be pulse-count type using a high frequency RC oscillator and integrated circuit counter for timing. Electrolytic capacitors shall not be used in the timing circuits. Time delays from 0.1 seconds to 48 hours shall be available with each timer model adjustable over a 20:1 range. On-delay, off-delay, and single-shot timing models shall be available. Timer shall reset in 0.03 seconds or less. Timer accuracy shall be plus or minus 2.0 percent under normal conditions. The timing relay shall have two NEMA Form-C timed contacts. Solid state timing relays shall be Agastat, STA series, Eagle Signals equivalent, or equal.

4. Intrinsically Safe Relays: These relays shall be suitable for use with 24VDC power source with pilot devices located in hazardous classified locations as defined by NEC Article 500. The relays shall be manufactured by :

   a. R.K Electronics
   b. Gem Sensors Divison of IMO, Inc
   c. R. Stalh, Inc.
   d. Idec
   e. Equal

   Provide each relay with two DPDT contacts each rated for at least 5-amp.

   All float switches located in Class 1 Div I hazardous location shall be provided with intrinsically safe relays located in control panel or where specifically shown on the drawings .

2.7 GROUNDING MATERIAL

A. Cable: Grounding cable shall be concentric stranded, annealed bare copper. Cable size shall be as specified, and shall not be smaller than #2/0 AWG.

B. Ground Rods: Ground rods shall be copper-covered steel, 3/4-inch diameter, and 10 feet long. Rods shall have threaded type, removable caps so that extension rods of the same diameter and length may be added where necessary. The rods shall be manufactured by ERICO, Galvan Industries, Inc. or equal.

C. Compression Connectors: Compression connectors shall be cast copper as manufactured by Thomas and Betts, OZ. Gedney, or equal.

D. Bolted Connectors: Bolted connectors shall be Burndy, O.Z. Gedney, or equal.

E. Equipment Grounding: Install a green insulated equipment grounding conductor with each feeder and branch circuit from the power source grounding means to the load equipment or device.

2.8 DISTRIBUTION EQUIPMENT

A. Panelboards: Where used, panelboards shall be circuit breaker, dead front type with bus bar construction. Panelboards shall be composed of individually mounted circuit breakers designed to be removed without disturbing other breakers.

Bus shall be tin-plated copper and shall have a current rating as shown on the panel schedules sized in accordance with UL 67. Panel fault withstand rating shall be equal to the interrupting rating of the smallest circuit breaker in the panel.

Panelboards shall be provided with a separate ground bus and a full capacity neutral bus. Neutral bus shall be mounted on insulated standoffs with removable link connector to ground bus. Provide an inside pocket to hold circuit directory. Panelboards shall be Cutler-Hammer, Allen-Bradley, or equal.

For outdoor locations, provide lighting panels with NEMA 4X enclosures with padlockable provisions.

B. Circuit Breakers: Circuit breakers shall be molded-case type provided for the current ratings and pole configurations specified on the panelboard schedule. Circuit breakers rated 120/208 volts and 120/240 volts AC shall have a minimum interrupting current rating of 42K amperes (symmetrical) at 240 volts AC. Circuit breakers rated 277/480 volts AC shall have a minimum interrupting current rating of 42K amperes (symmetrical) at 480 volts.

Circuit breakers shall be bolt-on type.

Circuit breakers shall be listed in accordance with UL-489 for the service specified. For breakers rated 200A or higher shall be 100% rated and provided with solid-state trip unit with multi-functions.

Load terminals of circuit breakers shall be solderless connectors.

Circuit breakers and panelboards shall be products of the same manufacturer.

2.8 SURGE SUPPRESSION SYSTEM

Provide and install an UL 1449 listed surge suppression system of latest MOV type technology. The suppressor shall be of voltage type with thermal fusing. The suppressor shall be capable of withstanding 100,000 amperes per phase and shall be equipped with LED indicator, dry contact for remote alarm and local audible alarm. It shall be Square D SurgeLogic XW series, Cutler-Hammer, or General Electric, or equal system suitable for use with 120/240V or 480/277V three-phase four-wire service as shown on the drawings. All main service switchboard or MCC shall be provided with surge suppression system.

2.9 NAMEPLATES

Nameplates shall be made from laminated phenolic plastic. The nominal size of the nameplates shall be 3/4 inch high by 2 inches long. Other sizes shall be as shown on the drawings. Nameplates shall have black backgrounds with 1/4-inch white letters. If abbreviations are

required because of space limitations, abbreviations shall be submitted to the Construction Manager for approval prior to manufacture. Nameplates shall be fastened using self-tapping stainless steel screws. The use of adhesives will not be permitted on the outside of enclosures.

2.10 LIMIT SWITCHES

Limit switches shall be NEMA 4X, corrosive resistant, rated suitable for monitoring door's opening to trigger two DPDT 5A rated contacts. They shall be heavy duty, lever, spring return, industrial type made by Allen-Bradley 802M series, Square D or equal.

2.11 ELECTRICAL SWITCHBOARD

See electrical section 16859.

2.12 COMBINATION METER and MAIN

Combination Meter and Main: This combination meter and main, pedestal style, shall be suitable for use with PG&E electrical service. Combination meter and main disconnect shall meet all requirements from PG&E who is the utility company for this site. It shall be pad-mounted with provisions for being bolted to the concrete pad as detailed on the drawings. The unit shall be rated as NEMA 4X, 316 stainless steel, 200A, 120/240V single-phase, 3-wire with metering section, 42kA short circuit rating, a power parameter digital display and accessories located on the inner door. Shop drawings for these items shall be submitted to PG&E, and the Owner for review and approval one month in advance of ordering of the gear. This combination meter and main shall be manufactured by Tesco, Eaton, Milbank or equal.

2.13 PORTABLE GENERATOR CAMLOK TAP BOX

Portable generator CAMLOK tap box shall be UL 1008 listed, UL 1691 listed receptacles, industrial rated, heavy-duty, rated 200A 120/240V 3W, 4-pole, grounded, NEMA 3RX (316SS), with a 200A UL listed molded case circuit breaker (LSIG), hinged, padlockable access door and with handle cover for security when not in use. Camlok receptacles in **male configuration** provided for two power legs, neutral and ground. They shall be manufactured by ESL Power Systems 4620 Series as per the District Standard. No other brands shall be acceptable.

2.14 POST LED LIGHTS

Post LED light fixtures shall be LED bollard style, UL listed for wet location. Housing shall be corrosion resistant aluminum housing with durable polyester bronze powder coat with PC lens to resist yellowing. They shall be rated for 24W, 120VAC, surge protection, LED with 54,000 hrs life, CCT 5000K, 43-in tall, 6.3-in diameter, with mounting hardware, mounting plate, anchor bolt carrier assembly, 5 yr warranty. The fixtures shall be manufactured by PLT Solutions, Catalog number PLT-12976, or equal.

PART 3 EXECUTION

3. 1 GENERAL

Unless otherwise detailed or dimensioned, electrical layout drawings are diagrammatic. Actual conduit installation shall be coordinated with field conditions. Junction boxes and pull boxes with quantity as required shall be furnished and installed. The Contractor shall coordinate the location of electrical material and equipment with the work.

Electrical equipment shall be protected from dust, water, and damage.

3.2 RACEWAY, FITTINGS, AND SUPPORTS

A. General: The Contractor shall limit the number of directional changes of conduit to a total of not more than 270 degrees in any run between pull boxes. Conduit runs shall be limited to 400 feet, less 100 feet for each 90-degree change in direction.

Signal conduit shall be separated from AC power and control conduits. The minimum separation shall be 12 inches for rigid steel and 24 inches for PVC conduits.

Tag power, signal and control conduits with stainless steel tag fastened to conduit with stainless steel cable. Tags shall be engraved or imprinted with identification as designated on the single-line diagrams and conduit schedule. Tags shall be installed at each conduit termination to an enclosure, MCC, control panel, disconnect, motor j-box, pull box, signal transmitter, sensor etc.

Cap each spare conduit as per detail shown on the drawings.

B. Exposed Conduits: Rigid metallic conduit shall be assembled to provide a continuous ground path. Joints shall be made with standard couplings or threaded unions. Bends and offsets shall be made with a hicky or conduit bending machine or shall be factory preformed bends.

Exposed conduit shall be run on supports spaced not more than 10 feet apart and shall be constructed with runs parallel and perpendicular to walls, structural members, or intersections of vertical planes and ceiling. No conduit shall approach closer than 6 inches to any object operating above 30 degrees C.

Conduit supports shall be secured to concrete walls and ceilings by means of cast-in-place anchors, die cast, rustproof alloy expansion shields, or cast-flush anchors. Wooden plugs, plastic inserts, or gunpowder driven inserts are not acceptable as a base for securing conduit supports.

Liquidtight, flexible steel conduit shall be used for the final connection to equipment, devices, and instruments where flexibility is required.

The length of liquidtight flexible steel conduit shall not exceed the lesser of 15 times the trade diameter of the conduit or 36 inches.

C. Embedded or Encased Conduit: Conduits constructed in concrete which is in contact with earth shall be separated from earth by at least 3 inches of concrete. Clearances equal to the nominal

conduit diameter but not less than 2 inches, shall be maintained between encased or embedded conduits except where conduits cross or terminate.

D. PVC-coated Rigid Galvanized Steel Conduit: All exposed conduits shall be PVC-coated rigid galvanized steel with matching conduit boxes and accessories.

E. "Eys" seals: Install "Eys" seals as required per NEC, and as shown on the drawings for hazardous locations and locations as identified on the drawings. Fill the seals with compound recommended by the seal manufacturer.

3.3 CONDUCTORS, WIRE, AND CABLE

A. General: Raceway construction shall be complete, cleaned, and protected from the weather prior to wire and cable being installed. Pulling wire and cable into conduit shall be completed without damaging or putting undue stress on the cable insulation. Soapstone, Talc, or UL listed pulling compounds are acceptable lubricants for pulling wire and cable. Grease is not acceptable. Nylon pull rope shall be pulled through the conduit immediately after concrete pour.

Each power, control, signal, and instrumentation conductor shall be identified at each terminal to which it is connected utilizing the wire markers specified in paragraph 16000-2.03 G.

600-volt conductors will be color coded as follows:

<u>120/240 Lighting, Power and Receptacles</u>

Phase A – Black
Phase B – Red
Neutral – White
Ground – Green

B. 600-Volt Conductor and Cable: Slack shall be provided in junction and pull boxes. Slack shall be sufficient to allow cable or conductors to be routed along the walls of the box.

Conductors crossing hinges shall be bundled in groups not exceeding 12 and shall be so arranged that they will be protected from chaffing when the hinged member is moved.

Raceway fill limitations shall be as defined by NEC and the following:

Lighting and receptacle circuits may be together in the same conduit in accordance with derating requirements of the NEC. However, lighting and receptacle circuits shall not be in conduit with other circuits.

Solid wire shall not be lugged nor shall electrical spring connectors be used on any except for solid wires in lighting and receptacle circuits. Lugs and connectors shall be installed with a compression tool.

For submersible pump cable installation, follow the pump manufacturer's recommendations and requirements. Furnish and install 316 stainless steel cable grips required to properly support the cables in addition to 316 stainless steel hooks and heavy duty, non corrosive, fiberglass cable ties as required. Cable grips shall be manufactured by Kellems, Hubbell, or equal.

C. Signal and Instrumentation Cables: Signal and instrumentation circuits shall be run as individual shield twisted pairs or triads. Triads shall be used wherever three-wire circuits are required. Terminal blocks shall be provided at cable junction for running signal leads and shield drain wires. Each conductor shall be identified at such junctions. Instrumentation cables shall be continuous without any splices.

Shields shall not be used as a ground path.

3.4 WIRING DEVICES

Switches and receptacles for use outdoors and in process areas shall be mounted in "FD" type boxes or PVC-coated boxes in locations specified. Unless otherwise specified, switches shall be mounted 48 inches above the floor. Receptacles shall be mounted 18 inches above the floor in finished areas and 48 inches above the floor in process areas and outdoors unless otherwise specified.

3.5 INDIVIDUAL MOTOR STARTERS

Individual motor starters shall be mounted with the operating mechanism 48 inches above the finished floor unless otherwise specified. The Contractor shall size the overload heater elements to the nameplate full load amperes of the motor served. Motor circuit protectors shall be adjusted to the lowest setting not causing false tripping.

3.6 MISCELLANEOUS CONTROL DEVICES

Control stations shall be mounted 48 inches above the floor unless otherwise specified.

3.7 GROUNDING

Electrical equipment and enclosures, metal surfaces of equipment, and metal structural members shall be grounded. Grounding system shall be provided in compliance with the NEC and as specified on the drawings.

Embedded and buried cable connections shall be made by cast copper compression connectors utilizing diamond or hexagon dies and a hand compression tool for wire sizes 2 AWG and smaller and a hydraulic pump and compression head for wire size 2/0 AWG and larger. Embedded ground cables and fittings shall be securely attached to concrete reinforcing steel with tie wires.

Grounding conductors which extend beyond concrete surfaces for equipment connection shall be extended a sufficient length to reach the final connection point without splicing. Grounding conductors which project from a concrete surface shall be located as close as possible to a corner of the equipment pad, protected by conduit or terminated in a flush grounding plate.

Exposed ground connections shall be made by bolted connectors. Exposed grounding conductors shall be supported by noncorrosive metallic hardware at 4-foot intervals or less.

Grounding conductors entering enclosures shall be bonded together to the enclosure if it is metallic and to metallic raceway within terminating at the enclosure. Metal surfaces shall be cleaned prior to making grounding connections and bonds.

When install ground rods, field verify exact location of existing underground utilities such as water piping, gas piping, electrical conduits or ductbanks, vault or manholes etc prior to installation of the ground rods to avoid damage to the existing underground utilities.

3.8 TESTING

A. General: Prior to energizing the electrical circuits, the tests shall be performed as specified. Unless otherwise specified, a 500-volt megohmmeter shall be used for resistance measurements.

The measurements of the tests shall be recorded on the specified forms and provided in accordance with paragraph 16000-1.3.

B. Insulation Resistance Measurements:

1. General: General insulation resistance measurements shall be made on conductors and energized parts of electrical equipment. Minimum acceptable values of insulation resistance shall be in accordance with the applicable ICEA, NEMA, or ANSI standards for the equipment or material being tested, unless otherwise specified. The ambient temperature at which insulation resistance is measured shall be recorded on the test form.

2. Conductor and Cable Tests: The phase-to-ground insulation resistance shall be measured for all circuits 120 volts and above except lighting circuits. Measurements may be made with motors and other equipment connected.
Insulation resistance measurements shall be recorded and submitted to the Engineer for review and approval. Insulation with resistance of less than 10 megohms is not acceptable.

C. FUNCTIONAL CHECKOUTS:

Prior to energization of equipment, the Contractor shall perform a NETA pre-energized functional checkout of the power and control circuits as well as the components. Prior to energized functional testing, all protective devices shall be adjusted and made operative. Energized checkout shall consist of energizing each power and control circuit and operating each control, alarm or malfunction device and each interlock in turn to verify that the specified action occurs. Contractor shall submit a description of his proposed functional test procedures prior to the performance of functional checkouts.

The Contractor shall verify that motors are connected to rotate in the correct direction. Verification may be accomplished by momentarily energizing the motor, provided the Contractor confirms that neither the motor nor the driven equipment will be damaged by reverse operation.

D. GROUNDING SYSTEM TESTS:

The Contractor shall test each grounding connection to determine the ground resistance. The grounding test shall be IEEE Standard 81. A plot of ground resistance readings for each isolated ground rod or ground mat shall be provided to the Construction Manager on 8-1/2 x 11 inch size graph paper. The current reference rod shall be driven at least 100 feet from the ground rod or grid under test. The measurements shall be made at 10-foot intervals beginning 25 feet from the test electrode and ending 75 feet from it, in direct line between the ground rod or center of grid and the current reference electrode.

A grounding system that shows greater than 2 ohm resistance for the flat portion of the plotted data shall be considered inadequately grounded. The Contractor shall add additional parallel connected ground rods and/or deeper driven rods until the ground resistance measurements meet the 2 ohm requirement. Ground rods required over that specified will be paid for as extra work. Use of salts, water, or compounds to attain the specified ground resistance is not acceptable.

3.9 RECORD DRAWINGS

Record drawings refer to those documents clearly maintained and annotated by the Contractor during construction include record drawings in accordance with these specifications. Contractor shall submit record drawings that reflect as-installed conditions. Record drawings do not conform or do not show as installed conditions shall be rejected and shall be resubmitted by the Contractor for no additional cost to the District until accepted by the Engineer. Markups for deviations and changes shall be on a full size set of drawings.

END OF SECTION

SECTION 16075
ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.2 SUMMARY

A. Section Includes: Identification of electrical conductors, raceways and equipment, and electrical equipment signs.

B. Related Sections:

1. Section 13000 – Instrumentation and Control System
2. Section 16000 – Requirements for Electrical Work
3. Section 16859 - 600V Switchboard

1.3 REFERENCES

A. National Electrical Code (NEC):

1. Article 110–22 - Disconnecting Means.
2. Article 210–4 - Multi-wire Branch Circuits.
3. Article 200 - Use and Identification of Grounded Conductors.
4. Article 384 - Switchboards and Panelboards.
5. Article 300 - Wiring Methods.

1.4 SUBMITTALS

A. Shop Drawings:

1. General: Submit Shop Drawings for electrical equipment room layouts, drawn at a minimum at 3/8 inch = 1 foot, scale.
2. Cross Reference: Diagram shall carry a uniform and coordinated set of wire numbers and terminal block numbers to permit cross-referencing between the Contract Document Drawings, the Drawings prepared by the CONTRACTOR, and equipment O&M Manual Drawings.
3. Drawing number cross references and continuation references shall also be provided. Contractor-prepared Drawings shall reference applicable CONTRACTOR Drawings such as P&IDs, control and logic diagrams, interface wiring diagrams, Panel Drawings, etc. Contractor-prepared Drawings shall also reference applicable Drawings provided by equipment manufacturers.
4. On any Drawing prepared for this project, if a wire, circuit, enclosure, panel, or device is continued on another Drawing, the continuation Drawing shall be referenced (and vice-versa). Wherever wires are shown connected to terminals, the Drawings which show the continuation of the circuits on those terminals must be referenced.

5. Interconnection Diagrams: Cables shall not be installed into raceways until the wiring interconnection diagrams are reviewed by the design engineer.
6. Sample schematics and diagrams are indicated on typical detail Drawings for reference and understanding of minimum information required for submittal of Shop Drawings schematics and diagrams, and submittal of O&M schematics and diagrams.
7. Include tagging system, labels, markers, hazard tape, nameplates, and signs.

B. Product Data: Include tagging system, labels, markers, and hazard tape.

C. Project Record Documents:

1. Document wire, cable, and conductor tags, and bundle tags installed in accordance with the Contract Documents.
2. Document installed wire, cable, and conductor tags and bundle tags when not specifically indicated.
3. Indicate on Record Drawings deviations from accepted Shop Drawing conductor identification.

1.5 QUALITY ASSURANCE

A. Pre-installation Meeting:

1. Conduct in accordance with Section 16000.
2. Purpose: To clearly define requirements specified for circuit/cable/conductor identification, hold a meeting including representatives of CONTRACTOR, DISTRICT, and ENGINEER prior to significant cable or conductor purchase and installation/termination.

PART 2 PRODUCTS

2.1 LABELS

A. Manufacturers: One of the following or equal:

1. Brady.
2. Seton.

B. Type: Sleeve type.

2.2 CONDUCTOR AND CABLE MARKERS

A. Manufacturers: One of the following or equal:

1. Brady.
2. Seton.

B. Type: Slip-on PVC sleeve or strap-on type.

C. Printed using Brady marker "XC PLUS," or equal.

D. Markers used in tunnels or other wet locations shall be on heat-shrinkable marking sleeves.

E. Use self-laminating vinyl on white background for markers within electrical equipment such as panels, termination cabinets, motor control centers.

F. Use engraved stainless steel tags with circuit designation fastened to direct buried cables in underground pull boxes as detailed on the drawings.

2.3 RACEWAYS IDENTIFICATION (TAGS)

A. Conduit numbers shall be pressure stamped into a non corrosive 2 inch long, 1/2 inch wide stainless steel tape, Dymo marking system or equal. A tag with number shall be fixed with No. 18 AWG or larger type 316 stainless steel wire, to each conduit segment and at the end of each conduit and within 3 feet of each pull box, panelboard, and switchboard.

2.4 NAMEPLATES, LABELS AND SIGNS

A. Nameplates:

1. Type: Black lamicoid with white letters.
2. Fastener: Round head stainless steel screws.

B. Automatic Equipment and High Voltage Warning Signs:

1. Type: Suitable for exterior use and meeting OSHA regulations.

C. Power Pole Labels: Vinyl plastic with details as shown on the drawings.

1. Manufacturers: One of the following or equal:
   a. Brady.
   b. Seton.

D. Underground Hazard Tape: 6 inches wide.

1. Manufacturers: One of the following or equal:
   a. Panduit.
   b. Thomas and Betts.

PART 3 EXECUTION

3.1 CIRCUIT IDENTIFICATION

A. Identify 1-phase system conductors and cables as Phases A and B and identify 1-phase system conductors and cables at electrical equipment including, but not limited to, switchgear, switchboards, panelboards, motor control centers, and motors.

1. Match DISTRICT's existing electrical system identification scheme or meet requirements of the authority responsible for the project.

2. Single-Phase Conductors for 120/240 VAC Circuits: Phase A, black; Phase B, red.
3. Neutral Conductor: White for 120 VAC
4. Insulated Equipment Grounding Conductor: Green.
5. General Purpose AC Control Conductors: Violet.
6. General Purpose DC Control Conductors: Violet with white stripes.

B. Use color coding and phasing consistent throughout the site. Bus bars at panelboards and motor control centers to be connected Phase A-B-C, top to bottom, or left to right facing connecting lugs.

C. Conductors Number 2 American Wire Gauge (AWG) and smaller to be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables to be coded by the use of colored tape.

D. In addition to color coding, for all 1-phase and 3-phase systems, identify each cable (single or multi-conductor) and conductor at each end, in each manhole, pullbox, cable tray, or other component of the raceway system. This identification is applicable to all power, control, alarm, signal, instrumentation cables, and conductors.

E. Identify each cable (single or multi-conductor) and groups or bundles of individual single conductors in each manhole, pullbox, cable tray, or other component of the raceway system with circuit identification markers. Implement a "from-to" cable/conductor bundle tagging system as part of this identification effort.

F. Identify each individual conductor at each termination. This includes such locations as switchgear, switchboards, motor control centers, variable frequency drives, control panels, junction/terminal boxes, all field devices, and all other locations where conductors are terminated. Identify the termination of these conductors in accordance with the accepted Shop Drawings. Tag conductors with sleeve type labels.

G. Where more than 1 nominal voltage system exists, identify each ungrounded system conductor by phase and system. Permanently post means of identification at each branch-circuit panelboard, switchboard, switchgear, motor control center, or other type of power distribution equipment.

H. Include the following minimum information for wire and cable identification.

1. Circuit number or load identification tag number as per section 16995.
2. Origin (from source).
3. Destination (to load).

3.2 NAMEPLATES

A. Furnish and install nameplates for all electrical equipment indicated on the Drawings. Each disconnect control system, breaker, switch, panelboard, MCC, controller, switchgear, switchboard etc., shall have nameplate indicating equipment name and circuit designation.

B. Each disconnect means for service, feeder, branch, or equipment conductors and pushbutton stations shall have nameplates indicating its purpose or identifying the load.

C. Each lighting switch and convenience outlet shall have a nameplate indicating its 120VAC power circuit number from lighting panelboard. Other required nameplates shall be as noted on the drawings specifically.

3.3 AUTOMATIC EQUIPMENT WARNING

A. Mount permanent warning signs at mechanical equipment which may be started automatically or from remote locations. Fasten warning signs with round head stainless steel screws or bolts, located and mounted in a manner acceptable to ENGINEER.

B. Mount permanent and conspicuous warning signs on (front and back) equipment, doorways to equipment rooms, pull boxes, manholes, where the voltage exceeds 600 volts.

C. Place a warning ribbon or other effective means suitable for conditions above ductbank underground installations.

D. Place warning signs on utilization equipment that has more than one source of power. Provide panel and circuit number of conductor tag of the power source disconnect.

E. Place warning signs on utilization equipment that has 120 VAC control voltage source used for interlocking. Provide panel, circuit number, and conductor tag of control voltage source disconnect.

3.4 CONDUIT TAGS

A. Install conduit tags (engraved stainless steel round tags) at each conduit termination to control panel, MCC, enclosure, disconnect, pull box, junction box etc.. Conduit tag names shall be as per single-line and control one-line diagrams and conduit schedule shown on the drawings.

END OF SECTION

SECTION 16159

PANELBOARDS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Dead-front panelboard. The panel shall be new, completed assembly of enclosure with breakers. It shall be integrated in a switchboard type enclosure.

B. Related Section:
   1. Section 01340 - Submittal Procedures.
   2. Section 16000 – Requirements for Electrical Work
   3. Section 16075 - Electrical Identification.

1.2 REFERENCES

A. National Electrical Manufacturers Association (NEMA):
   1. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).

B. Underwriter's Laboratories, Inc. (UL):
   1. UL 67 - Panelboards.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Interrupting Capacity of Device: Equal to available short circuit current at line terminals as determined by CONTRACTOR's short circuit fault analysis as accepted by ENGINEER, but not less than 42,000 amperes.

B. Provide main bus rating of panelboards, number of poles, and provisions for number of circuits as indicated on the Drawings.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's specifications and description.

B. Shop Drawings: Submit in accordance with Section 01340. Include panelboard layout.

1.5 WARRANTY

A. Provide manufacturer's standard warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Panelboards: One of the following or equal:
   1. Eaton
   2. Square D Company
   3. Approved equal

B. The manufacturer of the panelboard shall make all major components, including circuit breakers.

2.2 INTERIOR

A. Bus: Size main bus bars in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 50 degrees Centigrade above specified ambient maximum.
   1. Tin-plated copper bussing.
   2. Ground bus

B. Install protective devices such that they can be replaced without disturbing adjacent units. Wire connectors shall be suitable for wire sizes indicated on the Drawings.

C. Number branch circuits and spares as indicated on the Drawings and furnish complete typed circuit schedule in directory cardholder affixed to panel under a transparent cover.

D. Phase busing shall be full size and height without reduction. Include full size neutral bars with suitable lugs for the maximum number of circuits, which can be connected to the panel.

E. Spares and spaces for future protective devices in panels indicated on the Drawings shall be bussed for panel rating or the main circuit breaker rating.

F. Provide panels with tin-plated copper ground bus separate from neutral bars. Ground bus to have suitable lug for each circuit breaker installed including future circuits.

2.3 ENCLOSURES

A. Size panelboards sufficiently to provide minimum 4 inches of gutter space on all sides. Doors shall be such that:
   1. Live parts shall not be exposed when circuit breakers or switches are put in service.
   2. Hinges and latches shall not require tools to operate.

B. Furnish lock and minimum 2 keys each panelboard. Key all panelboard locks alike.

C. Enclosure shall be open type integrated in a switchboard as indicated on the Drawings. Mounting shall be as indicated on the Drawings.

2.4 CIRCUIT BREAKERS

A. Circuit Breakers: As specified in Section 16000.

B. Provide handle locks on all circuit breaker supplying motor loads.

2.5 IDENTIFICATION

A. Label panelboards to indicate use for each individual breaker as per single-line diagram.

B. Label panelboards with UL short circuit current rating.

C. Provide each panelboard with a lamicoid nameplate on outside of door, as specified in Section 16075 - Electrical Identification.

PART 3 EXECUTION

3.1 INSTALLATION

A. As indicated on the Drawings, or as required, in a workmanlike manner.

B. Terminate conduits towards backside of panelboard allowing top and bottom access for future conduits.

C. Provide a typed circuit directory indicating circuit numbers and names of loads served.

3.2 FIELD QUALITY CONTROL

A. Test main circuit breaker(s) as specified in Section 16000.

END OF SECTION

SECTION 16859

600V SWITCHBOARD

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: 600 VAC, dead-front type, molded case circuit breaker distribution switchboard.

B. Related Sections:

1. Section 16000 – Requirements for Electrical Work.

2. Section 13470 – SCADA PLC System

1.2 REFERENCES

A. American National Standards Institute (ANSI):

1. C37.16 - Preferred Ratings, Related Requirements and Application Recommendations for Low Voltage Power Circuit Breakers and AC Power Circuit Protectors.

2. C39.1 - Requirements for Electrical Analog Indicating Instruments.

3. C57.13 - Requirements for Instrument Transformers.

B. Institute of Electrical and Electronic Engineers (IEEE).

C. Insulated Cable Engineers' Association (ICEA).

D. National Electrical Code (NEC):

1. Article 310 - Conductors for General Wiring.

2. Article 384 - Switchboards and Panelboards.

E. National Electrical Manufacturers' Association (NEMA):

1. PB-2 - Dead-front Distribution Switchboards.

2. SG3 - Low Voltage Power Circuit Breakers.

F. Underwriters' Laboratories, Inc. (UL):

1. UL 489 - Molded Case Circuit Breakers.

2. UL 508A- Industrial Control Panel

1.3 SYSTEM DESCRIPTION

A. Factory assembled, wired, and tested switchboard, with major components being products of reputable manufacturers, including but not limited to, circuit breakers, transformers, instruments, meters, panelboard and other equipment specified herein and indicated on the Drawings.

1.4 SUBMITTALS

A. Shop Drawings: Submit as a minimum the following information and drawings in a three-ring binder (or electronic version) with separator for each section and table of contents:

1. Plan, front, and side view drawings including overall dimensions of each switchboard line-up. Identify shipping splits and show conduit stub-up area locations.

2. Internal wiring diagram of each compartment including wiring identification and terminal numbers.

3. Internal compartment-to-compartment interconnection wiring diagrams including wiring identification and terminal numbers.

4. Complete diagrams for each switchboard line-up. These drawings shall indicate devices comprising the switchboard assembly including, but not limited to, circuit breakers, control power and instrument transformers, meters, relays, and control devices. Clearly indicate electrical ratings of devices on Drawings.

5. Complete bill of material list and equipment data sheets identifying appropriate information specific to the switchboard being supplied.

6. Point to point wiring diagrams and product data for the power metering devices.

7. Nameplate schedule.

8. Seismic provisions as per section 16000

B. Product data.

1. Provide cut sheet for each of the devices furnished and installed in the switchboard.

1.5 WARRANTY

A. Submit manufacturer's standard warranty which shall not be less than one year minimum from the acceptance date.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Switchboard: One of the following:

1. Advanced Integration & Controls
2. Primex Controls
3. Calcon
4. Approved equal

B. Main Circuit Breaker: One of the following:

1. Square D
2. Eaton

C. Outgoing Feeder Breakers:

1. Square D
2. Eaton

2.2 600 VOLTS AC SWITCHBOARD

A. Furnish and install indoor dead-front type, low voltage metal-enclosed front accessible switchboard with an outdoor, auxiliary enclosure (NEMA 3RX) powder coated, painted 304 stainless steel panels. It shall be ANSI gray to match with the switchboard finish.

B. Switchboard and Equipment: Conform to current applicable standards of organizations listed under References.

C. Furnish and install a complete line-up of switchboard and control as detailed herein. Furnish and install devices or accessories not described, but necessary for the proper installation and operation of the equipment.

D. Rate complete switchboard assembly to withstand mechanical forces exerted during short circuit conditions when connected directly to a power source having available

fault current of 42,000 amperes symmetrical at rated voltage of 240VAC. Test switchboard for conformance according to applicable NEMA and UL standards.

E. 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 with ventilation fans as shown on the drawing. 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 without back access. Vented covers for all sections shall be grill type covers with fixed downward louvers. Doors shall be provided with 3-point latch, pad-lockable. Provide latch to prevent doors from closing when in full open position. Overhead lights with switches and exhaust fans controlled by individual thermostat shall be provided. Provide security switches for each door and inner panel as specified in section 16000.

2.3 VOLTAGE RATINGS

A. Design and construct switchboard for use on a 240 volt, 1-phase, 3-wire, 200A 60 hertz system with entire assembly suitable for 600 VAC maximum electric services.

2.4 POWER DISTRIBUTION

A. Power distribution blocks with required current rating to provide means for connections to molded case circuit breakers as details of the drawings.

B. Provide a UL 1449 listed surge suppression system of latest MOV type technology. The suppressor shall be of voltage type with thermal fusing. The suppressor shall be capable of withstanding 100,000 amperes per phase and shall be equipped with LED indicator, dry contact for remote alarm and local audible alarm. It shall be Square D SurgeLogic XW series suitable for use with 120/240V, single-phase three wire service. This surge suppression system shall be protected by a 15A or 20A 2P circuit breaker as shown on the Drawings.

C. Provide full size backpan for installation of SCADA PLC system by others. Inner door shall be full length hinged.

D. Provide thermostat controlled ventilation fans individually as shown on the drawings.

E. Provide thermostat controlled space heater for each vertical section.

2.5 GROUND BUS

A. Ground Bus: plated copper bar, 1/4 inch by 1 to 2 inch minimum, extending through all cubicles.

B. Provide bus joints with Bellville spring type washers where applicable.

C. Ground each housing section directly to this bus.

D. Adequately ground relays by No. 6 American Wire Gauge insulated copper wire.

2.6 CIRCUIT BREAKERS

Main circuit breaker and feeder breakers shall be as follows:

A. Feeder circuit breakers with a rating greater than or equal to 200A shall be molded case, 2 Pole, 600 Volt, 100 percent equipment rated, bolt-on type equipped with an adjustable, temperature insensitive, solid-state, trip device similar by the Square D Micrologic Series or equal with adjustable and high instantaneous, short time, long time and ground fault delay pickup trips for selective tripping.

B. Feeder protective devices less than 200A rating shall be molded case circuit breakers bolt-on type with electronic trip unit having inverse time and instantaneous tripping characteristics and shall be Square D or Eaton.

C. 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.

D. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the Drawings.

E. Main breaker shall have auxiliary contacts for future use.

F. Single-phase power failure relay (PFR) shall detect voltage anomalies such as power failure, low voltage, single-phasing etc. PFR shall be Eaton EMR6 series, Littelfuse 50R4003, or equal.

2.7 CURRENT TRANSFORMERS

A. Ring Type Current Transformers: Dry type, for indoor service, insulated for 600 volts. Design to have a mechanical and thermal rating to withstand short-circuit current, stresses, and heating effects equal to the rating of the circuit breaker of the application.

B. Current Ratio: As indicated on the Drawings.

C. Transformers: Rated in accordance with applicable standards; Accuracy of the current transformers suitable for metering accuracy class, and burden for the required devices.

D. Identify for polarity with standard marking or symbols, capable of carrying rated primary current continuously without damage, with ample capacity and accuracy for metering accuracy class, and burden for the required devices.

E. Run secondary wiring from current transformers in suitable wiring trough, or conduit, to proper short-circuiting type terminal blocks for connection to relays, instruments, and other devices.

2.8 POTENTIAL TRANSFORMERS

A. Indoor dry type, single-phase, 60 hertz.

B. Accuracy classification determined according to ANSI Standards suitable for relay accuracy class, and adequate burden for the required devices; potential transformers shall meet the following minimum requirements

1. Primary Voltage: 240 volts.

2. Secondary Voltage: 120 volts.

3. Winding Ratio: 4:1.

4. Metering Accuracy Class: 0.3 at ANSI Standard Burden Z (200 volt-amperes).

C. Identify for polarity with standard markings or symbols. Connect secondaries to potential buses as required. Protect potential transformers with primary and secondary fuses. Protect primary side with current-limiting fuses.

2.9 CONTROL POWER TRANSFORMERS

A. Provide 240 to 120 volt control power transformers as required. Verify that control power transformers have adequate capacity for the load to be served.

B. Protect control power transformers with both primary and secondary fuses. Protect primary side with current limiting fuses.

2.10 CONTROL WIRING AND TESTING

A. Wire and factory test switchboard to satisfy the requirements of the operation described or necessary.

B. Switchboard Wiring: NEC Type SIS, single-conductor, stranded copper, rated 600 volts bundled and secured with nylon ties. Provide flexible stranding for swinging panels. Minimum wire size: No. 14 for control circuits, and No. 12 for potential and current transformer circuits.

C. Route outgoing control wires to master terminal blocks with suitable numbering strips numbered in agreement with the manufacturer's detailed wiring diagrams.

D. Terminate control wiring in molded, screw-type terminal blocks acceptable to ENGINEER. Provide a minimum of 10 percent spare terminal blocks for each circuit breaker and auxiliary compartment. Compression type terminal blocks are not acceptable. Terminal blocks: States Company sliding link Type NT or as accepted by ENGINEER.

E. Number wiring with shrink-type tag devices at both ends consistent with the manufacturer's detailed wiring diagrams. Duplication of wire numbers and terminal block numbers is not acceptable.

F. Provide any necessary wiring between circuit breaker and auxiliary controls.

G. Provide any necessary wiring between metering devices, trip units and alarm dry contacts for future use.

2.11 INSTRUMENTS AND METERS

A. Furnish and install instruments and meters complete with devices and associated circuitry necessary to perform the required functions in accordance with these Specifications.

B. Mount instruments on hinged panels secured to the metal enclosed unit. Devices to have enclosing cases, dull black finish, and mount semi-flush. Provide nameplates.

C. Indicating Instruments: Square or rectangular type with anti-parallax scales. Provide zero adjustment external to the case. Include resistors, reactors, or other auxiliaries necessary for complete instruments.

2.12 NAMEPLATES

A. Provide engraved plastic nameplates to identify switchboard units, door mounted components, and internal components. Short circuit rating shall be clearly indicated on the front of the switchboard.

B. Black lamicoid nameplates with white letters fastened with round head stainless steel screws, engraved with the circuit number and circuit name consistent with the Drawings.

C. Label per requirements of NEC, Articles 110-16, 110-21 and 110-22.

2.13 ELECTRONIC MULTI-FUNTION METER

A. Microprocessor based multifunction meter shall be provided to provide the following functions:

1. The Individual phase and ground currents

2. Phase-to-phase and phase-to-neutral voltages

3. Vars, VA, power factor, frequency

4. Watts, watt demand, watt-hours

5. Device accuracy shall be 1% of full scale

6. All monitor values shall available via keypad and illuminated display

7. One ETHERNET communication port

8. The meter shall be Square D PowerLogic or Electro Industries DMM Shark Digital Meter, or equal.

2.14 WARNING SIGNS

A. Provide a minimum of two warning signs on the front and on the back of the switchboard line-up/enclosure.

1. Red laminated plastic engraved with white letters approximately 1/2 inch high.

2. Signs shall read "DANGER HIGH VOLTAGE."

3. Affix generic arc flash labels.

2.15 PANELBOARD

A. See section 16159.

2.16 SOURCE QUALITY CONTROL

A. Completely assemble, wire and test switchboard at the factory. Rigid inspections before and after assembly shall assure correctness of design and workmanship. Provide groups of wires leaving the shipping-assembled equipment with terminal blocks with suitable numbering strips. Provide paint spray cans (two) for touchup.

B. After assembly, provide the switchboard with lifting channels having eyebolts for attachment of crane slings to facilitate lifting and handling each shipping-assembly unit. These lifting channels shall be removable after equipment is placed on permanent foundations.

C. Furnish and install structural mounting channels in accordance with manufacturer's recommendations to provide proper alignment of the units.

D. Submit seismic structural calculations to support anchor bolt requirements to meet CBC and IBC seismic constraints. Calculations shall be signed by a California registered engineer.

E. For required auxiliaries located in the switchboard, refer to these devices as shown on the electrical drawings and shall be as specified in the relevant section of Div 16 specifications.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install equipment per the manufacturer's recommendations. All sections shall lineup evenly showing no gaps between each section of the lineup.

B. Provide adequate anchoring and supports to resist seismic forces in accordance with seismic calculations.

C. Provide adequate terminations of external wiring. Power cable terminations shall be color coded as per Section 16075.

D. Keep a copy of the as-built in an envelope located in a secured location on the side of the switchboard enclosure.

3.2 DEMONSTRATION

A. Demonstrate successful operation of equipment. Multi-function meter shall be operational and shall display power parameters properly. Include in the training of personnel in the operation and maintenance. Training shall include at least one day with two 4-hr sessions for four designated employees.

B. Perform Factory Tests (FT) optionally witnessed by the Owner or the Owner's representative. Submit FT procures which shall include forms to be checked during tests with remarks and signature spaces for test performer and witness. Schedule test at least two weeks in advance.

3.3 PROTECTION

A. Protect products until acceptance by the Owner.

B. Install external warning signage as specified at front and rear of the auxiliary enclosure.

END OF SECTION