RECLAMATION

Managing Water in the West

San Juan Lateral
Tohlakai Pumping Plant

Navajo Gallup Water Supply Project
New Mexico

U.S. Department of the Interior
Bureau of Reclamation
Technical Service Center
Denver, Colorado

FINAL SPECIFICATIONS

August 2013

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SECTION B – SUPPLIES OR SERVICES AND PRICES

San Juan Lateral – Tohlakai Pumping Plant
Navajo Gallup Water Supply Project
New Mexico

B.1 SCHEDULE

(a) Offers will be considered for award on the following schedule, but no offer will be considered for award on only a part of the schedule. All offers are subject to the terms and conditions of this solicitation.

(b) The quantities in the schedules are estimated quantities for comparison of offers only and except as provided in the contract clause at FAR 52.211-18, Variation in Estimated Quantity, no claim shall be made against the Government for overruns or underruns.

(c) See the contract clause at WBR 1452.232-81, Payment for Mobilization and Preparatory Work, for CLIN 1.

(d) Definitions:

(1) CLIN – Contract Line Item Number.

(e) Note: In accordance with Section 7-9-3.3 of the New Mexico Statutes Annotated (NMSA) 1978 and Section 402 of the Navajo Nation's Business Activity Tax Statute, it is the contractor's responsibility to ensure that all applicable New Mexico Gross Receipts Tax and Navajo Nation Gross Receipts Tax are included in their price proposal.

(f) In accordance with FAR 52.232-5 (Payments under Fixed-Price Construction Contracts) (b)(2), payment may be approved for materials delivered to the Contractor at locations other than the site if the Contractor obtains CO approval prior to making arrangements for obtaining the materials. The Contractor will also be required to complete a "Materials on Hand Certificate" which will certify:

(1) the materials described for use on the identified contract,

(2) the materials are clearly marked to identify that they belong to the contract cited,

(3) full title for those materials are vested in the prime contractor sited,

(4) the materials are free of liens and encumbrances, and

(5) the materials are properly store, secured, and protected against loss or damage.

SCHEDULE

CLIN	Section	Supplies or Services	Quantity and Unit	Unit Price	Amount
1	WBR 1452.23 2-81	Mobilization and preparatory work	For the Lump Sum of		$
2	01 31 30	Contract Document Management System	For the Lump Sum of		$
3	01 33 26	Electrical Drawings and Data	For the Lump Sum of		$
4	01 56 15	Underground Utility Line Investigations	For the Lump Sum of		$
5	03 20 00	Concrete Reinforcing	165,000 lbs	$	$
6	03 30 00	Pump Station Concrete	1250 yd^3	$	$
7	03 30 00	Chlorine Feed Building Concrete	110 yd^3	$	$
8	03 30 00	Vault Concrete	145 yd^3	$	$
9	03 30 00	Retaining Wall Concrete	210 yd^3	$	$
10	03 30 00	Concrete Lined Ditch	115 yd^3	$	$
11	03 48 00	Precast Concrete Structures	For the Lump Sum of		$
12	04 22 10	Reinforced Concrete Unit Masonry Assemblies	For the Lump Sum of		$
13	05 12 10	Structural Steel	For the Lump Sum of		$
14	05 15 24	Secondary Metal Framing	For the Lump Sum of		$
15	05 21 00	Steel Joists	For the Lump Sum of		$
16	05 30 00	Metal Roof Deck	For the Lump Sum of		$
17	05 40 00	Cold-Formed Metal Framing	For the Lump Sum of		$
18	05 50 00	Metal Fabrications	For the Lump Sum of		$
19	07 19 20	Silane Water Repellent	For the Lump Sum of		$
20	07 21 13	Sound Control Batt Insulation	For the Lump Sum of		$

SCHEDULE

CLIN	Section	Supplies or Services	Quantity and Unit	Unit Price	Amount
21	07 41 13	Preinsulated Metal Roof Panels	For the Lump Sum of		$
22	07 41 15	Removable Roof Covers	For the Lump Sum of		$
23	07 42 13	Preinsulated Metal Wall Panels	For the Lump Sum of		$
24	07 72 30	Roof Hatches	For the Lump Sum of		$
25	08 11 10	Steel Doors and Frames	For the Lump Sum of		$
26	08 33 19	Sliding Door	For the Lump Sum of		$
27	08 33 19	Monorail Door	For the Lump Sum of		$
28	08 51 23	Steel Windows	For the Lump Sum of		$
29	08 62 00	Unit Skylights	For the Lump Sum of		$
30	09 29 00	Gypsum Board	For the Lump Sum of		$
31	09 30 00	Reinforced Wall Panel	For the Lump Sum of		$
32	09 65 10	Rubber Wall Base	For the Lump Sum of		$
33	10 28 13	Toilet Accessories	For the Lump Sum of		$
34	10 44 20	Fire Extinguishers	For the Lump Sum of		$
35	10 51 00	Lockers	For the Lump Sum of		$
36	21 22 00	Clean Agent Fire Extinguishing System	For the Lump Sum of		$
37	22 11 10	Plant Auxiliary Water Systems	For the Lump Sum of		$
38	22 13 13	On-site Sewage Disposal System	For the Lump Sum of		$
39	22 13 16	Plant Drain, Waste, and Vent Piping Systems	For the Lump Sum of		$
40	22 14 30	Plant Auxiliary Water Sump Pumping Systems	For the Lump Sum of		$
41	22 15 10	Compressed Air System	For the Lump Sum of		$

SCHEDULE

CLIN	Section	Supplies or Services	Quantity and Unit	Unit Price	Amount
42	22 42 10	Plumbing Fixtures	For the Lump Sum of		$
43	23 00 00	Heating, Ventilating, and Air-Conditioning (HVAC) System	For the Lump Sum of		$
44	25 00 01	System Control and Monitoring	For the Lump Sum of		$
45	25 00 02	Installing and Programming Government-Furnished Controller	For the Lump Sum of		$
46	26 05 10	600 Volt Single Conductor Cable – 1/0 AWG	1,525 lin ft	$	$
47	26 05 10	600 Volt Single Conductor Cable – 2/0 AWG	150 lin ft	$	$
48	26 05 10	600 Volt Single Conductor Cable – 4/0 AWG	1,250 lin ft	$	$
49	26 05 10	600 Volt Multiconductor Cable – 8/c 18 AWG	525 lin ft	$	$
50	26 05 10	600 Volt Multiconductor Cable – 3/c 14 AWG	1,750 lin ft	$	$
51	26 05 10	600 Volt Multiconductor Cable – 5/c 14 AWG	1,350 lin ft	$	$
52	26 05 10	600 Volt Multiconductor Cable – 9/c 14 AWG	175 lin ft	$	$
53	26 05 10	600 Volt Multiconductor Cable – 3/c 12 AWG	5,350 lin ft	$	$
54	26 05 10	600 Volt Multiconductor Cable – 4/c 12 AWG	3,075 lin ft	$	$
55	26 05 10	600 Volt Multiconductor Cable – 3/c 10 AWG	925 lin ft	$	$

SCHEDULE

CLIN	Section	Supplies or Services	Quantity and Unit	Unit Price	Amount
56	26 05 10	600 Volt Multiconductor Cable – 4/c 10 AWG	1,025 lin ft	$	$
57	26 05 10	600 Volt Multiconductor Cable – 3/c 8 AWG	625 lin ft	$	$
58	26 05 10	600 Volt Multiconductor Cable – 3/c 6 AWG	1,725 lin ft	$	$
59	26 05 10	600 Volt Solid Conductor Premise Wire – 12 AWG	15,000 lin ft	$	$
59A	26 05 10	600 Volt Solid Conductor Premise Wire – 10 AWG	7500 lin ft	$	$
60	26 05 10	Instrumentation Cable Shielded Twisted Single Pair – 16 AWG	400 lin ft	$	$
61	26 05 10	Instrumentation Cable Shield Triad – 16 AWG	2,075 lin ft	$	$
62	26 05 10	Shielded Fire Alarm Wire - #16 Class A	1,200 lin ft	$	$
63	26 05 13	Medium-Voltage Power Cable – 6 AWG	825 lin ft	$	$
64	26 05 13	Medium-Voltage Power Cable – 4 AWG	300 lin ft	$	$
65	26 05 13	Medium-Voltage Power Cable – 2 AWG	550 lin ft	$	$
66	26 05 13	Medium-Voltage Power Cable – 2/0 AWG	1,425 lin ft	$	$
67	26 05 13	5-Kilovolt Power Cable Accessories	For the Lump Sum of		$
68	26 05 20	2 AWG Ground Cable	400 lin ft	$	$
69	26 05 20	4 AWG Ground Cable	150 lin ft	$	$

SCHEDULE

CLIN	Section	Supplies or Services	Quantity and Unit	Unit Price	Amount
70	26 05 20	4/0 AWG Ground Cable	1,200 lin ft	$	$
71	26 05 20	10-foot Ground Rods	5 rods	$	$
72	26 05 20	Electrical Ground Resistance Test	For the Lump Sum of		$
73	26 05 33	½-inch Red Rigid Steel Conduit	600 lin ft	$	$
73A	26 05 33	½-inch Rigid Steel Conduit	3,400 lin ft	$	$
73B	26 05 33	¾-inch Rigid Steel Conduit	2,500 lin ft	$	$
74	26 05 33	1-inch Rigid Steel Conduit	2,000 lin ft	$	$
75	26 05 33	1 1/2-inch Rigid Steel Conduit	250 lin ft	$	$
76	26 05 33	2-inch Rigid Steel Conduit	200 lin ft	$	$
77	26 05 33	2 1/2-inch Rigid Steel Conduit	150 lin ft	$	$
78	26 05 33	3-inch Rigid Steel Conduit	250 lin ft	$	$
79	26 05 33	1-inch PVC Schedule 80 Conduit	3,300 lin ft	$	$
80	26 05 33	1 1/2-inch PVC Schedule 80 Conduit	750 lin ft	$	$
81	26 05 33	2-inch PVC Schedule 80 Conduit	1,200 lin ft	$	$
82	26 05 33	2 1/2-inch PVC Schedule 80 Conduit	400 lin ft	$	$
83	26 05 33	3-inch PVC Schedule 80 Conduit	50 lin ft	$	$
84	26 05 33	1-inch Liquidtight Flexible Metal Conduit	400 lin ft	$	$

SCHEDULE

CLIN	Section	Supplies or Services	Quantity and Unit	Unit Price	Amount
85	26 05 33	1 1/2-inch Liquidtight Flexible Metal Conduit	50 lin ft	$	$
86	26 05 33	2 1/2-inch Liquidtight Flexible Metal Conduit	50 lin ft	$	$
87	26 05 33	Fabricated Sheet Steel Boxes, Wiring Troughs, and Precast Handholes	For the Lump Sum of		$
88	26 05 33	4-inch Wireway	350 lin ft	$	$
89	26 05 33	6-inch Wireway	250 lin ft	$	$
90	26 05 33	8-inch Wireway	120 lin ft	$	$
91	26 12 19	Pad Mounted Transformer	For the Lump Sum of		$
92	26 17 20	Metal-Clad Switchgear Assembly, UXA	For the Lump Sum of		$
93	26 18 39	Medium-Voltage Motor Controllers	For the Lump Sum of		$
94	26 22 12	Dry-Type Transformer	For the Lump Sum of		$
95	26 24 13	Switchboards	For the Lump Sum of		$
96	26 24 20	Control Boards	For the Lump Sum of		$
97	26 24 41	Distribution Panelboards	For the Lump Sum of		$
98	26 27 16	Electrical Enclosures	For the Lump Sum of		$
99	26 27 40	Wiring Devices	For the Lump Sum of		$
100	26 32 10	Engine-Generator Set	For the Lump Sum of		$
101	26 42 10	Impressed Current Cathodic Protection and Corrosion Monitoring Systems	For the Lump Sum of		$

SCHEDULE

CLIN	Section	Supplies or Services	Quantity and Unit	Unit Price	Amount
102	26 42 11	Submerged Galvanic Anode Cathodic Protection System	For the Lump Sum of		$
103	26 42 12	Galvanic Anode Cathodic Protection and Corrosion Monitoring Systems	For the Lump Sum of		$
104	26 51 00	Interior Lighting	For the Lump Sum of		$
105	26 52 00	Emergency and Exit Lighting	For the Lump Sum of		$
106	26 56 00	Exterior Lighting	For the Lump Sum of		$
107	27 20 01	Installing Government-Furnished Radio Modems	For the Lump Sum of		$
108	27 20 01	Radio System	For the Lump Sum of		$
109	27 30 01	Telephone System	For the Lump Sum of		$
110	28 10 01	Security and Surveillance System	For the Lump Sum of		$
111	28 31 00	Fire Detection and Alarm	For the Lump Sum of		$
112	31 02 10	Water for Dust Abatement	1000 MG	$	$
113	31 02 30	Dust Palliative for Reseeded Areas	4.3 Acres	$	$
113A	31 02 30	Dust Palliative for Non-reseeded Areas	4.0 Acres	$	$
114	31 23 10	Excavation	63,700 yd^3	$	$
115	31 23 10	Rock Excavation	27,300 yd^3	$	$
116	31 23 10	Processing Foundation Materials	55,000 yd^3	$	$
117	31 23 10	Compacting Backfill	55,000 yd^3	$	$

SCHEDULE

CLIN	Section	Supplies or Services	Quantity and Unit	Unit Price	Amount
118	31 23 22	Excavation for Pipeline Trenches	5465 yd^3	$	$
119	31 23 22	Backfill for Pipeline Trenches	4655 yd^3	$	$
120	31 23 22	Compacting Backfill in Pipeline Trenches	975 yd^3	$	$
121	31 23 22	Rock Excavation for Pipe Trenches	330 yd^3	$	$
122	31 23 50	Excavation for Roads	12,000 yd^3	$	$
123	31 24 15	Gravel Drain	35 yd^3	$	$
124	31 37 00	Grouted Cobble	260 yd^3	$	$
125	32 15 10	Gravel Surfacing	3000 yd^3	$	$
126	32 31 10	Chain Link Fence	1,700 Lin ft	$	$
127	32 31 70	Cattle Guards	1 Each	$	$
128	32 91 60	Erosion Control Blanket	10,900 yd^2	$	$
129	32 92 20	Seeding	4.3 Acre	$	$
130	33 05 22	Hwy 491 Road Crossing Casing Pipe for Twin Lakes Turnout	For the Lump Sum of		$
131	33 05 22	Hwy 491 Road Crossing Casing Pipe for Reach 12.1	For the Lump Sum of		$
132	33 09 12	Magnetic Flowmeter Systems	For the Lump Sum of		$
133	33 11 10	12DR25	1630 Lin ft	$	$
134	33 11 10	30B550	200 Lin ft	$	$
135	33 11 10	30C550	460 Lin ft	$	$

SCHEDULE

CLIN	Section	Supplies or Services	Quantity and Unit	Unit Price	Amount
136	33 11 10	30C575	380 Lin ft	$	$
137	33 11 10	36C375	100 Lin ft	$	$
138	33 11 10	36D375	207 Lin ft	$	$
139	33 11 10	36B400	140 Lin ft	$	$
140	33 11 10	36C400	200 Lin ft	$	$
141	33 11 10	Filling and Testing Water	For the Lump Sum of		$
142	33 11 10	Concrete Block at Station 12516 + 40	For the Lump Sum of		$
143	33 11 10	Connection to Reach 12B	For the Lump Sum of		$
144	33 11 10	Connection to Reach 121	For the Lump Sum of		$
145	33 11 10	Repair Kit	For the Lump Sum of		$
145A	33 11 16	Site Water Utility Piping	For the Lump Sum of		$
146	33 12 73	Mechanical Seal Water and Filtration Booster System Equipment	For the Lump Sum of		$
147	33 12 74	Two(2) – Horizontal Centrifugal Pumps	For the Lump Sum of		$
148	33 16 14	Air Chambers and Air Compressors	For the Lump Sum of		$
149	33 16 40	85-Feet Diameter Water Storage Tank	For the Lump Sum of		$
150	33 42 30	24 Inch Diameter Corrugated Metal Pipe Culvert	Lin ft	$	$
151	33 82 23	Fiber Optic Cable	780 Lin ft	$	$
152	33 82 23	Conduit	200 Lin ft	$	$

SCHEDULE

CLIN	Section	Supplies or Services	Quantity and Unit	Unit Price	Amount
153	34 71 10	W-Beam Guardrails	For the Lump Sum of		$
154	35 21 94	Steel Manifolds	For the Lump Sum of		$
155	35 22 14	8-inch AWWA Class 150 Manually Operated Butterfly Valve	1 Each	$	$
156	35 22 14	16-inch AWWA Class 150 Manually Operated Butterfly Valve	9 Each	$	$
157	35 22 14	24-inch AWWA Class 150 Manually Operated Butterfly Valve	2 Each	$	$
158	35 22 14	8-inch AWWA Class 150 Manually Operated Butterfly Valve for Buried Service	1 Each	$	$
159	35 22 14	12-inch AWWA Class 150 Manually Operated Butterfly Valve for Buried Service	1 Each	$	$
160	35 22 14	30-inch AWWA Class 150 Manually Operated Butterfly Valve for Buried Service	1 Each	$	$
161	35 22 14	36-inch AWWA Class 150 Manually Operated Butterfly Valve for Buried Service	2 Each	$	$
162	35 22 14	42-inch AWWA Class 150 Manually Operated Butterfly Valve for Buried Service	5 Each	$	$

SCHEDULE

CLIN	Section	Supplies or Services	Quantity and Unit	Unit Price	Amount
163	35 22 14	16-inch AWWA Class 250 Manually Operated Butterfly Valve	2 Each	$	$
164	35 22 14	24-inch AWWA Class 250 Manually Operated Butterfly Valve	2 Each		
165	35 22 14	12-inch AWWA Class 250 Manually Operated Butterfly Valve for Buried Service	7 Each	$	$
166	35 22 14	30-inch AWWA Class 250 Manually Operated Butterfly Valve for Buried Service	1 Each	$	$
167	35 22 14	8-inch AWWA Class 150 Motor Operated Butterfly Valve	2 Each	$	$
168	35 22 14	6-inch AWWA Class 250 Motor Operated Butterfly Valve	2 Each	$	$
169	35 22 14	8-inch AWWA Class 250 Motor Operated Butterfly Valve	3 Each	$	$
170	35 22 14	8-inch ANSI Class 150 Tilting Disc Check Valve	2 Each	$	$
171	35 22 14	6-inch ANSI Class 150 Pressure Sustaining Valve with Anti-Cavitation Trim	1 Each	$	$
172	35 22 14	8-inch Air Valve Assemblies	1 Each	$	$
173	35 22 14	4-inch Air Valve Assemblies	1 Each	$	$

SCHEDULE

CLIN	Section	Supplies or Services	Quantity and Unit	Unit Price	Amount
174	35 22 14	3-inch Air Valve Assemblies	1 Each	$	$
175	35 22 14	2-inch Air Valve Assemblies	16 Each	$	$
176	35 22 14	8-inch AWWA Class 125 Flanged GateValve	1 Each	$	$
177	35 22 14	8-inch Class 125 Flanged FlapValve	1 Each	$	$
178	35 22 14	4-inch Class 250 Line Pipe Blowoff Assembly	1 Each	$	$
179	41 22 20	Overhead Traveling Crane	For the Lump Sum of		$
180	41 22 23	Monorail Crane	For the lump sum of		$
181	46 31 10	Chlorine Disinfection System	For the lump sum of		$

TOTAL FOR SCHEDULE $_____

END OF SCHEDULE

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SUMMARY OF WORK

PART 1 GENERAL

1.01 LOCATION

A. Work is located approximately 8 miles north of Gallup, New Mexico, in McKinley County.

1.02 PRINCIPAL COMPONENTS OF WORK

A. Construct a pumping plant with the following components.

1. Metal building.
2. Horizontal split case pumps.
3. Steel Manifolds.
4. Air chambers.
5. Electrical system.
6. Water storage tank.
7. Chlorine feed building.
8. SCADA System.
9. Potable and raw water transmission lines.
10. Highway crossings.

1.03 SPECIFICATIONS REQUIREMENTS

A. Requirements in Division 1, General Requirements, apply to Divisions 2 through 53.

B. Imperative statements in these specifications are Contractor requirements, unless otherwise stated.

C. Where specifications are written in streamlined form, the words “shall be” are included by inference where a colon (:) is used within the sentence or phrase.

1.04 DEFINITIONS

A. When the specifications use a word or term defined in the Federal Acquisition Regulations (FAR), the definition of the word or term shall be in accordance with FAR sections in effect at the time the solicitation was issued.

1.05 ACRONYMS

A. The following acronyms apply to specifications Divisions 1 through 53:

1. CO: Contracting Officer.
2. COR: Contracting Officer's Representative.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 14 10

USE OF SITE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (USBR)

1. USBR Cleaning Manual — Inspection and Cleaning Manual for Equipment and Vehicles to Prevent the Spread of Invasive Species (Technical Memorandum No. 86-68220-07-05) 2012 Edition
Available online at:
http://www.usbr.gov/mussels/prevention

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 01 14 10-1, Land Use and Landscape Rehabilitation Plan:

1. For each Contractor use site on ROW or easements.

a. Show use location and extent of impact. Uses include but are not limited to the following:

1) Buildings and service areas including onsite offices, shops, warehouses, storage areas, fuel and oil storage areas, and fabrication yards.

2) Parking areas, temporary roads, and haul routes.

3) Utilities including air, power, gas product lines, water lines; fire hydrants; and compressor station.

4) First-aid and medical facilities.

5) Concrete, CLSM and aggregate processing plants. Show sizes, rated capacities, and general features of plants including transporting, storing, screening, and washing facilities; concrete batching and mixing plant; and concrete conveying, placing, cooling plants and concrete washouts.

6) Areas for processing, storing, and disposing of waste materials from construction operations.

7) Temporary fences.

b. Vegetation plan: Methods to preserve, protect, and repair if damaged, vegetation (such as trees, shrubs, and grass) and other landscape features on or adjacent to the jobsite, which are not to be removed and which do not interfere with the work required under this contract. Include methods to mark work area limits, protect disturbed areas, and prevent erosion.

c. Describe methods to protect, and repair if damaged, existing improvements and utilities at or near the jobsite.

d. Describe methods for removing temporary structures and facilities, cleanup, and rehabilitating site after completion of construction activities.

2. Submit revised drawings of changes in use of Tribal land made during design and erection stages or after use of Tribal land is in operation.

1.04 PROJECT CONDITIONS

A. General:

1. Stay within ROW as shown on drawings.
2. When private land is used for construction facilities, or other construction purposes, make necessary arrangements associated with use of private land.
3. Location, construction, operation, maintenance, and removal of construction facilities on easements or ROW will be subject to approval of the COR.
4. Do not interfere with work of other contractors, the Navajo Nation and/or Government in vicinity, or with reservations made by the Government for use of such land.
5. Housing for construction personnel will not be permitted.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 CLEANING

A. Construction Equipment:

1. Before bringing on site, clean construction equipment, personal and work vehicles, remove dirt, vegetation, and other organic material to prevent introduction of noxious weeds, and invasive plant and animal species.

2. Contractor cleaning procedures shall result in equipment and vehicles being cleaned as well or better than the procedures described in USBR Cleaning Manual.

3. The COR will inspect construction equipment following procedures described in USBR Cleaning Manual before allowing the equipment onsite.

3.02 RESTORATION

A. Restore temporary construction roads to original contours and make impassable to vehicular traffic when no longer required.

B. After completion of work, regrade and scarify easements and ROW used for construction purposes and not required for completed installation so that surfaces blend with natural terrain and are in a condition that will facilitate revegetation, provide proper drainage, and prevent erosion.

C. Seed disturbed areas of Tribal land used for construction purposes and not required for completed installation in accordance with Section 32 92 20 – Seeding.

END OF SECTION

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SECTION 01 31 19

PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (USBR)

1. RSHS-2009 Reclamation Safety and Health Standards

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 01 31 19-1, Pre-Design Meeting Notification:

1. Provide confirmation to COR regarding requested date and time of meeting and indicated who will attend and affiliation.
2. Provide copies of preliminary drawings.

C. RSN 01 31 19-2, Written Summary:

1. Written summary of upcoming submittals work, and traffic plans. Provide work schedule for next 3 weeks.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 PROJECT COORDINATION

A. Contractor shall coordinate work with the COR, other Bureau of Reclamation Staff, Bureau of Indian Affairs, and other tribal, local, state and Federal Agencies as needed.

B. Contractor shall facilitate the on-site work of the above listed agencies.

C. The City of Gallup (Gallup) and/or other contractors may be working in the construction area throughout the project. Coordinate work with others to allow both parties to complete their work.

3.02 MEETINGS

A. The following meetings are considered significant, but do not relieve the Contractor from the responsibility of other meetings required by the specifications.

1. Pre-Design Coordination Conference:

   a. The contractor and subcontractors' technical engineering representatives responsible for submitting, reviewing, purchasing, and installing the Pumps, HVAC, Electrical, Architectural, Plumbing, and Chlorination Systems shall attend a pre-design conference prior to submitting approval data and drawings.

   b. Technical representatives to be fully informed of the equipment specification requirements and the coordination required between the various equipment manufacturers.

   c. Conference to occur within 45 days following receipt of Notice to Proceed and will be scheduled by COR.

   d. Conference Location: Four Corners Construction Office, 2200 Bloomfield Highway, Farmington, New Mexico; or a site agreed upon by the Contractor and COR.

2. Submittal Comment and Review Conference:

   a. The contractor and subcontractors' technical staff responsible for submitting, reviewing, purchasing, and installing the Pumps, HVAC, Electrical, Architectural, Plumbing, and Chlorination Systems shall attend a submittal comment and review conference prior to performing any manufacturing and within 20 days following the Government's mailing of the response to the RSN's titled, "Approval Drawings and Manufacturer's Data (manufacturer's technical catalog data, equipment layout, bill of material, nameplate list, schematic diagrams, and sample wiring and interconnection diagrams)".

   b. The Approval Drawing and Manufacturer's Data submittals are due no later than the date listed in Section 01 33 00 – Submittals, Table 01 33 00A – List of Submittals.

   c. It is intended to conduct this conference within 20 days following the Government's review of all the Approval Submittals for the equipment listed above. The conference will be scheduled by the COR.

   d. The Contractor is responsible for all construction schedule impacts due to incomplete submittals and late submittals.

   e. It is intended to discuss in detail the Government's review comments for the Approval Submittals described above.

f. Conference Location: Four Corners Construction Office, 2200 Bloomfield Highway, Farmington, New Mexico; or a site agreed upon by the Contractor and COR.

3. Preconstruction Meeting:

a. Meet with the Government prior to the start of construction. The Contractor shall provide as a minimum the Project Manager or Project Superintendent for the Preconstruction Meeting. Review will include, but may not be limited to:

1) Use of premises by Contractor, Government, and the public.

2) Construction facilities and controls.

3) Access to the work and haul routes.

4) Temporary utilities.

5) Survey layout.

6) Security.

7) Housekeeping procedures.

8) Schedules and sequence of work.

9) Procedures for testing.

10) Procedures for maintaining record documents.

11) Special site requirements:

a) Archeological: Refer to Section 01 57 90 – Preservation of Historical and Archaeological Data.

b) Biological: Refer to Section 01 57 60 – Protected Species.

c) Environmental: Refer to Sections 01 57 20 – Environmental Controls and 01 57 30 – Water Pollution Control.

12) Roles and responsibilities:

a) Government organization and personnel.

b) Contractor organization and personnel.

c) Subcontractors.

d) Proposed work schedule.

13) Contract requirements:

a) Progress payments.

b) Invoices.

c) Differing site conditions.

d) Changes.

e) Superintendence by the Contractor.

f) Payment for mobilization and preparatory work.

g) Submittal procedures.

h) Emails, faxes, and telephone calls.

4. Preconstruction Safety Meeting:

   a. Meet with COR prior to the start of construction.

   b. Review will include:

      1) Safety requirements.

      2) Monthly joint safety policy meetings.

      3) Weekly toolbox safety meetings.

      4) Safety program.

      5) Job hazard analysis.

      6) Required safety inspections.

      7) Government will monitor Contractor's operations for compliance with RSHS.

5. Progress Meetings:

   a. Meet weekly with Government to review work, progress made, difficulties in performing work, and resolution necessary to meet specifications requirements.

   b. Meetings will include review of submittals, construction program work and updating of progress reports.

END OF SECTION

SECTION 01 31 30
CONTRACT DOCUMENT MANAGEMENT SYSTEM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Contract Document Management System:

1. Payment: Lump sum price offered in schedule.

1.02 DEFINITIONS

A. CDMS: Contract Document Management System.

1. Contract Documents include, but are not limited to:

a. Specifications.

b. Contract drawings.

c. Submittals.

d. RFIs.

e. RFPs.

f. CMs.

g. Contractor proposals.

h. Value engineering proposals.

i. Bureau of Reclamation (Reclamation) Inspection Reports.

j. Invoices and progress payments.

k. Contract schedules.

l. Meeting agendas and meeting minutes.

m. Letters and memos.

B. CM: Contract Modifications.

C. RFI: Request for Information (Contractor generated document).

D. RFP: Request for Proposal (Reclamation generated document).

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 01 31 30-1, Approval Data:

1. Documentation of system capabilities.
2. Instructions for system use.

C. RSN 01 31 30-2, Final Data:

1. DVD or CD with all uploads to CDMS.

1.04 CDMS REQUIREMENTS

A. CDMS shall be capable of generating, storing, tracking, categorizing, and managing Contract Documents.

B. Access:

1. Web-based:
   a. Contract Documents are stored and accessed by authorized individuals via an internet site.
   b. Compatible with web browsers MS Internet Explorer, Apple Safari, and Mozilla Firefox, Google Chrome.
2. Ability to upload Contract Documents and make available for user download in the following supported file formats, minimum:
   a. Adobe Acrobat.
   b. MS Word.
   c. MS Excel.
   d. MS Project.
   e. Primavera P6.
   f. AutoCAD 2007.
   g. Contract Manager.
3. Allow Contract Documents to be prepared by the Contractor or by Reclamation.
   a. Preparing organization will control access of documents. See Document Security and Backup paragraph below.
4. The Contractor and Reclamation shall each have a project manager for CDMS.
   a. Each project manager shall have capabilities to assign users within their organization and to assign user rights which control access to documents based on user class and document type.
   b. Each organization shall be capable of defining its access hierarchy.
   c. Inclusion of users will be the prerogative of the organizational project manager.
   d. Reclamation project manager shall be able to create and modify project properties (i.e., Contractor, project location, description, bid amount, project directory, etc.).

5. Email notifications shall be automatically sent to selectable users when new documents are submitted and available for viewing, or alerts are generated. Examples:
    a. Updates to project information (e.g., entry of a new submittal);
    b. Changes to project information (e.g., approval of a submittal);
    c. Alerts (e.g., submittal under review for >15 days without action).
6. Ability to link files; examples:
    a. RFP linked to a CM.
    b. Submittal linked to a Specification or Drawing.

C. Reports:

1. CDMS shall generate reports that list and sort documents by status; examples:
    a. Submittals that have been approved.
    b. Invoices paid to date.
    c. RFIs under review.
2. CDMS shall generate alerts when documents requiring action approach or exceed allowable time.
3. CDMS shall have the ability to generate customizable summary reports; examples:
    a. Submittal Turn-around.
    b. RFI Turn-Around.
    c. CM Processing Turn-Around.
    d. Total CM costs.
    e. Total CM Request Exposure.
4. Reports shall be printable, exportable as searchable .pdf or printer friendly HTML, and exportable to Excel, XML, or CSV.
5. CDMS shall have ability to link from an item in a report directly to the item by clicking on it.
    a. For example: in a submittal report, clicking on a submittal that is 15 days old takes you directly to information on that submittal.
6. CDMS shall be capable of producing a complete and logically organized set of documents within the CDMS in both .pdf and .xml format.

D. Document Security and Backup:

1. SSL encryption for secured data exchange between browser and server (Secure access to documents and information).

2. CDMS shall provide document access security until authoring party chooses to share it with others.

    a. CDMS shall show parties that have access to a document.

    b. Extent of document sharing shall be determined by authoring party.

    c. Once documents are shared, CDMS shall track documents so that changes cannot occur without a record of changes.

3. Backup/Archiving to FTP site of documents to which an organization has access on a regular (minimum monthly) basis. Backups shall be in PDF format.

4. Documents shall be downloadable to ftp sites where Reclamation and other organizations can each access their own data confidentially.

E. General Tracking and Control:

1. Documents shall be grouped into categories (Submittals, RFI, RFP, CM, Payments, Daily Inspection Reports, Meeting Minutes).

2. CDMS shall track when documents were received or returned, as well as the status of the documents (e.g. Under Review; or Returned, Approved or Rejected, etc.).

3. CDMS shall track document changes including who entered or changed document and date change was made.

4. CDMS shall track when a reviewer has opened an item.

F. Submittal Tracking and Control:

1. Ability to create master list of submittals (“Schedule of Submittals”).

2. Provide standard submittal form for entering information. CDMS shall allow customizing of standard submittal form. Contractor shall be able to enter submittal summary information (Required submittal number, title, description, and specification section shall be required fields) and then upload submittal data in electronic format.

3. CDMS shall track date received, date response due, date returned, and status.

    a. Status designations may be modified to fit Reclamation standard designations - A/AAN/PAR/NA/ACK (Approved/Approved As Noted/Partially Approved - Resubmit/Not Approved/Acknowledged).

4. Provide Submittal Tracking form for Reclamation to enter review comments and action taken. CDMS shall allow customizing of submittal tracking form.

    a. Allow for Reclamation to route submittal to third parties (e.g., consultant, internal design or operations and maintenance groups, etc.) by generating design-review transmittals with each submittal package item, to track the status of individual sub-items within the submittal package, and to route each sub-item to the appropriate reviewers.

5. Ability to generate automatic notification after specified days without response.

G. RFI Tracking and Control:

1. Provide standard RFI form to enter information.
2. Ability to create or attach documents to the RFI form or links to other documents within CDMS.
3. Ability for Reclamation to route RFI to appropriate reviewers and for reviewers to enter comments into standard response form.

H. Inspection Reports Tracking and Control:

1. Ability to attach Reclamation standard inspection and report forms into CDMS and ability to create customizable inspection forms in CDMS. Typical forms:
   a. Daily Inspection Report (DIR).
   b. Survey requests.
   c. Plant inspection reports.
   d. Testing reports.
2. Ability to link or attach photos to forms and link forms to other documents within CDMS.

I. Contract Modifications:

1. Provide standard Contractor Proposal form with ability to attach documents and link to other documents within CDMS.
2. Provide ability to upload Reclamation's standard CM form and RFP forms, or create an acceptable alternative, to enter information.
3. Ability to attach documents to these forms, and link to other documents within CDMS.
4. Ability for Contractor to respond to RFP and CM form with Cost and Time impacts.
5. Ability to track date CM issued and date responded, with automatic notification after specified days without response.

J. Cost Tracking and Payment Request Management:

1. Ability to import payment bid items cost from a MS Excel spreadsheet.
2. Ability to edit percent complete and payment amount each month. Format to be spreadsheet, e.g. items available for editing at once, rather than needing to edit one item at a time, save, open next item and edit that, etc.

K. Correspondence:

1. Ability to generate letters and memos.
   a. Ability to attach documents to letters and memos, and to reference other documents within CDMS.

b. CDMS shall automatically assign sequential numbers to letters and memos.

2. Ability to generate responses to letters and memos.

a. System automatically generates memo suffixes, e.g. the 1st response to Memo 32 to be 32.1, 2nd response to be 32.2, etc.

3. Official correspondence from Reclamation to Contractor shall contain Reclamation's official letterhead and corresponding logos.

4. Ability to generate meeting agendas and meeting minutes and to attach documents to the minutes.

a. CDMS shall automatically assign sequential meeting numbers.

L. Miscellaneous Tracking and Controls:

1. Ability to generate logs tracking RFIs, CORs, COs, Submittals, Payments, Memos, DIR, survey requests, plant inspection reports and testing reports.

2. Ability to filter logs based on criteria e.g. for Submittals: Specification Section, Days Out, Status (A/AAN/RandR/ ACK/RWR); for RFI's: Days out, Status (Open/Closed), Specification Section / Dwg No., Responsibility / Ball-In-Court

3. Ability to sort Logs based on a criteria, e.g., for Submittal, Specification Section, Days Out, Status, or other criteria determined by the COR.

4. Ability to provide forms to match Reclamation's CM Form and Progress Payment Form or other forms when needed.

5. Ability to track Cost Exposure with links to RFI and CM requests.

6. Ability to measure productivity benchmarks on a project such as computing average review days for RFIs and submittals, categorize CMs, and track total CM percentages by category.

7. Ability for keyword search of documents in database.

8. Ability to allow online Payment Requests (electronic invoicing) by Contractor.

M. Budget and Funding Source Tracking:

1. Ability to enter funding sources and assign contract line items to multiple funding sources.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 IMPLEMENTATION

A. CDMS shall be in place and operating before the Contractor transmits Contract Documents, as defined in this Section, to the Government other than RSN 01 31 30-1, Approval Data.

1. CDMS operation includes the COR, or other authorized Government representative, having program control to assign users and user rights to Government personnel to access appropriate areas of the system.

B. The Contractor shall input entrees to Schedule of Submittals before making submittals.

1. Schedule of Submittals shall include RSNs listed in Table 01 33 00A - List of Submittals.

2. Schedule of Submittals shall include scheduled submittal date.

C. CDMS shall be operational until final project closeout.

END OF SECTION

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SECTION 01 32 10

CONSTRUCTION PROGRAM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Costs:

1. Developing Baseline Schedule: Include in lump sum price offered in the schedule for mobilization and preparatory work.

2. Updating and Using Construction Program: Include as an element of Contractor's overhead.

1.02 REFERENCE STANDARDS

A. Associated General Contractors of America (AGC)

1. AGC Manual Construction Planning and Scheduling Manual, 2004

1.03 DEFINITIONS

A. Schedule: The Critical Path Method (CPM) of planning and scheduling a construction project where activities are arranged based on activity relationships and network calculations determine when activities can be performed and the critical path of the project.

B. Project Calendar(s): Cross reference of numerical work days with calendar days. The project calendar serves as the basis for the day/date conversion and assigns work days and non-workdays.

C. Resources: Equipment, labor or crews, materials, subcontractors, fabricators, manufacturers, and consultants.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

1. Furnish database files in format compatible with Primavera P6 Professional Project Management.

2. Upon request, provide information and data used to develop and maintain the Construction Program to the CO.

B. RSN 01 32 10-1, Representative Information:

1. Designation of authorized representative to develop and maintain Construction Program. Representative experienced in developing and maintaining construction

schedules and knowledgeable of activities and progress on-site to develop and maintain accurate and reliable schedules.

C. RSN 01 32 10-2, Baseline Schedule:

1. Include:

a. Construction Program/Schedule database.

b. Definition of project calendars.

c. Gantt chart (Bar chart) for project.

d. Activity report including all logic constraints consisting of predecessors, successors, and constraint dates.

e. Table listing equipment, manpower, and material limitations used to produce baseline schedule. This listing may be independent of the schedule database.

D. RSN 01 32 10-3, Updated Schedule:

1. Include:

a. Construction Program database with updated activity and milestone data.

b. Definition of project calendars if revised from baseline calendars.

c. Gantt chart for project.

d. Narrative report specifically stating status of project.

1) If negative float exists, cite specific actions and conditions which caused the "behind schedule" condition and provide proposed course of action to complete the project within the specified delivery time.

2) List of Contractor-initiated changes to the current schedule stating the reason for the action taken and any unresolved issues relating to the Construction Program. Government reserves the right to reject Contractor-initiated changes to the current schedule which negatively impact any Government action which was initiated on the basis of the current schedule.

e. RSN submittals register. Register updated monthly includes submittals as listed in submittal table; revised submittals; dates and status. This register document is separate from the scheduling database.

E. RSN 01 32 10-4, Time Impact Analysis:

1. Include:

a. Construction Program database with proposed revised activity and milestone data.

b. Proposed revised schedule due to the change or delay with added, changed, or deleted activities highlighted.

c. Narrative report explaining results and conclusions.

1.05 GENERAL

A. Develop, maintain, and use approved Construction Program to plan, monitor, evaluate, and report accomplishment of work.

1.06 SCHEDULES

A. Prepare construction schedules using Critical Path Method, under concepts and methods outlined in AGC Manual. Use a computer software program to perform a mathematical analysis of the scheduling data.

1. Use the Precedence Diagramming Method (PDM) in preparing the CPM networked schedule. Prepare schedule based on required sequence and interdependence of activities.

2. Prepare detailed activity network for accomplishing required work organized by work breakdown structure.

3. Activities except “Award” shall have predecessor activities and activities except “Contract Complete” shall have successor activities.

4. Meet contract requirements; milestone(s) in accordance with the clause at FAR 52.211-10, Commencement, Prosecution, and Completion of Work; funding constraints in accordance with the clause at WBR 1452.232-80, Limitation of Funds; and other relevant specification sections. Include interim milestone dates, Government interface dates, contract completion date, and other time or seasonal constraints specified in the contract documents.

5. Include work of subcontractors, Government interfaces, and contract milestones.

6. Adjust Construction Program/schedule for seasonal weather conditions.

7. If activity codes are utilized, use unique activity code names assigned as project codes rather than global codes. Utilize the Work Breakdown Structure in lieu of activity codes for general organization of the schedule.

8. Define activities to a level of detail resulting in their durations being no greater than 20 workdays unless otherwise accepted by CO.

   a. Durations for administrative activities (e.g., submittals and reviews, fabrication, manufacturing), or other specific activities identified in the contract will not be subject to the workday limitation.

9. Include activities for Government reviews and approvals. Assign Government submittal review activities to a seven-day calendar with durations as specified in Section 01 33 00 - Submittals. Include activities for submittal preparation, submittal reviews, and fabrication or manufacturing activities when work involves

significant quantities, long lead times, on the critical path, or as requested by the COR.

10. Include contract title, contract number, and Contractor's name on the transmittal cover sheet and each sheet of the Gantt chart.

11. For each activity on the Gantt chart, display identification number, activity description, planned duration, start date, finish date, total float, and calendar identification.

12. Include table of abbreviations used in the schedule, listed and defined alphabetically.

13. Use finish to start logic relationships between activities. Do not utilize start to start, finish to finish, or start to finish logic relationships. Do not use negative lead or lag times.

14. Use durations in units of whole workdays.

15. Provide best estimate of time required to complete the activity considering the quantity of work and planned resources for the activity.

16. Equate durations of Government reviews and other identified actions to the maximum number of calendar days specified in their respective paragraphs.

17. Establish workday calendar(s) and use these in the schedule to translate the activity's workday duration into calendar dates. Use calendar names unique for this project, do not use software default calendar names. Save calendars as project calendars, not global calendars.

B. Baseline Schedule:

1. Represents Contractor's as-planned approach to accomplishing the work. Do not include actual start dates, percent completes, or actual finish dates.

2. Meets all requirements of the Construction Program.

C. Updated Schedule:

1. Meet monthly with COR at Government's project office, or at a location approved by the COR, to review progress made to the end date of the progress payment period. Establish dates that activities were started and completed and remaining duration for each activity started but not completed during the period.

   a. Discuss and mutually agree upon changes to the schedule.

   b. Update schedule and Construction Program database with mutually agreed upon changes.

2. Following receipt of an executed contract modification, incorporate the activity data and logic relationships stipulated in the modification into the current schedule for inclusion in the next scheduled progress update.

3. Assign a unique project file name for each schedule update.

4. Monthly updated schedules shall be submitted and approved by government before monthly progress payments may be submitted by the contractor.

1.07 TIME IMPACT ANALYSIS

A. Provide a time impact analysis for contract changes, e.g., a change order, proposed modification, or value engineering change proposal to support a claim or request for an equitable adjustment to the contract which involves a delay or accelerated schedule.

B. The CO may use time impact analysis to determine if a time extension or reduction to the contract milestone dates is justified.

C. A time impact analysis is applicable whether the Contractor's current schedule milestone dates are the same as, earlier, or later than, those required under the contract.

D. Changes, additions, or deletions to activities; activity durations; or activity time frames will not automatically mean that an extension or reduction of contract time is warranted or due the Contractor.

E. Time extensions for performance will be considered only to the extent that the Contractor's current scheduled milestone dates exceed the contract milestone dates.

F. For activities directly affected by the change or delay, include the current and proposed items:

1. Activity description.
2. Types and quantities of major pieces of equipment, principal manpower, and pacing materials (materials that affect activity start, duration, or finish).
3. Activity duration.
4. A narrative containing the rationale used in developing the proposed logic relationships and activity data.

G. Float is not for the exclusive use by or benefit of either the Government or the Contractor.

H. Prepare a single time impact analysis for modifications issued after Notice to Proceed (NTP) and prior to approval of the baseline schedule. Submit the time impact analysis with the first progress update.

I. Perform time impact analyses using data in the most recent approved schedule prior to change or delay event.

1. Prepare proposed revised schedule and narrative description describing and highlighting where changes or delays will be included.
2. Prepare summary comparing the results of two schedule analyses: One using current schedule data from the last approved schedule prior to event requiring

analysis, and one using proposed schedule data incorporating the changes or delays.

a. Show contract milestones and activities whose periods of performance have shifted as a result of any change which affects production and/or manufacture schedules, material orders, construction seasons, and labor and/or equipment utilization.

b. Base mathematical analyses on status of work and available float at the time the CO directs or proposes a change to the work, the Contractor submits a value engineering change proposal, or when a delay occurs.

1.08 REVIEW AND EVALUATION

A. Baseline Schedule:

1. Within 42 calendar days after receipt of baseline schedule:

a. CO will accept or reject the proposed baseline schedule.

b. Upon request from the CO, meet with COR for a joint review of the proposed baseline schedule.

c. If schedule is rejected, revise and resubmit within 7 calendar days following the date of the rejection letter.

2. Do not proceed with onsite work, except mobilization and surveying, until baseline schedule has been approved by the Government.

B. Updated Schedules:

1. The Government will require 14 calendar days after receipt of each monthly update to review and approve or reject the updated schedule.

2. If the updated schedule is rejected, revise and resubmit updated schedule within 7 calendar days following the date of the rejection letter.

C. Failure to include any element of the work will not release Contractor from completing required work under the contract.

D. Performance will be evaluated by the Government using the approved CPM schedules.

1.09 FAILURE TO COMPLY

A. Failure to comply with the requirements of this Section shall be grounds for a determination by the CO that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the specified time.

B. The CO may terminate the Contractor’s right to proceed with the work, or any separable part of it, in accordance with the default terms of this contract.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 01 33 00
SUBMITTALS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1. ASME Y14.1-2005(2010) Decimal Inch Drawing Sheet Size and Format

B. National Institute of Building Sciences (NIBS)

1. NIBS NCS-2011 United States National CAD Standards, Version 5

1.03 DEFINITIONS

A. Days: Calendar days.

B. Required Submittal Number (RSN): Identifies items to be submitted together as a complete submittal.

C. Submittal Types, as listed in Table 01 33 00A – List of Submittals:

1. A – Action:
    a. Government will respond as to adequacy of submittal.
    b. Action submittals are considered to be “shop drawings” within the terms of the clause at FAR 52.236-21, Specifications and Drawings for Construction.
2. I – Informational:
    a. The Government will acknowledge receipt of Informational submittals.
    b. The Government may reject an Informational submittal when the submittal does not comply with the contract. The Contractor shall correct mistakes or deficiencies in rejected Informational submittals and resubmit.
    c. Informational submittals are considered to be “shop drawings” within the terms of the clause at FAR 52.236-21, Specifications and Drawings for Construction, except that approval by the Government is not required.

1.04 UNSATISFACTORY PROGRESS

A. Contractor is responsible for the accuracy and completeness of submittals and that the submittals meet specifications requirements, prior to submission to the Government.

1. In accordance with the terms of the clause 52-236-21 Government review and approval of submittals does not relieve the contractor from:

a. Responsibility of errors or omissions.

b. Meeting the requirements of the contract.

B. The Government will review a submittal and the first resubmittal at no charge.

1. Review of subsequent submittals for the same RSN will be at the expense of the Contractor.

2. At the sole discretion of the CO, a non-refundable amount equal to the review charges will be deducted from the contract price.

3. Currently, charges vary between $74 and $116 per hour, depending upon the complexity of the submittal and the level of expertise required to perform the review.

C. RSN's will be tracked by the Government based on the due dates and time frames established in Table 01 33 00A – List of Submittals

1. Progress will be considered unsatisfactory where RSN's are submitted late or are delinquent.

2. Retention of payment from the Contractor's progress payments in accordance with clause 52.232-05(e) – Payments under Fixed-Price Construction Contracts may begin at the discretion of the CO.

3. Progress will be considered for each submittal and resubmittal.

D. Only complete RSN's with sufficient data for Government review, in the opinion of the COR, will be considered a submittal meeting the RSN due date.

1. Unsatisfactory progress will apply if the due date was missed due to an incomplete submittal.

2. Unsatisfactory progress will continue until the Contractor's submittal(s) or resubmittal(s) are approved by the Government.

E. A maximum of 10 percent of the amount of the progress payment may be retained by the CO until satisfactory progress is reestablished.

1. Withheld funds will be released to the Contractor when the work is substantially complete.

2. CO may retain from previously withheld funds and future progress payments, that amount the CO considers adequate to protect the Government.

1.05 SUBMITTAL REQUIREMENTS

A. In case of conflict between requirements of this section and requirements included elsewhere in these specifications, requirements included elsewhere take precedence.

B. General:

1. Prepare in English.
2. Label with contract number and title, and RSN.
3. Measurement units: US Customary Units.

C. Drawings:

1. Minimum identification in title block:
    a. Contract number and title.
    b. Contractor's or supplier's title and drawing number.
    c. Date.
2. Reserve 3- by 3-inch space next to title block for review stamps.
3. Print Size: D size (22 inches by 34 inches).
4. Draw to scale using computer drafting or drafting equipment, unless otherwise specified.
    a. Lettering shall be neat when drawing preparation with drafting equipment is allowed.
5. Government Format drawings:
    a. Prepare drawings designated as "Government Format" in the specifications as follows:
        1) Title block and sheet format:
            a) As shown on Drawing 40-D-7102.
            b) Government will provide specific title block information to be used.
        2) Drawing format:
            a) Develop in AUTOCAD, Version 2007 or later.
            b) In accordance with NIBS NCS.
        3) Size: D-size (22-inch by 34-inch) as defined by ASME Y14.1.
        4) Government will provide an electronic AutoCAD template.
        5) Compile using eTransmit utility in AutoCAD for a complete package including support files.
6. Final drawings:
    a. Drawing format: Develop in AUTOCAD, Version 2007 or later.

b. Show as-built changes, including revision dates, made during installation. Indicate changes by clouding.

c. Compile using eTransmit utility in AutoCAD for a complete package including support files.

d. Electronic files: On CD or DVD discs.

e. Original plots: D size (22 inches by 34 inches).

f. Government will provide an electronic AutoCAD template.

D. Product Data:

1. Mark manufacturer's data for commercial products or equipment, such as catalog cut sheets.

a. Identify manufacturer's name, type, model, size, and characteristics.

b. Illustrate that product or equipment meets requirements of specifications.

c. Mark items to be furnished in a manner that will photocopy (no highlighter).

d. Strike through items that do not apply.

E. Certifications:

1. Certifications by a registered professional: Signed and sealed by registered professional.

2. Manufacturer’s certifications: Signed by authorized representative of manufacturer.

a. Electronic copies: Searchable Adobe pdf on CD or DVD.

1) Bookmark longer files to assist in navigating file.

F. Manuals:

1. Copies:

a. Printed copies: Bound and indexed.

b. Electronic copies: Searchable Adobe pdf on CD or DVD.

1) Bookmark longer files to assist in navigating file.

2. Contents:

a. Parts identification lists, lists of special tools, and accessories.

b. Schematics and wiring diagrams.

c. Detailed instructions for installing, operating, lubricating, and maintaining equipment.

d. As-built drawings, photographs, and test records or reports if required by the specifications.

G. Photographs:

1. Prints: Professional quality 8-inch by 10-inch color for each listed view.
   a. Identify with adhesive labels on back.
      1) Include contract number, name of equipment and view title.
      2) Do not type directly on back of photograph.
2. Include negatives, or digital files on CD or DVD in Joint Photographic Experts Group (.jpeg) or similar format.

H. Samples and Color Selection Submittals:

1. Label with complete manufacturer's product and color identification.
2. Include type and quantity of materials specified in the referenced section in each "set" of samples.
3. Samples: Representative of product to be installed. Xerographic sheets for color selection are not acceptable.
4. Color chips: Sample paint chips. Ink color reproductions are not acceptable.
5. Label each sample, sample kit, set of color chips, or color chart with contract number and title.
6. The Government will select architectural color and pattern after product approval.

1.06 SUBMITTALS PROCEDURES

A. Submit only submittals that have been contractor reviewed. Submittals without evidence of Contractor's approval will be returned for resubmission.

B. Submit complete sets of required materials for each RSN as specified in "Submittals Required" column in Table 01 33 00A - List of Submittals. A complete set includes all listed items for RSNs with multiple parts.

C. Submit sets specified in "Sets to be sent:" columns in Table 01 33 00A - List of Submittals.

1. Submittals identified with "CDMS" in the "Sets to be sent" column shall be submitted electronically in accordance with Section 01 31 30 - Contract Document Management System.

D. Include the following information in transmittal letters:

1. Contract number and title.
2. RSN for each attached submittal.
3. Responsible code.
4. Identify submittal as initial or resubmittal.

E. Resubmittal of submittals not approved:

1. Mark changes such that they are readily identifiable and show revision date.
2. Describe reasons for significant changes in transmittal letter.
3. Resubmit returned submittals within 14 days after receiving the comments, unless otherwise directed.
4. Requirements for initial submittals apply to resubmittals.

1.07 REVIEW OF SUBMITTALS

A. Time Required:

1. Submittal review will require 42 days for review of each submittal or resubmittal, unless otherwise specified.
2. Time required for review of each submittal or resubmittal begins when complete sets of materials required for a particular RSN are received and extends through return mailing postmark date.

B. Time in Excess of Specified:

1. The CO may extend the contract completion date to allow additional time for completing work affected by excess review time.
    a. The time extension will be to the extent that excess review time caused delay to the contract completion date.
    b. The time extension will not exceed the time used in excess of the specified number of days for review of submittals or resubmittals.
    c. Concurrent days of excess review time resulting from review of two or more separate submittals or resubmittals will be counted only once in extending the contract completion date.
2. No time extension will be allowed if the Contractor fails to make complete action submittals in sequence and within time periods specified.
3. Adjustment for delay will be made only to the extent that:
    a. Approval was required under the contract, and
    b. Requests for approval were properly and timely submitted and were approved.
4. Adjustment will be subject to terms of paragraphs (b) and (c) of the clause at FAR 52.242-14, Suspension of Work, however, no such delay shall be deemed to be a “suspension order” as the term is used in that clause.

C. Return of Submittals:

1. Return of submittals will be by CDMS response or hard copy, as applicable.
2. Action Submittals: One set of submittals required for action will be returned either approved, approved subject to identified changes, or not approved.
    a. Revise and resubmit submittals not approved.

b. Do not change designs without approval of the CO after drawings, documentation, and technical data have been approved.

3. Informational Submittals: The Government will acknowledge Informational submittals.

a. Informational submittals will not be returned when they comply with the specifications.

b. Informational submittals that do not comply with the specifications may be returned for resubmittal or additional information may be requested.

1.08 HARD COPY OF TRANSMITTALS

A. Addresses for codes listed in Table 01 33 00A - List of Submittals:

1. Contracting Officer, Bureau of Reclamation, Attn: UC-840, 125 South State St., Room 6107, Salt Lake City, UT 84138-1147.

2. Construction Engineer, Bureau of Reclamation, 2200 Bloomfield Hwy, Farmington, New Mexico, 87401.

3. Technical Service Center, Bureau of Reclamation, Attn 86-68170, PO Box 25007, Denver CO 80225-0007; Express Mail: Sixth and Kipling, Building 67, Room 152.

4. Executive Director Gallup Joint Utilities, PO Box 1270, Gallup, New Mexico, 87305.

B. Send original transmittal letter with appropriate number of sets to office listed in "Responsible Code" column in Table 01 33 00A – List of Submittals.

1. Responsible codes starting with "86-6" are located in the Technical Service Center. Send these submittals to the TSC address shown above.

C. Send copy of transmittal letter with appropriate number of sets to offices that are not the responsible code, but show "No. of sets to be sent to" in Table 01 33 00A – List of Submittals.

D. When "No. of sets to be sent to" is 0, send a copy of transmittal letter to that office.

E. Submittals required by the specifications, but not listed in Table 01 33 00A - List of Submittals:

1. Submit in accordance with this section.

2. Submit to CE, unless otherwise specified.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

Table 01 33 00A. - List of Submittals

* Submittal types: A – Action, I – Information

** CO indicates Contracting Officer, CE indicates Construction Engineer, WCAO indicates Western Colorado Area Office, TSC indicates Technical Service Center Gallup indicates the City of Gallup New Mexico.

RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	No. of sets to be sent to: **			
						CO	CE	TSC	Gallup
I-1	Safety and Health (WBR 1452.223-81)	Safety program	Submitted and accepted before commencing onsite work. See section 3 of RSHS	A	CE	CDMS			
I-2	Safety and Health (WBR 1452.223-81)	Monthly Accident Summary Report	First day of each month. See paragraph 3.8 of RSHS.	I	CE	CDMS			
01 14 10-1	Use of Site	Land Use and Landscape Rehabilitation Plan	At least 42 days before use of Tribal land	A	CE	CDMS			
01 31 19-1	Project Management and Coordination	Pre-Design Meeting Notification	Within 28 days of issuance of Notice to Proceed.	I	CE	CDMS			
01 31 19-2	Project Management and Coordination	Written Summary	Monthly once on-site construction begins.	A	CE	CDMS			
01 31 30-1	Contract Document Management System	Approval Data	Within 7 days of Award	A	CE	0	1	0	0
01 31 30-2	Contract Document Management System	Final Data	Within 14 days of completion of work	A	CE	0	2	2	0
01 32 10-1	Construction Program	Representative Information	Within 7 days after receipt of Notice of Award	I	CE	CDMS			
01 32 10-2	Construction Program	Baseline Schedule: 1. Blackline prints 2. Reports	Within 21 days after receipt of Notice to Proceed	A	CE	CDMS			
01 32 10-3	Construction Program	Updated Schedule: 1. Blackline prints 2. Reports	As needed	A	CE	CDMS			

Table 01 33 00A. - List of Submittals

* Submittal types: A – Action, I – Information

** CO indicates Contracting Officer, CE indicates Construction Engineer, WCAO indicates Western Colorado Area Office, TSC indicates Technical Service Center Gallup indicates the City of Gallup New Mexico.

RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	No. of sets to be sent to: **			
						CO	CE	TSC	Gallup
01 32 10-4	Construction Program	Time Impact Analysis: 1. Blackline prints 2. Reports	Within 28 days after the CO directs a contract change, with any proposal for a future modification, with any value engineering proposal, or with any request or claim for an equitable adjustment to the contract.	A	CE	CDMS			
01 35 10-1	Material Safety Data Sheets	Complete LHM and MSDS	At least 14 days before jobsite delivery of hazardous material	I	CE	CDMS			
01 35 10-2	Material Safety Data Sheets	Updated LHM and MSDS	At least 14 days before jobsite delivery of hazardous material not previously listed	I	CE	CDMS			
01 35 22-1	First-Aid	Medical Facilities Plan	At least 42 days before beginning on-site construction	A	CE	CDMS			
01 35 30-1	Contractor‘s Onsite Safety Personnel	Resumes	At least 7 days before beginning on-site construction	I	CE	CDMS			
01 35 30-2	Contractor’s Onsite Safety Personnel	Safety Inspection Reports	At least once each week	I	CE	CDMS			
01 46 20-1	Testing Laboratory Services	Testing Laboratory Services Plan	At least 42 days before testing is required	A	CE	CDMS			
01 51 00-1	Temporary Utilities	Water Storage	At least 42 days before beginning on-site construction	A	CE	CDMS			
01 55 20-1	Traffic Control	Traffic Control Plan	At least 70 days before affecting public traffic.	A	CE	CDMS			
01 55 20-2	Traffic Control	Permit Applications	At least 70 days before affecting public traffic.	A	CE	CDMS			
01 55 20-3	Traffic Control	Permits	At least 14 days before affecting public traffic.	I	CE	CDMS			
01 56 15-1	Protection of Existing Utilities	Utility Line Information	At least 42 days prior to submitting pipe laying diagram	A	CE	CDMS			
01 56 15-2	Protection of Existing Utilities	Work Plan Within Utility Easements	With pipe laying diagram	A	CE	CDMS			

Table 01 33 00A. - List of Submittals

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RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	No. of sets to be sent to: **			
						CO	CE	TSC	Gallup
01 57 20-1	Environmental Controls	Copy of Applicable Air Quality Permit	At least 14 days before beginning on-site work	I	WCAO	CDMS			
01 57 30-1	Water Pollution Control	Updated Stormwater Pollution Prevention Plan	At least 42 days before start of onsite construction work	A	WCAO	CDMS			
01 57 30-2	Water Pollution Control	Spill Prevention Control and Countermeasure Plan (SPCC)	At least 42 days before delivery or storage of oil	A	WCAO	CDMS			
01 57 40-1	Pesticides	Pesticide Use Plan	At least 42 days before application of first pesticide	A	CE	CDMS			
01 57 50-1	Tree and Plant Protection	Protection Plan	At least 42 days before beginning on-site work	A	CE	CDMS			
01 64 40-1	Government-Furnished Products	Shortage Report	Within 24 hours of after unloading	A	CE	CDMS			
01 71 20-1	Surveying	Surveying Plan	At least 42 days before beginning survey work	A	CE	CDMS			
01 71 20-2	Surveying	Resume	At least 42 days before beginning survey work; At least 42 days before personnel change	I	CE	CDMS			
01 71 20-3	Surveying	Accuracy Check Results	At least 42 days before beginning survey work	I	CE	CDMS			
01 71 20-4	Surveying	Completed and Reduced Survey Notes	Within 2 days of completing and reducing notes	I	CE	CDMS			
01 71 20-5	Surveying	Original Field Survey Books	Weekly	I	CE	CDMS			
01 71 20-6	Surveying	Quantity Survey Notes and Computations	Accompanying progress payment requests	I	CE	CDMS			
01 71 20-7	Surveying	Workday's Survey Notes	At conclusion of workday if requested by Government	I	CE	CDMS			
01 74 00-1	Cleaning and Waste Management	Waste Production and Disposal Records	Within 7 days of waste disposal	I	CE	CDMS			
01 74 00-2	Cleaning and Waste Management	Hazardous Wastes Manifest	Within 7 days of hazardous waste disposal	I	CE	CDMS			

Table 01 33 00A. - List of Submittals

* Submittal types: A – Action, I – Information

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RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	No. of sets to be sent to: **			
						CO	CE	TSC	Gallup
01 74 00-3	Cleaning and Waste Management	Environmental Consultant Resume	At least 42 days before beginning environmental assessment	I	CE	CDMS			
01 74 00-4	Cleaning and Waste Management	Environmental Site Assessment	Within 14 days of completion of work	I	CE	CDMS			
01 78 30-1	Project Record Documents	Final As-built Drawings	Within 14 days of completion of work	A	CE	0	2	0	2
01 80 15-1	Commissioning	Testing Procedures	After check prints are approved and 42 days before testing	A	CE	CDMS			
01 80 15-2	Commissioning	Calibration Certification Documents	28 days before testing	A	CE	CDMS			
01 80 15-3	Commissioning	Test Reports	Within 14 days of completing each test	I	CE	CDMS			
03 11 10-1	Concrete Forming	Formwork Design and Drawings	28 days before placing concrete	A	86-68180	CDMS			
03 15 12-1	PVC Waterstop	Purchase Orders	28 days before placing concrete	A	86-68180	CDMS			
03 15 12-2	PVC Waterstop	Certification	28 days before placing concrete	A	86-68180	CDMS			
03 15 12-3	PVC Waterstop	Drawings	28 days before placing concrete	A	86-68180	CDMS			
03 15 12-4	PVC Waterstop	Instructions	28 days before placing concrete	A	86-68180	CDMS			
03 20 00-1	Concrete Reinforcing	Reinforcement Diagrams and Lists	28 days before placing concrete	A	CE	CDMS			
03 30 00-1	Cast-In-Place Concrete	Approval Data	At least 42 days before placing concrete	A	86-68180	CDMS			
03 30 00-2	Cast-In-Place Concrete	Concrete Placement Drawings	At least 42 days before placing concrete	A	86-68180	CDMS			
03 30 00-3	Cast-In-Place Concrete	Concrete Placement Schedule	At least 42 days before placing concrete	A	86-68180	CDMS			
03 30 00-4	Cast-In-Place Concrete	Certifications	At least 42 days before placing curing compound	A	86-68180	CDMS			

Table 01 33 00A. - List of Submittals

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RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	No. of sets to be sent to: **			
						CO	CE	TSC	Gallup
03 30 00-5	Cast-In-Place Concrete	Test Reports	At least 42 days before placing curing compound	A	86-68180	CDMS			
03 30 00-6	Cast-In-Place Concrete	Contractor Field Quality Test Results	Within 2 days of completing tests.	A	86-68180	CDMS			
03 48 00-1	Precast Concrete Structures	Product Approval Drawings and Data	At least 42 days before installing first structure	A	86-68180	CDMS			
03 63 00-1	Epoxy Grout	Approval Data	At least 42 days before beginning grouting	A	86-68180	CDMS			
04 22 10-1	Reinforced Concrete Unit Masonry Assemblies	Approval Data	At least 42 days before beginning construction of the wall	A	86-68120	CDMS			
04 22 10-2	Reinforced Concrete Unit Masonry Assemblies	Sample Kit	At least 42 days before beginning construction of the wall	A	86-68120	0	1	1	0
04 22 10-3	Reinforced Concrete Unit Masonry Assemblies	Certifications	At least 42 days before beginning construction of the wall	A	86-68120	CDMS			
04 22 10-4	Reinforced Concrete Unit Masonry Assemblies	Mix Design	At least 42 days before beginning construction of the wall	A	86-68120	CDMS			
04 22 10-5	Reinforced Concrete Unit Masonry Assemblies	Instructions	At least 42 days before beginning construction of the wall	A	86-68120	CDMS			
05 12 10-1	Structural Steel	Dimensional Drawings	At least 42 days before fabrication	A	86-68120	CDMS			
05 12 10-2	Structural Steel	Detail Drawings and Data	At least 63 days before fabrication	A	86-68120	CDMS			
05 12 10-3	Structural Steel	Test Reports	At least 42 days before fabrication	A	86-68120	CDMS			
05 12 10-4	Structural Steel	Final Drawings and Data	At least 42 days before fabrication	A	86-68120	CDMS			
05 12 10-5	Structural Steel	Fabrication Data for Crane Girders	At least 42 days before fabrication	A	86-68120	CDMS			
05 15 24-1	Secondary Framing	Approval Drawings and Data	At least 42 days before installing framing	A	86-68120	CDMS			
05 15 24-2	Secondary Framing	Certifications	At least 42 days before installing framing	A	86-68120	CDMS			

Table 01 33 00A. - List of Submittals

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RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	No. of sets to be sent to: **			
						CO	CE	TSC	Gallup
05 15 24-3	Secondary Framing	Erection Plans and Manual	At least 42 days before installing framing	A	86-68120	CDMS			
05 15 24-4	Secondary Framing	Documentation	At least 42 days before installing framing	A	86-68120	CDMS			
05 21 00-1	Steel Joists	Approval Drawings and Data	At least 42 days before fabricating joists	A	86-68120	CDMS			
05 21 00-2	Steel Joists	Welder Qualifications	At least 42 days before fabricating joists	A	86-68120	CDMS			
05 21 00-3	Steel Joists	Inspection Report	Within 30 days of completing inspection	A	86-68120	CDMS			
05 30 00-1	Metal Roof Deck	Approval Drawings and Data	At least 42 days before installing roof deck	A	86-68120	CDMS			
05 30 00-2	Metal Roof Deck	Welder Qualifications	At least 42 days before installing roof deck	A	86-68120	CDMS			
05 40 00-1	Cold-Formed Metal Framing	Approval Drawings and Data	At least 42 days before installing framing	A	86-68120	CDMS			
05 40 00-2	Cold-Formed Metal Framing	Certifications	At least 42 days before installing framing	A	86-68120	CDMS			
05 40 00-3	Cold-Formed Metal Framing	Erection Plans and Manual	At least 42 days before installing framing	A	86-68120	CDMS			
07 19 20-1	Silane Water Repellent	Approval Data	At least 42 days before applying repellent	A	86-68120	CDMS			
07 19 20-2	Silane Water Repellent	Instructions	At least 42 days before applying repellent	A	86-68120	CDMS			
07 19 20-3	Silane Water Repellent	Documentation	At least 42 days before applying repellent	A	86-68120	CDMS			
07 21 13-1	Sound Control Batt Insulation	Approval Data	At least 42 days before installing insulation	A	86-68120	CDMS			
07 21 13-2	Sound Control Batt Insulation	Instructions	At least 42 days before installing insulation	A	86-68120	CDMS			
07 21 50-1	Spray-Applied Polyurethane Foam Insulation	Approval Data	At least 42 days before installing insulation	A	86-68120	CDMS			
07 21 50-2	Spray-Applied Polyurethane Foam Insulation	Instructions	At least 42 days before installing insulation	A	86-68120	CDMS			
07 21 50-3	Spray-Applied Polyurethane Foam Insulation	Documentation	At least 42 days before installing insulation	A	86-68120	CDMS			
07 21 60-1	Insulation Jacket	Approval Data	At least 42 days before installing insulation	A	86-68120	CDMS			
07 21 60-2	Insulation Jacket	Instructions	At least 42 days before installing insulation	A	86-68120	CDMS			

Table 01 33 00A. - List of Submittals

* Submittal types: A – Action, I – Information

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RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	No. of sets to be sent to: **			
						CO	CE	TSC	Gallup
07 41 13-1	Preinsulated Metal Roof Panels	Sample and Color Sample Kit	At least 42 days before installing panels	A	86-68120	0	1	1	0
07 41 13-2	Preinsulated Metal Roof Panels	Product Data and Shop Drawings	At least 42 days before installing panels	A	86-68120	CDMS			
07 41 13-3	Preinsulated Metal Roof Panels	Closeout Maintenance Data	Within 14 days of installing panels	A	86-68120	CDMS			
07 41 15-1	Removable Roof Cover	Sample and Color Sample Kit	At least 42 days before installing cover	A	86-68120	0	1	1	0
07 41 15-2	Removable Roof Cover	Product Data and Shop Drawings	At least 42 days before installing cover	A	86-68120	CDMS			
07 42 13-1	Preinsulated Metal Wall Panels	Sample and Color Sample Kit	At least 42 days before installing panels	A	86-68120	0	1	1	0
07 42 13-2	Preinsulated Metal Wall Panels	Product Data and Shop Drawings	At least 42 days before installing panels	A	86-68120	CDMS			
07 42 13-3	Preinsulated Metal Wall Panels	Closeout Maintenance Data	Within 14 days of installing panels	A	86-68120	CDMS			
07 92 00-1	Pumping Plant Expansion Joint	Approval Data	At least 42 days before installing joint	A	86-68120	0	1	1	0
07 92 00-2	Pumping Plant Expansion Joint	Instructions	At least 42 days before installing joint	A	86-68120	CDMS			
08 11 10-1	Steel Doors and Frames	Approval Drawings and Data	At least 42 days before installing doors	A	86-68120	CDMS			
08 11 10-2	Steel Doors and Frames	Instructions	At least 42 days before installing doors	A	86-68120	CDMS			
08 33 19-1	Industrial Doors	Approval Drawings, Data, and Color Charts	At least 42 days before installing doors	A	86-68120	CDMS			
08 33 19-2	Industrial Doors	Certification	At least 42 days before installing doors	A	86-68120	CDMS			
08 33 19-3	Industrial Doors	Instructions	At least 42 days before installing doors	A	86-68120	CDMS			
08 33 19-4	Industrial Doors	Check Prints	At same time as equipment is shipped	I	CE	Ship with equipment			
08 51 23-1	Steel Windows	Approval Drawings and Data	At least 42 days before installing windows	A	86-68120	CDMS			
08 62 00-1	Unit Skylights	Approval Drawings and Data	At least 42 days before installing skylight	A	86-68120	CDMS			

Table 01 33 00A. - List of Submittals

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RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	No. of sets to be sent to: **			
						CO	CE	TSC	Gallup
08 62 00-2	Unit Skylights	Instructions	At least 42 days before installing skylight	A	86-68120	CDMS			
08 71 00-1	Door Hardware	Approval Data	At least 42 days before installing hardware	A	86-68120	CDMS			
08 71 00-2	Door Hardware	Instructions	At least 42 days before installing hardware	A	86-68120	CDMS			
09 29 00-1	Gypsum Board	Approval Data	At least 42 days before installing gypsum	A	86-68120	CDMS			
09 30 00-1	Fiber Reinforced Wall Panel	Approval Data and Color Sample Kits	At least 42 days before installing panel	A	86-68120	0	1	1	0
09 30 00-2	Fiber Reinforced Wall Panel	Instructions	At least 42 days before installing panel	A	86-68120	CDMS			
09 65 10-1	Rubber Wall Base	Approval Data and Color Sample Kits	At least 42 days before installing tile	A	86-68120	0	1	1	0
09 65 10-2	Rubbert Wall Base	Instructions	At least 42 days before installing tile	A	86-68120	CDMS			
09 91 10-1	Coatings for Concrete, Masonry, and Gypsum Board	Approval Data	At least 42 days before beginning coating work	A	86-68180	0	1	1	0
09 91 10-2	Coatings for Concrete, Masonry, and Gypsum Board	Final Approval Data	At least 42 days before beginning coating work	A	86-68180	CDMS			
09 91 10-3	Coatings for Concrete, Masonry, and Gypsum Board	Documentation	At least 42 days before beginning coating work	A	86-68180	CDMS			
09 96 20-1	Coatings	Approval Data	At least 42 days before beginning coating work	A	86-68180	CDMS			
09 96 20-2	Coatings	Final Approval Data	At least 42 days before beginning coating work	A	86-68180	CDMS			
09 96 20-3	Coatings	Certifications	At least 42 days before beginning coating work	A	86-68180	CDMS			
09 96 20-4	Coatings	Documentation	At least 42 days before beginning coating work	A	86-68180	CDMS			
09 96 20-5	Coatings	Contractor Quality Testing Data	At least 14 days of completing testing	A	86-68180	CDMS			
09 96 21-1	Coating Concrete or Steel Tanks	Approval Data	At least 42 days before beginning coating work	A	86-68180	CDMS			
09 96 21-2	Coating Concrete or Steel Tanks	Final Approval Data	At least 42 days before beginning coating work	A	86-68180	CDMS			

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						CO	CE	TSC	Gallup
09 96 21-3	Coating Concrete or Steel Tanks	Certifications	At least 42 days before beginning coating work	A	86-68180	CDMS			
09 96 21-4	Coating Concrete or Steel Tanks	Documentation	At least 42 days before beginning coating work	A	86-68180	CDMS			
09 96 21-5	Coating Concrete or Steel Tanks	Contractor Quality Testing Data	At least 14 days of completing testing	A	86-68180	CDMS			
10 28 13-1	Toilet Accessories	Approval Data	At least 42 days before installation of accessories	A	86-68120	CDMS			
10 28 13-2	Toilet Accessories	Instructions	At least 42 days before installation of accessories	A	86-68120	CDMS			
10 44 20-1	Fire Extinguishers	Approval Data	At least 42 days before procurement	A	86-68410	CDMS			
10 51 00-1	Lockers	Approval Data and Color Sample Kit	At least 42 days before procurement	A	86-68120	0	1	1	0
21 22 00-1	Clean Agent Fire Extinguishing System	Approval Drawings and Data	At least 42 days before procurement	A	86-68410	CDMS			
21 22 00-2	Clean Agent Fire Extinguishing System	Final Drawings and Data	Within 14 days after completing installation and testing	I	86-68410	CDMS			
21 22 00-3	Clean Agent Fire Extinguishing System	Test Reports	Within 7 days after completing tests	I	86-68410	CDMS			
22 11 10-1	Plant Auxiliary Water Systems	Approval Data	At least 42 days before procurement	A	86-68410	CDMS			
22 11 10-2	Plant Auxiliary Water Systems	Test Plan	At least 42 days before procurement	A	86-68410	CDMS			
22 11 10-3	Plant Auxiliary Water Systems	Final Drawings and Data	Within 14 days after completing installation and testing	I	86-68410	CDMS			
22 13 13-1	On-site Sewage Disposal System	Product Approval Data	At least 42 days before procurement	A	86-68410	CDMS			
22 13 13-2	On-site Sewage Disposal System	Test Report	Within 7 days after completing tests	I	86-68410	CDMS			
22 13 13-3	On-site Sewage Disposal System	O&M Manual	Within 7 days after completing installation and testing	I	86-68410	CDMS			

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						CO	CE	TSC	Gallup
22 13 13-4	On-site Sewage Disposal System	As-built Drawings	Within 14 days after completing installation and testing	I	86-68410	CDMS			
22 13 16-1	Plant Drain, Waste, and Vent Piping Systems	Approval Drawings and Data	At least 42 days before procurement	A	86-68410	CDMS			
22 13 16-2	Plant Drain, Waste, and Vent Piping Systems	Test Plan	At least 42 days before procurement	A	86-68410	CDMS			
22 13 16-3	Plant Drain, Waste, and Vent Piping Systems	Final Drawings and Data	Within 14 days after completing installation and testing	I	86-68410	CDMS			
22 14 30-1	Sump Pumping Systems	Approval Data	At least 42 days before procurement	A	86-68410	CDMS			
22 14 30-2	Sump Pumping Systems	Check Prints	At same time as equipment is shipped to site	I	CE	Ship with equipment			
22 14 30-3	Sump Pumping Systems	Test Plan	At least 42 days before procurement	A	86-68410	CDMS			
22 14 30-4	Sump Pumping Systems	Final Drawings and Data	Within 14 days after completing installation and testing	I	86-68410	CDMS			
22 15 10-1	Compressed Air System	Approval Drawings and Data	At least 42 days before procurement	A	86-68410	CDMS			
22 15 10-2	Compressed Air System	Check Prints	At same time as equipment is shipped to the site	I	CE	Ship with equipment			
22 15 10-3	Compressed Air System	Test Plan	At least 42 days before procurement	A	86-68410	CDMS			
22 15 10-4	Compressed Air System	Final Drawings and Data	Within 14 days after completing installation and testing	I	86-68410	CDMS			
22 42 10-1	Plumbing Fixtures	Approval Data	At least 42 days before procurement	A	86-68410	CDMS			
22 42 10-2	Plumbing Fixtures	Final Data	Within 14 days after completing installation and testing	I	86-68410	CDMS			
23 05 29–1	Supports For Exterior HVAC Duct	Approval Data	At least 42 days before procurement	A	86-68410	CDMS			
23 05 48–1	Vibration And Seismic Controls For Hvac Piping And Equipment	Approval Data	At least 42 days before procurement	A	86-68410	CDMS			

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						CO	CE	TSC	Gallup
23 05 48–2	Vibration And Seismic Controls For Hvac Piping And Equipment	Final Data	Within 14 days after completing installation and testing	I	86-68410	CDMS			
23 05 53-1	Identification - HVAC	Approval Data	At least 42 days before procurement	A	86-68410	CDMS			
23 05 93-1	Testing, Adjusting and Balancing for HVAC	Final Data	Within 14 days after completing installation and testing	I	86-68410	CDMS			
23 07 13-1	Duct Wrap Insulation	Approval Data	At least 42 days before procurement	A	86-68410	CDMS			
23 09 00-1	Instrumentation and Control for HVAC	Approval Drawings and Data	At least 42 days before procurement	A	86-68410	CDMS			
23 09 00-2	Instrumentation and Control for HVAC	Check Prints	When the equipment is shipped to the site	I	CE	Ship with equipment			
23 09 00-3	Instrumentation and Control for HVAC	Final Data and Drawings	Within 14 days after completing installation and testing	I	86-68410	CDMS			
23 33 00-1	Air Duct Accessories	Approval Data	At least 42 days before procurement	A	86-68410	CDMS			
23 33 13-1	Draft Control Damper	Approval Data	At least 42 days before installing draft damper	A	CE	CDMS			
23 33 13-2	Draft Control Damper	Final Data	Within 14 days after completing installation and testing	I	CE	CDMS			
23 34 00-1	HVAC Fans	Approval Data	At least 42 days before procurement	A	86-68410	CDMS			
23 34 00-2	HVAC Fans	Final Data	Within 14 days after completing installation and testing	I	86-68410	CDMS			
23 37 00-1	Air Inlets and Outlets	Approval Data	At least 42 days before procurement	A	86-68410	CDMS			
23 37 00-2	Air Inlets and Outlets	Sample Color Kit	At least 42 days before procurement	A	86-68120	0	1	1	0
23 37 00-3	Air Inlets and Outlets	Final Data	Within 14 days after completing installation and testing	I	86-68410	CDMS			
23 73 39-1	Evaporative Cooling HVAC Units	Approval Drawings and Data	At least 42 days before procurement	A	86-68410	CDMS			

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						CO	CE	TSC	Gallup
23 73 39-2	Evaporative Cooling HVAC Units	Check Prints	At same time as equipment is shipped to the site	I	CE	Ship with equipment			
23 73 39-3	Evaporative Cooling HVAC Units	Final Drawings and Data	Within 14 days after completing installation and testing	I	86-68410	CDMS			
23 81 00-1	Direct Expansion Refrigeration Air Conditioners	Approval Drawings and Data	At least 42 days before procurement	A	86-68410	CDMS			
23 81 00-2	Direct Expansion Refrigeration Air Conditioners	Check Prints	At same time as equipment is shipped to the site	I	CE	Ship with equipment			
23 81 00-3	Direct Expansion Refrigeration Air Conditioners	Final Drawings and Data	Within 14 days after completing installation and testing	I	86-68410	CDMS			
23 82 39-1	Electric Heat Units	Approval Data and Drawings	At least 42 days before procurement	A	86-68410	CDMS			
23 82 39-2	Electric Heat Units	Check Prints	At same time as equipment is shipped to the site	I	CE	Ship with equipment			
23 82 39-3	Electric Heat Units	Final Data and Drawings	Within 14 days after completing installation and testing	I	86-68410	CDMS			
25 00 01-1	System Control and Monitoring	Approval Data – Monitoring and Control Systems Technical Specialist Work Summary	Within 70 days after Notice to Proceed	A	86-68450	CDMS			
25 00 01-2	System Control and Monitoring	Approval Drawings and Data	At least 42 days before procurement	A	86-68450	CDMS			
25 00 01-3	System Control and Monitoring	Approval Data – Software Development Documentation	Within 120 days after notice to proceed	A	86-68450	CDMS			
25 00 01-4	System Control and Monitoring	Approval Data – Design Coordination Meeting Agenda	At least 14 days before meeting	A	86-68450	CDMS			
25 00 01-5	System Control and Monitoring	Check Prints	At the same time as equipment is shipped to the site	A	86-68450	Ship with Equipment			

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						CO	CE	TSC	Gallup
25 00 01-6	System Control and Monitoring	Approval Data – Final Drawings, Documentation, and Operations and Maintenance Manuals	Within 35 days after system performance availability test	I	CE	0	4	1	0
25 00 02-1	Programmable Controller	Approval Drawings	At least 42 days before procurement	A	86-68450	CDMS			
25 00 02-2	Programmable Controller	Approval Data	Within 120 days after notice to proceed	A	86-68450	CDMS			
25 00 02-3	Programmable Controller	Final Drawings, Documentation, and Operation and Maintenance Manuals	At least 42 days before procurement	I	86-68450	CDMS			
25 08 10-1	Automation System Testing, Acceptance, and Training	FAT Procedure and Start Date	At least 42 days before FAT.	A	86-68450	CDMS			
25 08 10-2	Automation System Testing, Acceptance, and Training	FAT Test Report	Within 14 days of completing tests	A	86-68450	CDMS			
25 08 10-3	Automation System Testing, Acceptance, and Training	SPAT Procedure and Start Date	At least 42 days before SPAT.	A	86-68450	CDMS			
25 08 10-4	Automation System Testing, Acceptance, and Training	Spat Test Report	Within 14 days of completing tests	I	86-68450	CDMS			
25 08 10-5	Automation System Testing, Acceptance, and Training	OAT Procedure and Start Date	At least 42 days before OAT	A	86-68450	CDMS			
25 08 10-6	Automation System Testing, Acceptance, and Training	OAT Report	Within 14 days of completing tests	I	86-68450	CDMS			
25 08 10-7	Automation System Testing, Acceptance, and Training	Training Plan	At least 42 days before the training	A	86-68450	CDMS			
26 05 10-1	Conductors and Cables	Approval Data	Within 42 days after Notice to proceed	A	86-68430	CDMS			

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						CO	CE	TSC	Gallup
26 05 10-2	Conductors and Cables	Field Test Reports	Within 28 days after tests are completed	I	86-68430	CDMS			
26 05 13-1	Medium Voltage Power Cables	Approval Drawings and Data	Within 56 days after Notice to proceed	A	86-68430	CDMS			
26 05 13-2	Medium Voltage Power Cables	Field Test Reports	Within 28 days after tests are completed	I	86-68430	CDMS			
26 05 20-1	Grounding and Bonding	Approval Drawings and Data	Within 42 days after Notice to proceed	A	86-68430	CDMS			
26 05 20-2	Grounding and Bonding	As-built Drawings	Within 21 days after construction is completed	I	CE	CDMS			
26 05 20-3	Grounding and Bonding	Test Reports	Within 28 days after tests are completed	I	86-68430	CDMS			
26 05 33-1	Raceways and Boxes	Approval Drawings and Data	Within 42 days after Notice to proceed	A	86-68430	CDMS			
26 05 33-2	Raceways and Boxes	As-built Drawings	Within 21 days after installation of conduit	I	CE	CDMS			
26 12 19-1	Pad Mounted Transformer	Approval Drawings and Data	Within 56 days of Notice to Proceed	A	86-68430	CDMS			
26 12 19-2	Pad Mounted Transformer	Approval Drawings	Within 70 days after Notice to Proceed	A	86-68430	CDMS			
26 12 19-3	Pad Mounted Transformer	Factory Test Report	Within 14 days after tests are completed	I	86-68430	CDMS			
26 12 19-4	Pad Mounted Transformer	Field Test Report	Within 28 days after tests are completed	I	86-68430	CDMS			
26 12 19-5	Pad Mounted Transformer	Final Drawings	Within 28 days after installation of equipment	I	86-68430	CDMS			
26 12 19-6	Pad Mounted Transformer	Operation and Maintenance Instruction Book	Within 35 days after installation of equipment	I	CE	0	4	1	0
26 17 20-1	Metal-Clad Switchgear, UXA	Approval Drawings and Data	Within 70 days after Notice to proceed	A	86-68430	CDMS			
26 17 20-2	Metal-Clad Switchgear, UXA	Wiring Diagrams	Within 105 days after Notice to proceed	A	86-68430	CDMS			
26 17 20-3	Metal-Clad Switchgear, UXA	Check Prints	At same time as equipment is shipped to the site	I	CE	Shipped with equipment			
26 17 20-4	Metal-Clad Switchgear, UXA	Factory Test Reports	Within 28 days after tests are completed	I	86-68430	CDMS			

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						CO	CE	TSC	Gallup
26 17 20-5	Metal-Clad Switchgear, UXA	Field Test Reports	Within 28 days after tests are completed	I	86-68430	CDMS			
26 17 20-6	Metal-Clad Switchgear , UXA	Final Drawings	Within 28 days after installation of equipment	I	86-68430	CDMS			
26 17 20-7	Metal-Clad Switchgear, UXA	Operation and Maintenance Instruction Book	Within 35 days after installation of equipment	I	86-68430	CDMS			
26 18 39-1	Medium-Voltage Motor Controllers	Approval Data	Within 70 days after Notice to proceed	A	86-68430	CDMS			
26 18 39-2	Medium-Voltage Motor Controllers	Approval Drawings: Layouts, Nameplate List, Bill of Materials	Within 70 days after Notice to proceed	A	86-68430	CDMS			
26 18 39-3	Medium-Voltage Motor Controllers	Approval Drawings: Schematic Diagrams	Within 84 days after Notice to proceed	A	86-68430	CDMS			
26 18 39-4	Medium-Voltage Motor Controllers	Time-Current Characteristic Curves	Within 112 days after Notice to proceed	I	86-68430	CDMS			
26 18 39-5	Medium-Voltage Motor Controllers	Approval Drawings: Wiring Diagrams	Within 112 days after Notice to proceed	A	86-68430	CDMS			
26 18 39-6	Medium-Voltage Motor Controllers	Check Prints	At same time as equipment is shipped to the site	I	CE	Shipped with equipment			
26 18 39-7	Medium-Voltage Motor Controllers	Factory Test Report	Within 28 days after tests are completed	I	86-68430	CDMS			
26 18 39-8	Medium-Voltage Motor Controllers	Field Test Report	Within 28 days after tests are completed	I	86-68430	CDMS			
26 18 39-9	Medium-Voltage Motor Controllers	Final Drawings	Within 28 days after installation of equipment	I	86-68430	CDMS			
26 18 39-10	Medium-Voltage Motor Controllers	Operation and Maintenance Instruction Book	Within 35 days after installation of equipment	I	86-68430	CDMS			

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						CO	CE	TSC	Gallup
26 22 12-1	Dry-Type Transformer, KCA & KCB	Approval Data	Within 56 days after Notice to proceed	A	86-68430	CDMS			
26 22 12-2	Dry-Type Transformer, KCA & KCB	Operation and Maintenance Instruction Book	Within 35 days after installation of equipment	I	86-68430	CDMS			
26 24 13-1	Switchboards, DCA	Approval Drawings and Data in Manufacturer's Format	Within 56 days after Notice to Proceed	A	86-68430	CDMS			
26 24 13-2	Switchboards, DCA	Approval Drawings in Government Format	Within 70 days after Notice to Proceed	A	86-68430	CDMS			
26 24 13-3	Switchboards, DCA	Factory Test Report	Within 14 days after tests are completed	I	86-68430	CDMS			
26 24 13-4	Switchboards, DCA	Check Prints	At same time as equipment is shipped to the site	I	CE	Shipped with equipment			
26 24 13-5	Switchboards, DCA	Final Drawings	Within 28 days after installation of equipment	I	86-68430	CDMS			
26 24 13-6	Switchboards, DCA	Operation and Maintenance Instruction Book	Within 35 days after installation of equipment	I	CE	CDMS			
26 24 20-1	Control Boards	Approval Data	Within 70 days after Notice to proceed	A	86-68430	CDMS			
26 24 20-2	Control Boards	Approval Drawings	Within 70 days after Notice to proceed	A	86-68430	CDMS			
26 24 20-3	Control Boards	Final Drawings	Within 28 days after installation of equipment	I	86-68430	CDMS			
26 24 20-4	Control Boards	Operation and Maintenance Instruction Book	Within 35 days after installation of equipment	I	86-68430	CDMS			
26 24 41-1	Distribution Panelboards	Approval Data	Within 56 days after Notice to proceed	A	86-68430	CDMS			
26 24 41-2	Distribution Panelboards	Approval Layouts	Within 56 days after Notice to proceed	A	86-68430	CDMS			
26 24 41-3	Distribution Panelboards	Test Data	Within 14 days after passing test completion	I	86-68430	CDMS			
26 27 16-1	Electrical Cabinets and Enclosures	Approval Data and Drawings	Prior to purchase of enclosure	A	86-68430	CDMS			

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						CO	CE	TSC	Gallup
26 27 40-1	Wiring Devices	Approval Data	Within 56 days after Notice to Proceed	A	86-68430	CDMS			
26 32 10-1	Engine-Generator Set	Approval Drawings and Data for Engine-Generator Set	At least 42 days before procurement	A	86-68410	CDMS			
26 32 10-2	Engine-Generator Set	Approval Drawings and Data for Propane Fuel System	At least 42 days before procurement	A	86-68410	CDMS			
26 32 10-3	Engine-Generator Set	Check Prints	At same time as equipment is shipped to the site	I	CE	Shipped with equipment			
26 32 10-4	Engine-Generator Set	Final Drawings and Data	Before shipment to site	I	86-68410	CDMS			
26 32 10-5	Engine-Generator Set	Site Test Report and Photographs	Within 28 days of completing testing	I	86-68410	CDMS			
26 42 10-1	Buried Impressed Current Cathodic Protection and Corrosion Monitoring Systems	Certification and Data	At least 42 days before procuring materials	A	86-68180	CDMS			
26 42 10-2	Buried Impressed Current Cathodic Protection and Corrosion Monitoring Systems	Final Data	Within 28 days of final testing	A	86-68180	CDMS			
26 42 11-1	Submerged Galvanic Anode Cathodic Protection System	Certification and Data	At least 42 days before procuring materials	A	86-68180	CDMS			
26 42 11-2	Submerged Galvanic Anode Cathodic Protection System	Final Data	Within 28 days of final testing	A	86-68180	CDMS			

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						CO	CE	TSC	Gallup
26 42 12-1	Buried Galvanic Cathodic Protection and Corrosion Monitoring System	Certification and Data	At least 42 days before procuring materials	A	86-68180	CDMS			
26 42 12-2	Buried Galvanic Cathodic Protection and Corrosion Monitoring System	Final Data	Within 28 days of final testing	A	86-68180	CDMS			
26 51 00-1	Interior Lighting	Approval Data	Within 56 days after Notice to proceed	A	86-68430	CDMS			
26 51 00-2	Interior Lighting	As-built Drawings	Within 35 days after installation of equipment	A	86-68430	CDMS			
26 52 00-1	Emergency and Exit Lighting	Approval Data	Within 56 days after Notice to proceed	A	86-68430	CDMS			
26 52 00-2	Emergency and Exit Lighting	As-built Drawings	Within 35 days after installation of equipment	A	86-68430	CDMS			
26 56 00-1	Exterior Lighting	Approval Data	Within 56 days after Notice to proceed	A	86-68430	CDMS			
26 56 00-2	Exterior Lighting	As-built Drawings	Within 35 days after installation of equipment	A	86-68430	CDMS			
27 15 00-1	Communications Cabling	Approval Data	Within 70 days after Notice to proceed	A	86-68450	CDMS			
27 20 01-1	Radio Equipment	Approval Drawings and Data	Within 70 days after Notice to proceed		86-68450	CDMS			
27 20 01-2	Radio Equipment	Check Prints	At same time as equipment is shipped to the site	I	CE	Shipped with equipment			
27 20 01-3	Radio Equipment	Operations and Maintenance Manual	Within 70 days after Notice to proceed	I	CE	0	4	1	0
27 30 01-1	Telephone System	Approval Drawings and Data	Within 70 days after Notice to proceed	A	86-68450	CDMS			
27 30 01-2	Telephone System	Check Prints	At same time as equipment is shipped to the site	I	CE	Shipped with equipment			

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						CO	CE	TSC	Gallup
27 30 01-3	Telephone System	Operations and Maintenance Manual	Within 70 days after Notice to proceed	I	CE	0	4	1	0
27 30 01-4	Telephone System	Field Operational Checkout Test Report	Within 28 days of completing test	I	86-68450	CDMS			
28 10 01-1	Security and Surveillance Equipment	Approval Drawings and Data	Within 70 days after Notice to proceed	A	86-68450	CDMS			
28 10 01-2	Security and Surveillance Equipment	Test Procedure and Start Date	Within 70 days after Notice to proceed	A	86-68450	CDMS			
28 10 01-3	Security and Surveillance Equipment	Test Report	Within 28 days after completion of test	I	86-68450	CDMS			
28 10 01-4	Security and Surveillance Equipment	Check Prints	At same time as equipment is shipped to the site	I	CE	Shipped with equipment			
28 10 01-5	Security and Surveillance Equipment	Final Drawings and Operations and Maintenance Manuals	Within 28 days after completion of tests	I	CE	0	4	1	0
28 31 00-1	Fire Detection and Alarm	Approval Data	Within 56 days after Notice to proceed	A	86-68430	CDMS			
28 31 00-2	Fire Detection and Alarm	Testing Notification	At least 30 days prior to testing date	I	CO	CDMS			
28 31 00-3	Fire Detection and Alarm	Test Reports	Within 14 days after test completion	A	CO	CDMS			
28 31 00-4	Fire Detection and Alarm	As-built Drawings	Within 35 days after installation of equipment	A	86-68430	CDMS			
28 31 00-5	Fire Detection and Alarm	Operations and Maintenance Instruction Book	At least 30 days prior to on-site training	A	86-68430	CDMS			
31 02 30-1	Dust Palliative	Dust Palliative	At least 42 days before beginning on-site work	A	CE	CDMS			
31 03 33-1	Removal of Water from Excavation	Removal of water plan	At least 42 days before beginning on-site work	A	CE	CDMS			
31 23 02-1	Compacting Earth Materials	Test Results	Within 7 days after completion of tests	I	CE	CDMS			
31 23 10-1	Earthwork	Processing Plan	At least 42 days before beginning on-site work	A	CE	CDMS			

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						CO	CE	TSC	Gallup
31 23 39-1	Disposal of Excavated Materials	Agreement and Permits	At least 42 days before beginning on site work.	A	CE	CDMS			
31 23 70-1	Controlled Low strength Material (CLSM)	Approval Data	At least 42 days before beginning on-site work	A	CE	CDMS			
31 23 70-2	Controlled Low strength Material (CLSM)	On-site Mix Design (if mixing on-site)	At least 42 days before beginning on-site work	A	CE	CDMS			
31 23 70-3	Controlled Low strength Material (CLSM)	Trial Test Results	Within 7 days after completion of test	A	CE	CDMS			
31 23 70-4	Controlled Low strength Material (CLSM)	Quality Control Test Results	Within 7days after completion of test	I	CE	CDMS			
31 23 70-5	Controlled Low strength Material (CLSM)	Revised Mix Design	Within 2 days of failing test results	A	CE	CDMS			
31 24 15-1	Gravel Drain	Source of Materials	At least 42 days before beginning on-site work	A	CE	CDMS			
31 24 15-2	Gravel Drain	Pipe Data	At least 42 days before beginning on-site work	A	CE	CDMS			
31 24 15-3	Gravel Drain	Certification and Test Results	Within 28 days after completion of tests	I	CE	CDMS			
31 31 30-1	Soil-Applied Herbicide	Use Plan	At least 42 days before beginning on-site work	A	CE	CDMS			
31 31 30-2	Soil-Applied Herbicide	Applicator Certification	At least 42 days before beginning on-site work	A	CE	CDMS			
31 37 00-1	Grouted Cobble	Approval Data and Test Results	At least 42 days before beginning on-site work	A	CE	CDMS			
32 15 10-1	Gravel Surfacing	Installation	At least 42 days before placing surfacing.	A	CE	CDMS			
32 15 10-2	Gravel Surfacing	Certifications	At least 42 days before placing surfacing.	A	CE	CDMS			
32 31 10-1	Chain Link Fence	Certification	At least 42 days before installing fencing	A	CE	CDMS			
32 31 70-1	Cattle Guards	Drawings and Data	At least 42 days before installing cattle guards	A	CE	CDMS			
32 91 60-1	Erosion Control Blanket	Manufacturer's Information	At least 42 days before placing blanket	A	CE	CDMS			
32 91 60-2	Erosion Control Blanket	Installation Plan	At least 42 days before placing blanket	A	CE	CDMS			
32 92 20-1	Seeding	Seeding Plan	At least 42 days before seeding	A	CE	CDMS			

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						CO	CE	TSC	Gallup
32 92 10-2	Seeding	Certifications	At least 42 days before seeding	A	CE	CDMS			
33 05 22-1	Bored Road Crossings	Placement Plan	At least 42 days prior to beginning work	A	CE	CDMS			
33 05 22-2	Bored Road Crossings	Material Certification	At least 42 days prior to beginning work	I	CE	CDMS			
33 05 22-3	Bored Road Crossing	Copy of Application for Utility Permit	Prior to beginning work	I	CE	CDMS			
33 09 12-1	Magnetic Flowmeter Systems	Approval Data	At least 42 days before procurement	A	86-68410	CDMS			
33 09 12-2	Magnetic Flowmeter Systems	Check Prints	At same time as equipment is shipped to the site	I	CE	Shipped with equipment			
33 09 12-3	Magnetic Flowmeter Systems	Final Data	Before shipment to site	I	86-68410	CDMS			
33 09 12-4	Magnetic Flowmeter Systems	Simulated Test Report	Within 15 days of complication of tests	I	86-68410	CDMS			
33 11 10-1	Pipeline General Requirements	Qualifications	At least 42 days before pipe fabrication or procurement.	A	86-68140	CDMS			
33 11 10-2	Pipeline General Requirements	Pipelaying Diagrams	At least 42 days before pipe fabrication or procurement.	A	86-68140	CDMS			
33 11 10-3	Pipeline General Requirements	Use in a Public Water System Certification	At least 42 days before pipe fabrication or procurement.	A	86-68140	CDMS			
33 11 10-4	Pipeline General Requirements	Flotation Prevention Plan	At least 42 days before pipe fabrication or procurement.	A	86-68140	CDMS			
33 11 10-5	Pipeline General Requirements	Safety Plan	At least 42 days before pipe fabrication or procurement.	A	86-68140	CDMS			
33 11 10-6	Pipeline General Requirements	Filling and Testing Plan and Inspection Plan	At least 42 days before pipe fabrication or procurement.	A	86-68140	CDMS			
33 11 10-7	Pipeline General Requirements	Field Inspection Video	Within 7 days of recording	A	CE	0	1	0	0
33 11 10-8	Pipeline General Requirements	Final Inspection Video	Within 7 days of recording	A	CE	0	1	0	0

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						CO	CE	TSC	Gallup
33 11 11-1	Steel Line Pipe	Shop Drawings and Data	At least 42 days before f pipe fabrication or procurement.	A	86-68140	CDMS			
33 11 12-1	PVC Pressure Pipe (If used)	Shop Drawings	At least 42 days before pipe fabrication or procurement.	A	86-68140	CDMS			
33 11 13-1	Ductile Iron Pipe (If used)	Shop Drawings	At least 42 days before pipe fabrication or procurement.	A	86-68140	CDMS			
33 11 14-1	HDPE Pressure Pipe (If used)	Fitting Details	At least 42 days before pipe fabrication or procurement.	A	86-68140	CDMS			
33 11 14-2	HDPE Pressure Pipe (If used)	Fusion Procedures	At least 42 days before pipe fabrication or procurement.	A	86-68140	CDMS			
33 11 16-1	Site Utility Piping	Pipe Layout Drawings	At least 42 days before pipe fabrication or procurement.	A	86-68120	CDMS			
33 11 16-2	Site Utility Piping	Product Approval Data	At least 42 days before pipe fabrication or procurement.	A	86-68120	CDMS			
33 11 16-3	Site Utility Piping	Final Data	Within 28 days of installation of pipe	A	86-68120	CDMS			
33 12 73-1	Horizontal Centrifugal Pumping Units	Pump Approval Data and Drawings	Within 70 days after Notice to proceed	A	86-68420	CDMS			
33 12 73-2	Horizontal Centrifugal Pumping Units	Seismic Calculations	Within 70 days after Notice to proceed	I	86-68420	CDMS			
33 12 73-3	Horizontal Centrifugal Pumping Units	Motor Equipment Approval Data	Within 70 days after Notice to proceed	A	86-68420	CDMS			
33 12 73-4	Horizontal Centrifugal Pumping Units	Motor Approval Data and Drawings	Within 70 days after Notice to proceed	A	86-68420	CDMS			
33 12 73-5	Horizontal Centrifugal Pumping Units	Pump Certified Shop Test Data and Reports	Within 70 days after Notice to proceed	A	86-68420	CDMS			
33 12 73-6	Horizontal Centrifugal Pumping Units	Motor Factory Test Report	Within 70 days after Notice to proceed	I	86-68420	CDMS			
33 12 73-7	Horizontal Centrifugal Pumping Units	Pump Final Data and Drawings	Within 70 days after Notice to proceed	A	86-68420	CDMS			

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						CO	CE	TSC	Gallup
33 12 73-8	Horizontal Centrifugal Pumping Units	Motor Check Prints	At same time as equipment is shipped to the site	I	CE	Shipped with equipment			
33 12 73-9	Horizontal Centrifugal Pumping Units	Motor Final Data and Drawings	Within 70 days after Notice to proceed	A	86-68420	CDMS			
33 12 73-10	Horizontal Centrifugal Pumping Units	Resumes and Qualifications	Within 70 days after Notice to proceed	I	86-68420	CDMS			
33 12 73-11	Horizontal Centrifugal Pumping Units	Pumping Unit Field Test Plan	Within 70 days after Notice to proceed	I	86-68420	CDMS			
33 12 73-12	Horizontal Centrifugal Pumping Units	Pumping Unit Field Test Reports	No more than 14 days after testing	I	86-68420	CDMS			
33 12 74-1	Mechanical Seal Filtration and Booster System	Approval Data	At least 42 days before procurement	A	86-68410	CDMS			
33 12 74-2	Mechanical Seal Filtration and Booster System	Check Prints	At same time as equipment is shipped to the site	I	CE	Shipped with equipment			
33 12 74-3	Mechanical Seal Filtration and Booster System	Final Data	Within 14 days after completing installation and testing	I	86-68410	CDMS			
33 12 74-4	Mechanical Seal Filtration and Booster System	Test Plan	At least 42 days before procurement	A	86-68410	CDMS			
33 16 14-1	Air Chambers	Qualifications	At least 42 days before procurement	A	86-68420	CDMS			
33 16 14-2	Air Chambers	Air Chambers Data and Drawings	At least 56 days before procurement	A	86-68420	CDMS			
33 16 14-3	Air Chambers	Air Compressors and Compressed Air Filtration System Data and Drawings	At least 56 days before procurement	A	86-68420	CDMS			
33 16 14-4	Air Chambers	Commercial Products Data	At least 56 days before procurement	A	86-68420	CDMS			
33 16 14-5	Air Chambers	Service Manuals	At least 56 days before procurement	I	86-68420	0	4	1	0
33 16 14-6	Air Chambers	Combination Air Valves	At least 56 days before procurement	A	86-68420	CDMS			

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						CO	CE	TSC	Gallup
33 16 14-7	Air Chambers	Control Cabinet Equipment Layouts, Electrical Bill of Material, Nameplate Lists, Schematic Diagrams Approval Drawings	At least 56 days before procurement	A	86-68420	CDMS			
33 16 14-8	Air Chambers	Wiring Diagrams Approval Drawings	At least 56 days before procurement	A	86-68420	CDMS			
33 16 14-9	Air Chambers	Check Prints	At same time as equipment is shipped to the site	I	CE	Shipped with equipment			
33 16 14-10	Air Chambers	Final Drawings	Within 28 days of installation	I	86-68420	CDMS			
33 16 40-1	Water Storage Tank	Designer, Erection Engineer and Contractor Qualifications	At least 56 days before procurement	A	86-68420	CDMS			
33 16 40-2	Water Storage Tank	Commercial Products Data	At least 56 days before procurement	A	86-68420	CDMS			
33 16 40-3	Water Storage Tank	Final Drawings	Within 28 days of installation	I	86-68420	CDMS			
33 16 50-1	Steel Storage Tank	Shop Drawings, Design Calculations, and Design Data	At least 56 days before procurement	A	86-68420	CDMS			
33 16 50-2	Steel Storage Tank	Welder Qualifications	At least 56 days before procurement	A	86-68420	CDMS			
33 16 50-3	Steel Storage Tank	Nondestructive Weld Test Reports	Within 28 days of test completion	I	86-68420	CDMS			
33 16 51-1	Concrete Wire Wrapped Tank	Approval Drawings and Data	At least 56 days before procurement	A	86-68120	CDMS			
33 16 51-2	Concrete Wire Wrapped Tank	Test Reports	Within 28 days of test completion	I	86-68120	CDMS			
33 16 51-3	Concrete Wire Wrapped Tank	Documentation	At least 56 days before procurement	I	86-68120	CDMS			
33 16 51-4	Concrete Wire Wrapped Tank	Final Drawings and Data	At least 56 days before procurement	I	86-68120	CDMS			
33 16 52-1	Concrete Prestressed Tank	Approval Drawings and Data	At least 56 days before procurement	A	86-68120	CDMS			

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						CO	CE	TSC	Gallup
33 16 52-2	Concrete Prestressed Tank	Test Reports	Within 28 days of test completion	I	86-68120	CDMS			
33 16 52-3	Concrete Prestressed Tank	Documentation	At least 56 days before procurement	I	86-68120	CDMS			
33 16 52-4	Concrete Prestressed Tank	Final Drawings and Data	At least 56 days before procurement	I	86-68120	CDMS			
33 82 23-1	Optical Fiber Communications Distribution Cabling	Approval Data: Manufacturer's Product Data	At least 42 days before installing cables	A	86-68450	CDMS			
33 82 23-2	Optical Fiber Communications Distribution Cabling	Approval Data: Preinstallation Test Reports	At least 42 days before installing cables	A	86-68450	CDMS			
33 82 23-3	Optical Fiber Communications Distribution Cabling	Approval Data: Post Installation Test Reports	Within 28 days of installation	I	86-68450	CDMS			
35 21 94-1	Steel Manifolds	Shop Drawings	At least 56 days before procurement	A	86-68420	CDMS			
35 21 94-2	Steel Manifolds	Commercial Products Data	At least 56 days before procurement	A	86-68420	CDMS			
35 21 94-3	Steel Manifolds	Final Drawings	Within 28 days of installation	I	86-68420	CDMS			
35 22 14-1	Valves and Equipment	Commercial Product Data	At least 42 days before fabrication or procurement.	A	86-68420	CDMS			
35-22-14-2	Valves and Equipment	Service Manuals	No more than 28 days after installation.	I	86-68420	CDMS			
35 22 14-3	Valves and Equipment	Motor-Operated Butterfly Valve Data	At least 42 days before fabrication or procurement.	A	86-68420	CDMS			
35 22 14-4	Valves and Equipment	Check Prints	At same time as equipment is shipped to the site	I	CE	Shipped with equipment			
35 22 14-5	Valves and Equipment	Motor-Operated Butterfly Valve Approval Drawings	At least 42 days before fabrication or procurement.	A	86-68420	CDMS			
35 22 14-6	Valves and Equipment	Motor-Operated Butterfly Valves Service Manuals	No more than 28 days after installation	I	86-68420	CDMS			
41 22 20-1	Overhead Traveling Crane	Approval Data	At least 42 days before procurement	A	86-68410	CDMS			

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						CO	CE	TSC	Gallup
41 22 20-2	Overhead Traveling Crane	Check Prints	At same time as equipment is shipped to the site	I	CE	Shipped with equipment			
41 22 20-3	Overhead Traveling Crane	Final Data	Within 21 days of completion of tests	I	86-68410	CDMS			
41 22 23-1	Monorail Crane	Approval Data	At least 42 days before procurement	A	86-68410	CDMS			
41 22 23-2	Monorail Crane	Final Data	Within 21 days of completion of tests	I	86-68410	CDMS			
46 31 11-1	Chlorine Feed Equipment	Approval Drawings and Data	At least 56 days before procurement	A	86-68120	CDMS			
46 31 11-2	Chlorine Feed Equipment	Check Prints	At same time as equipment is shipped to the site	I	CE	Shipped with equipment			
46 31 11-3	Chlorine Feed Equipment	Final Data and Drawings	Within 28 days of installation	I	86-68420	CDMS			
46 31 12-1	Chlorine Residual Sampling Equipment	Approval Drawings and Data	At least 56 days before procurement	A	86-68120	CDMS			
46 31 12-2	Chlorine Residual Sampling Equipment	Final Drawings and Data	Within 28 days of installation	I	86-68420	CDMS			
46 31 13-1	Chlorine Gas Containment Systems	Qualifications	At least 56 days before procurement	A	86-68120	CDMS			
46 31 13-2	Chlorine Gas Containment Systems	Approval Drawings and Data	At least 56 days before procurement	A	86-68120	CDMS			
46 31 13-3	Chlorine Gas Containment Systems	Final Drawings and Data	Within 28 days of installation	I	86-68120	CDMS			
46 31 33-1	Warning Signs	Approval Data	At least 28 days before installation	A	CE	CDMS			

END OF SECTION

SECTION 01 33 26

ELECTRICAL DRAWINGS AND DATA

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Electrical Drawings and Data:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME Y14.1 – 2005(2010)	Decimal Inch Drawing Sheet Size And Format

B. International Electrotechnical Commission

1.	IEC 61131-3 – 2013	Programmable Controllers – Part 3: Programming Languages

C. Institute of Electrical and Electronic Engineers (IEEE)

1.	IEEE 315 -1975(1993)	Graphic Symbols For Electrical And Electronics Diagrams (Including Reference Designation Class Designation Letters)

1.03 SUBMITTAL PROCEDURES

A. In addition to the requirements in Section 01 33 00 – Submittals, prepare electrical drawings and data submittals in accordance with the following.

1. General:
   a. Complete, accurate in content, and legible.
   b. Schematic and wiring diagrams made expressly for this contract. Manufacturer's typical drawings will not be accepted.
   c. After approval drawings and data have been returned approved, with or without comments, make no further changes in design without COR approval.
2. Drawings:
   a. Prepared using computer drafting equipment. Freehand sketches and hand-drafted drawings will not be accepted.
   b. Provide as PDF file.

c. Furnish with Government title block and in form as indicated on standard drawing 40-D-7102.

d. Government will provide specific title block information when drawings are submitted.

e. Indicate changes on revised drawings to distinguish them from previous submittals. Describe reasons for changes in submittal letters.

f. Ensure "As Built" wiring diagrams agree with actual equipment wiring and schematic diagrams.

g. Government may revise conductor or device designations on Contractor's drawings at no change in contract price or completion time.

3. The 1695-D-XXXX drawings included in these specifications are available in AutoCAD DWG format. The 40-D-XXXX and 104-D-XXXX drawings included in these specifications are available in Adobe PDF. With at least 14 days notice, the Government will make any drawing files available to the Contractor.

B. Approval Drawings and Manufacturer's Data:

1. General: Furnish with manufacturer's standard format, except as noted.

2. Manufacturer's Technical Catalog Data:

a. Provide technical data for each device or item of equipment.

b. Include manufacturer's name and address; catalog number, type, style, or model number; electrical ratings; and dimensions.

c. Where several items are listed on same sheet, indicate items being submitted for approval.

d. Demonstrate proposed device or item of equipment meets specifications requirements.

e. Mark catalog data sheet with appropriate Bill of Material (BOM) item number.

f. Assemble catalog data sheets into one enclosing cover with BOM index.

3. Equipment Layout Drawings:

a. Indicate dimensions of equipment.

b. Indicate location of devices and items of equipment including nameplates, terminal blocks, wiring ducts, bus, conduit entries, and other features in their relative physical location.

c. Indicate method of securing equipment to floor, or wall. Include dimensioned drawing of equipment channel base for floor-mounted equipment and method of attaching equipment to base.

d. Identify each device and item of equipment with a bill of material reference number.

4. Bill of Material List:
    a. Provide information on manufacturer, style, type, rating, quantity, and other identifying information for each device or item of equipment.
    b. Provide unique reference number for each device or item of equipment listed on bill of material.
5. Nameplate Lists: Provide information on type of material, size, and engraved lettering.
6. Schematic Diagrams:
    a. Schematic diagram to show all portions of the actual circuitry, regardless of where the circuitry is located.
    b. Format:
        1) Vertical ladder diagram form.
        2) Label rungs with sequential numbers starting with number 1.
        3) Locate rung numbers adjacent and to left of associated rung.
        4) Provide unique rung numbers for each circuit.
    c. Conductor designations: As indicated on drawings or as developed by Contractor. Contractor-developed conductor designations shall consist of:
        1) Circuit prefix.
        2) Rung number.
        3) Unique rung wire letter such as 5P15C (“5”-Unit Number, “P”-Protection Circuit, “15”-Rung Number, “C”-Unique Rung Wire Letter).
    d. Show device terminal and terminal block designations.
    e. Show functional operation and describe unusual or nonstandard operation.
    f. Show ratings and/or values of devices.
    g. Show contacts, including spare contacts, for motor contactors, auxiliary relays, timers, and protective relays.
    h. Show cross-referencing between other schematic and wiring diagrams.
    i. Show switch developments for control, selector, and limit switches.
    j. Device designations and symbols:
        1) As indicated on standard drawing 104-D-757, supplemented by IEEE 315 as needed.
    k. Include programmable logic, as applicable.
7. Programmable Logic:
    a. When approved as a means of control logic, include with the schematic diagram submittals: PDF listings of the programmable logic program file

written in a programming language specified by IEC 61131-3. Include color PDF screen shots of HMI displays, as applicable.

8. Wiring Diagrams:

   a. Match with schematic diagrams.

   b. Wireless connection (point-to-point) type:

      1) Show equipment in its physical location as mounted on back, side, swing, and door panels. Show panel as viewed from wiring side of panel.

      2) Indicate the location of each device with a double letter designation in bold face. This double letter matrix is to begin with AA in the upper left corner of each panel or door. Continuing this double letter matrix from a door to a panel or from panel to panel is not acceptable. Standard drawing 104-D-1165 shows a typical arrangement of the double letter matrix.

      3) Indicate the location of each group of vertical terminal blocks with a single letter designation in bold face beginning with letter A. Locate terminal block number and wire designation on terminal block as shown on standard drawing 104-D-1165. The number of terminals in a single group of vertical terminal blocks may exceed twelve.

      4) Identify panel destination of wires that leave a panel or door as shown on standard drawing104-D-1165.

   c. In addition to the double letter designation, show each item of equipment with designation indicated on schematic diagram.

   d. Identify components such as fuses and resistors by value.

   e. Show wiring of devices and items of equipment including terminal number.

   f. Show cables, cable and individual wire designations, and connections to remote equipment. Standard drawing 104-D-1165 shows the manner in which external cables are to be shown. External cabling may not be fully known at the time of Approval Wiring Diagrams submittals. Therefore, wiring diagrams may be approved prior to all connections to remote equipment are shown. All external cables must be shown on Wiring Diagram “Final drawings” (below).

C. Time-Current Characteristic and Equipment Coordination Curves:

1. Provide time-current characteristic curves for adjustable and non-adjustable protective devices.

2. Provide equipment coordination curves for:

   a. Equipment inrush current.

b. Equipment full load current.

c. Equipment thermal and mechanical damage.

3. Curves to be plotted on same log-log graph paper in order to illustrate degree of coordination, protection, and selectivity being provided.

D. Job Hazard Analysis (JHA):

1. Provide when the Government will be performing factory inspection.

2. Prepare JHA in accordance with 29 CFR 1910, Subpart I.

3. As a minimum include the following in JHA:

a. Factory address and name of site visit contact person.

b. Date of JHA.

c. Purpose of JHA, for example "Visitor Safety Procedures."

d. Hazards:

1) Types of hazards at factory.

2) Safety procedures in or around high-voltage test labs.

3) Safety procedures on factory floor.

e. Personal protective equipment:

1) List of equipment required.

2) List of equipment provided by factory.

f. Emergency response:

1) Name and phone number of Factory Safety Officer.

2) Employees trained in emergency conditions (CPR, First Aid).

3) Factory fire protection/evacuation procedures.

4) Nearest hospital or emergency room.

g. Name, title and signature of factory official approving JHA.

E. Check Prints:

1. Schematic and wiring diagrams that show "As-Built" condition of equipment at time of shipment. Check prints to be made from latest approval drawings. Furnish one complete hard-copy set of full-size (D-size) drawings for Government use. Contractor shall supply copies for their own use.

2. Schematic diagrams to include all device terminal points numbered and all terminal block points identified.

3. Mark with changes and revisions made during installation and checkout of equipment.

4. Maintain separate, identical set of prints with field revisions for use in preparing final drawings.
5. As-shipped program file of any programmable logic.
6. Contractor shall supply check prints for their use.

F. As-built Drawings:

1. Mark prints of electrical specifications drawings to indicate as-built changes made to equipment and systems during construction.
2. Provide for grounding and conduit systems, and single-line diagrams.
   a. Indicate as-built changes made during construction.
   b. Indicate dimensions of:
      1) Location of grounding electrodes.
      2) Location of embedded and direct buried grounding cables.
      3) Location of embedded and direct buried conduit.
   c. Single-line diagrams to show actual values and ratings of installed equipment.
3. Include revision dates.
4. Mark the drawings in the following colors:
   a. Red – Additions to original drawings.
   b. Green – Deletions to original drawings.
   c. Blue – Notations necessary for explanation of as-built markings.

G. Final Drawings:

1. Revised to reflect approval comments and "As-Built" condition of installed equipment at time of contract completion.
2. On Wiring Diagram Final Drawings, show all connections to remote equipment with external cabling as illustrated on standard drawing 104-D-1165.
3. Provide computer drawing files in AutoCAD (*.dwg) format for schematic diagram, wiring diagram, and equipment layout drawings. Compile using 'eTransmit' utility in AutoCAD® for a complete package including support files.
4. Control software and support files for programmable logic

H. Test Reports:

1. Typed, 8 1/2- by 11-inch sheets.
2. Written certification by individual or authorized representative of organization performing the test.
3. Submit multi-page reports in bound folder or three-ring binder.

I. Operation and Maintenance Instructions Books:

1. Include electronic copy:
   a. Portable Document Format (.pdf) format on CD or DVD disk.
   b. Conform to print copies.
   c. Bookmark file(s) to aid in navigating.
2. Assemble each set of material into one or more books with enclosing covers.
3. Use double-sided copying for multi-page catalog data, maintenance instructions, operation instructions, etc.
4. Use single-side copying for half-size drawings.
5. Provide following:
   a. Table of contents, which includes an index sheet with page or index tab number information for each device or item of equipment in book.
   b. Manufacturer's operation and maintenance procedures; installation details, as necessary; and catalog data sheets for each device or item of equipment.
   c. List of recommended spare parts and components.
   d. Complete parts lists for all replacement parts.
   e. Manufacturer's circuit breaker, fuse, and motor overload time-current characteristic curves.
   f. Copies of all test reports.
   g. Copies of all drawings and bills of material.
      1) Revised to reflect “As-Built” condition.
      2) Size: 11- by 17-inch.
   h. List of settings for protective relays, adjustable circuit breakers, and motor overload relays.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

A. Prior to submitting approval data and drawings, attend the Pre-Design Meeting as detailed in Section 01 31 19 – Project Management and Coordination.

END OF SECTION

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SECTION 01 35 10

MATERIAL SAFETY DATA SHEETS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 DEFINITIONS

A. LHM: List of Hazardous Materials.

B. MSDS: Material Safety Data Sheet.

1.03 APPLICATION

A. For the purposes of this contract, the definition of "materials delivered under this contract" in the clause at FAR 52.223-3, Hazardous Material Identification and Material Safety Data - Alternate 1, includes materials delivered to the Government and all materials expected to be used during contract performance at the jobsite.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 01 35 10-1, Complete LHM and MSDS.

C. RSN 01 35 10-2, Updated LHM and MSDS:

1. Comply with paragraph (e) of clause at FAR 52.223-3, Hazardous Material Identification and Material Safety Data - Alternate 1.

1.05 DELIVERY

A. Do not deliver hazardous materials to jobsite which are not included on the original or previously updated LHM and MSDS before receipt of updated LHM and MSDS by CE.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 35 20
SAFETY AND HEALTH

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (USBR)

1. RSHS-2009 Reclamation Safety and Health Standards

a. Available on the Internet at:
http://www.usbr.gov/ssle/safety/RSHS/rshs.html

2. Form 7-2218 or other accepted form in accordance with paragraph 3.8 of the RSHS.

B. National Fire Protection Association (NFPA)

1. NFPA 1670 Standard on Operations and Training for Technical Search and Rescue Incidents.

C. Navajo Nation Occupational Safety and Health Administration (NNOSHA)

1. N.N.C Chapter 15 Navajo Nation Occupational Safety and Health Act of 2000

a. Available by contacting NNOSHA at:
P.O. Box 1447
Window Rock, AZ 86515
Telephone: 928-871-6742
http://nnosha.org/

1.03 PROJECT CONDITIONS

A. The Contractor shall not require persons employed in the performance of this contract, including subcontracts, to work under conditions that are unsanitary, hazardous, or dangerous to the employee's health or safety.

B. Provide and maintain a work environment and procedures that will safeguard the public and Government personnel from recognized hazards associated with Contractor operations and activities.

C. Comply with RSHS and CFR 1910.46 and NFPA 1670.

1. Including confined space rescue and equipment. Do not rely on local rescue.

D. Comply with NNOSHA regulation and direction when contract activities occur within the jurisdiction and boundary of the Navajo Nation.

E. The Contractor shall maintain accurate records and complete reporting in accordance with RSHS requirements. For the purposes of this contract, a serious accident or incident is defined as resulting in:

1. Fatality;
2. Hospitalization of three or more individuals; and/or
3. Property damage in excess of $250,000.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 35 22

FIRST AID

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (USBR)

1. RSHS-2009 Reclamation Safety and Health Standards

1.03 SERVICE

A. First-aid and medical facilities: In accordance with section 5 of RSHS.

B. Conform to most stringent requirement in cases of conflict between requirements of this section and requirements of RSHS.

C. Do not perform onsite work until first aid plans have been submitted, approved by the CO, and implemented on site.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 01 35 22-1, Medical Facilities Plan:

1. Describe facilities for providing medical attention for injured or disabled employees.

2. Include onsite emergency facilities and ambulance service.

1.05 AVAILABILITY

A. Make facilities and services available for providing emergency aid to employees, subcontractor employees, Government employees, and public.

B. Provide services free of charge to Government employees injured on job.

C. Government employees not injured on job and public may be charged fees for rendered services based on reasonable and established fee rates.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 35 30

CONTRACTOR'S ONSITE SAFETY PERSONNEL

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 01 35 30-1, Resumes:

1. Contractor's Onsite Safety Professional.

C. RSN 01 35 30-2, Safety Inspection Reports:

1. Include a list of noted deficiencies, their abatement dates, and follow-up action for all jobsite activities.
2. Base inspection report on findings of jobsite walk-through with Government personnel.

1.03 QUALIFICATIONS

A. Contractor's Onsite Safety Professional:

1. Competent supervisory employee with appropriate level of safety related training and experience prior to the start of the work.

1.04 APPLICATION

A. Designate an employee as the Contractor's Onsite Safety Professional prior to start of construction.

1. Safety Professional requirements may be met by retaining appropriate level of services of an acceptable safety consultant.

B. Contractor's Onsite Safety Professional authorities, duties, and responsibilities:

1. Responsible for effectively implementing the Contractor's Safety Program
2. Full authorization to correct unsafe acts on the spot.
3. Prepare safety inspection reports.
4. Onsite during any and all construction activities.

1.05 QUALITY ASSURANCE

A. Contractor's Onsite Safety Professional:

1. The effectiveness of the Contractor's Onsite Safety Professional in prosecuting the safety program will be subject to continued review and approval by the CO.

2. Should the Contractor's safety effort be considered inadequate, the CO has the option to require the Contractor to replace the full-time qualified Safety Professional.

B. Safety Program:

1. The effectiveness of the Contractor's Safety Program will be subject to continued review and approval by the CO.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 42 10

REFERENCE STANDARDS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Referenced editions of standard specifications, codes, and manuals form a part of this specification to the extent referenced.

B. These specifications take precedence when conflicting requirements occur between specifications and referenced standard.

1.03 JOBSITE REFERENCE STANDARDS

A. Maintain at fabrication site, a copy of referenced standard specifications, codes, and manuals required for work in progress at fabrication site. Make available for use by the Government.

B. Maintain onsite, a copy of referenced standard specifications, codes, and manuals required for onsite work in progress. Make available for use by the Government.

1.04 AVAILABILITY

A. Code of Federal Regulation (CFR):

1. Available online, authorized by the National Archives and Records Administration (NARA) and the Government Printing Office (GPO), at www.gpoaccess.gov/cfr/index.html.

B. Federal Specifications, Standards, and Commercial Item Descriptions; and Military Specifications:

1. Copies of Federal Specifications, Standards, and Commercial Item Descriptions may be obtained from GSA Federal Supply Service, see the provision at FAR 52.211-1, Availability of Specifications Listed in the GSA Index of Federal Specifications, Standards and Commercial Item Descriptions, FPMR Part 101-29.

2. Copies of Military Specifications may be obtained from Department of Defense, see the provision at FAR 52.211-2, Availability of Specifications, Standards, and Data Item Descriptions Listed in the Acquisition Streamlining and Standardization Information System (ASSIST).

C. Bureau of Reclamation Documents:

1. Reclamation Safety and Health Standards (RSHS), 2009 edition, may be downloaded at http://www.usbr.gov/ssle/safety/RSHS/rshs.html.

   a. Hard copies of RSHS, stock number 024-003-00204-6, may be purchased from The Superintendent of Documents at the U.S. Government Printing Office (GPO), phone number 202-512-1800.

      1) GPO online bookstore: http://bookstore.gpo.gov/actions/GetPublication.do?stocknumber=024-003-00204-6.

2. Bureau of Reclamation Standard Specifications are designated with an M- number. Copies of individual standards may be obtained from Bureau of Reclamation, Attn: 86-68170, P.O. Box 25007, Denver, CO 80225-0007. Specify which standard(s) is needed when requesting a copy.

3. Bureau of Reclamation manuals and other publications including significant scientific, technical, and engineering works are available from the National Technical Information Service (NTIS). Information regarding availability and pricing may be obtained by contacting NTIS at the following address:

   United States Department of Commerce
   National Technical Information Service
   5285 Port Royal Road
   Springfield, VA 22161
   Telephone: 703-487-4650 or 1-800-553-6847

D. Industrial and Governmental Documents:

1. When a reference has a joint designation (e.g. ANSI/IEEE) these specifications generally cite the proponent organization (e.g. IEEE).

2. Addresses for obtaining industrial and governmental (other than Federal and Bureau of Reclamation specifications and standards) specifications, standards, and codes are listed in Table 01 42 10A - Addresses for Specifications, Standards, and Codes.

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
AA	Aluminum Association 1525 Wilson Boulevard Arlington, VA 2209 www.aluminum.org	703-358-2960

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
AABC	Associated Air Balance Council 1518 K Street, NW. Washington, DC 20005 www.aabc.com	202-737-0202
AAMA	American Architectural Manufacturers Association 1827 Walden Office Square, Suite 550 Schaumburg, Illinois 60173 www.aamnet.org	874-303-5664
AASHTO	American Association of State Highway and Transportation Officials 444 North Capitol Street, NW., Suite 249 Washington, DC 20001 www.aashto.org	202-624-5800 800-231-3475
ABMA	American Bearing Manufacturers Association 22025 M. Street, NW., Suite 800 Washington, DC 20036 www.americanbearings.org	202-367-1155
ACI	American Concrete Institute 38800 Country Club Drive Farmington Hills, MI 48331 www.concrete.org	248-848-3701
AEIC	Association of Edison Illuminating Companies 600 North 18th Street P.O. Box 2641 Birmingham, AL 35291 www.aeic.org	205-257-2530
AGC	Associated General Contractors of America 333 John Carlyle Street, Suite 200 Alexandria VA 22314 www.agc.org	703-548-3118
AGMA	American Gear Manufacturers Association 1001 N. Fairfax Street, Suite 500 Alexandria, VA 22314 www.agma.org	703-684-0211

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
AHRI	Air-Conditioning, Heating & Refrigeration Institute 2111 Wilson Boulevard, Suite 500 Arlington, VA 22201 www.ahrinet.org	703-524-8800
AISC	American Institute of Steel Construction One East Wacker Drive, Suite 3100 Chicago, IL 60601-2001 www.aisc.org	312-670-2400
AISI	American Iron and Steel Institute 25 Massachusetts Avenue, NW., Suite 800 Washington, DC 20001 www.steel.org	202-452-7100
AMCA	Air Movement and Control International, Inc. 30 West University Drive Arlington Heights, IL 60004 www.amca.org	847-394-0150
ANSI	American National Standards Institute 1819 L. Street, NW. Washington, DC 20036 www.ansi.org	202-293-8020
APA	APA-The Engineered Wood Association 7011 So. 19th Street Tacoma, WA 98466 www.apawood.org	253-565-6600
ASCE	American Society of Civil Engineers 1801 Alexander Bell Drive Reston, VA 20191 www.asce.org	800-548-2723
ASHRAE	American Society of Heating, Refrigeration and Air-Conditioning Engineers 1791 Tullie Circle, N.E. Atlanta, GA 30329 www.ashrae.org	404-636-8400

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
ASME	American Society of Mechanical Engineers 3 Park Avenue New York, NY 10016-5990 www.asme.org	800-843-2763
ASSE	American Society of Sanitary Engineering 18927 Hickory Creek Drive, Suite 220 Mokena, IL 60448 www.asee-plumbing.org	708-995-3019
ASTM	ASTM International 100 Barr Harbor Drive West Conshohocken, PA 19428-2959 www.astm.org	610-832-9585
AWS	American Welding Society 550 NW LeJeune Road Miami, FL 33126 www.amweld.org	800-443-9353 305-443-9353
AWWA	American Water Works Association 6666 W. Quincy Avenue Denver, CO 80235 www.awwa.org	303-794-7711
BHMA	Builders Hardware Manufacturers Association 355 Lexington Avenue, 15th Floor New York, NY 10017 www.buildershardware.com	212-297-2122
BICSI	Building Industry Consulting Services International 8610 Hidden River Parkway Tampa, FL 33637 www.bicsi.org	813-979-1991
CI	Chlorine Institute 1300 Wilson Boulevard, Suite 525 Arlington, VA 22209 www.chlorineinstitute.org	703-894-4140
CISPI	Cast Iron Soil Pipe Institute 1064 Delaware Avenue, S.E. Atlanta, GA 30316 www.cispi.org	404-622-0073

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
CLFMI	Chain Link Fence Manufacturers Institute 10015 Old Columbia Road, Suite B-215 Columbia, MD 21046 www.associationsites.com/clfma/index.cfm	410-290-6267
CMAA	Crane Manufacturers Association of American 8720 Red Oak Boulevard, Suite 201 Charlotte, NC 28217 www.mhi.org/cmaa	704-676-1199
GA	Gypsum Association 6525 Belcrest Road, Suite 480 Hyattsville, MD 20782 www.gypsum.org	301-277-8686
HI	Hydraulic Institute 6 Campus Drive, First Floor North Parsippany, NJ 07054 www.pumps.org	973-267-9700
ICC	International Code Council 500 New Jersey Avenue, NW., 6th Floor Washington, DC 20001 www.iccsafe.org	888-422-7233
ICEA	Insulated Cable Engineers Association P.O. Box 1568 Carrollton, GA 30112 www.icea.net	800-447-3352
ICRI	International Concrete Repair Institute 10600 West Higgins Road, Suite 607 Rosemont, Il 60018 www.icri.org	847-827-0830
IEC	International Electrotechnical Commission 446 Main Street, 16th Floor Worcester, MA 01608 www.iec.ch	508-755-5663
IEEE	Institute of Electrical and Electronics Engineers 3 Park Avenue,17th Floor New York, NY 10016-5997 www.ieee.org	212-419-7900

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
ISA	The International Society of Automation 67 T.W. Alexander Driver Research Triangle Park, NC 27709 www.isa.org	919-549-8411
ISEE	International Society of Explosives Engineers 30325 Bainbridge Road Cleveland, OH 44139 www.isee.org	440-349-4400 Fax: 440-349-3788
ISO	International Organization for Standardization 1, ch. de la Voie-Creuse, Case postale 56 CH-1211 Geneva 20, Switzerland www.iso.org	+41 22 749 01 11
MBMA	Metal Buildings Manufacturers Association 1300 Sumner Avenue Cleveland, OH 44115 www.mbma.com	216-241-7333
MFMA	Metal Framing Manufacturers Association 401 N. Michigan Avenue Chicago, IL 60611 www.metalframingmfg.org	312-644-6610
MPI	Master Painters Institute 2800 Ingleton Avenue Burnaby, B.C., Canada V5C 6G7 www.mpi.net	604-298-7578
MSS	Manufactures Standardization Society of Valves and Fittings Industry 127 Park Street, NE Vienna, VA 22180-4602 www.mss-hq.org	703-281-6613
NAAMM	National Association of Architectural Metal Manufacturers 800 Roosevelt Road, Bldg. C, Suite 312 Glen Ellyn, IL 60137 www.namm.org	630-942-6591

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
NACE	NACE International 1440 South Creek Drive Houston, TX 77084 www.nace.org	281-228-6200
NAPF	National Association of Pipe Fabricators 2887 Goat Creek Road, Box 242 Kerrvilee, TX 78028 www.napf.com	889-798-1924
NCMA	National Concrete Masonry Association 13750 Sunrise Valley Drive Herndon, VA 20171 www.ncma.org	703-713-1900
NEBB	National Environmental Balancing Bureau 8575 Grovemont Circle Gaithersburg, MD 20877 www.nebb.org	301-977-3698
NECA	National Electrical Contractors Association 3 Bethesda Metro Center, Suite 1100 Bethesda, MD 20814 www.necanet.org	301-657-3110
NEIS	National Electrical Installation Standards 3 Bethesda Metro Center, Suite 1100 Bethesda, MD 20814 www.neca-neis.org	301-657-3110
NETA	InterNational Electrical Testing Association 3050 Old Centre Avenue, Suite 102 Portage, MI 49024 www.netaworld.org	269-488-6382
NEMA	National Electrical Manufacturers Association 1300 N 17th Street, Suite 1847 Rosslyn, VA 22209 www.nema.org	703-841-3200
NFPA	National Fire Protection Association One Batterymarch Park P.O. Box 9101 Quincy, MA 02269-9101 www.nfpa.org	800-344-3555 617-770-3000

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
NIBS	National Institute of Building Sciences 1090 Vermont Avenue, NE., Suite 700 Washington, DC 20005 www.nibs.org	202-289-1092
NMDOT	New Mexico Department of Transportation 1120 Cerrillos Road Santa Fe, NM 87504-1149 www.dot.state.nm.us	505-827-5100
NSF	NSF International P.O. Box 130140 789 N. Dixboro Road Ann Arbor, MI 48113 www.nsf.org	734-769-8010
PTI	Post Tensioning Institute 38800 Country Club Drive Farmington Hills, MI 48331 www.post-tensioning.org	248-848-3180
SDI	Steel Deck Institute P.O. Box 426 Glenshaw, PA 15116 www.sdi.org	412-487-3326
SJI	Steel Joist Institute 234 W. Cheves Street Florence, SC 29501 www.steeljoist.org	843-407-4091
SMACNA	Sheet Metal and Air-Conditioning Contractors' National Association 4201 Lafayette Center Drive Chantilly, VA 20151 www.smacna.org	703-803-2980
SSPC	SSPC: The Society for Protective Coatings 40 24th Street, 6th Floor Pittsburgh, PA 15222-4656 www.sspc.org	800-837-8303 412-281-2331

Table 01 42 10A - Addresses for Specifications, Standards, and Codes

Acronym	Name and Address	Telephone
TCNA	Tile Council of North America 100 Clemson Research Boulevard Anderson, SC 29625 www.tcnatile.com	864-646-8453
TIA	Telecommunications Industry Association 1320 N. Courthouse Road, Suite 200 Arlington, VA 22201 www.tiaonline.com	703-907-7700
UL	Underwriters Laboratories Inc. 333 Pfingsten Road Northbrook, IL 60062-2096 www.ul.com	847-272-8800
WWPA	Western Wood Products Association 522 SW Fifth Avenue Portland, OR 97204-2122 www.wwpa.org	503-224-3930

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 46 00

QUALITY PROCEDURES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 DEFINITIONS

A. Quality Assurance: Inspection and tests performed by Government to ensure compliance with the terms of the contract.

B. Quality Control: Activities performed by Contractor to ensure work conforms to contract requirements.

1. The clause at FAR 52.246-12 - Inspection of Construction, requires the Contractor to establish an inspection system to ensure quality.

2. Quality Control also includes other Contractor activities to ensure work conforms to contract requirements.

C. Contractor Quality Testing: Specified tests to be performed by the Contractor.

1. The Government may use the test results for Quality Assurance.

2. The Contractor may use the test results as part of Contractor quality control.

a. The Government anticipates that these tests will be part of the Contractor's quality control program, however the tests do not relieve the Contractor of providing adequate quality control measures in accordance with the clause at FAR 52.246-12 - Inspection of Construction.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 01 46 20

TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

B. Progress Payments: If test reports are not submitted within 3 days of receiving the test results, the Contractor will be considered to be in non-compliance and delaying that phase of the work to which the testing applies. The CO may retain appropriate amounts of applicable progress payments.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM C1077 - 13a	Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
2.	ASTM D 3740-12a	Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
3.	ASTM E329 - 11c	Agencies Engaged in Construction Inspection, Testing, or Special Inspection

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 01 46 20-1, Testing Laboratory Services Plan:

1. Include:
   a. Names of laboratories to perform sampling and testing.
   b. Laboratory certification to perform specified testing or laboratory qualifications to perform specified testing.
   c. Samples of report forms.
2. No change in the approved plan may be made without written concurrence by the COR.

1.04 QUALIFICATIONS

A. Testing Laboratory and Equipment: Employ certified independent laboratory to perform sampling and testing.

1. Testing laboratory organization:

a. Laboratories testing construction materials: Meet requirements of ASTM E 329.

b. Laboratories testing concrete and concrete aggregates: Meet requirements of ASTM C 1077.

c. Laboratories testing soil and rock: Meet requirements of ASTM D 3740.

2. Calibrate measuring devices, laboratory equipment, and instruments at established intervals.

3. Upon request, make measuring and testing devices available for use by the Government for verification tests.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 CONTRACTOR QUALITY TESTING

A. Independent testing laboratory shall perform sampling, testing, and reporting as required in the following sections:

1. Section 03 30 00 – Cast-in-Place Concrete.

2. Section 31 23 02 – Compacting Earth Materials.

3. Section 31 23 70 – Controlled Low Strength Material (CLSM).

3.02 QUALITY ASSURANCE

A. The Government may inspect the Laboratory.

B. During the course of the work, the Government may perform quality assurance tests. Tests performed by the Government will be used to ensure compliance with contract requirements and not as a replacement for specified contractor quality testing.

C. If a conflict arises between Contractor quality testing results and Government quality assurance tests, Government testing results will take precedence over Contractor testing results.

END OF SECTION

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SECTION 01 51 00

TEMPORARY UTILITIES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE C2-2012 National Electric Safety Code (NESC)

1.03 SUBMITTALS

A. RSN 01 51 00-1, Water Storage:

1. Location and method of water storage.
    a. Include a drawing showing location and dimensions.
    b. Travel route from water source to and from the work site.
    c. Culturally clear and meet environmental requirements for road maintenance and or minor improvements.
    d. Provide agreement with entity providing water.

1.04 TEMPORARY ELECTRICITY

A. Provide required electric power for construction.

B. Provide generators, transmission lines, distribution circuits, transformers, and other electrical equipment and facilities required for obtaining power and distributing power to points of use.

C. Comply with IEEE C2 clearances and spacing for temporary communications and supply lines.

D. Remove temporary equipment and facilities upon completion of work under this contract.

1.05 TEMPORARY WATER

A. The Contractor shall provide water required for construction purposes.

1. Includes:

a. Determining source, obtaining permits, transporting, and paying fees.

B. Potential Sources:

1. Depending on availability the following entities may have potable water:

a. The City of Gallup:

1) Contact:

a) Gallup Joint Utilities
P.O. Box 1270
Gallup, NM 87305
505-863-1289.

2) Potable water for cleaning, filling and testing may only be available between November 31 to March 1.

b. The Navajo Tribal Utility Authority (NTUA):

1) Contact:

a) Navajo Tribal Utility Authority
P.O. Box 170
Fort Defiance, AZ 86504
928-729-6277.

2. The Navajo Department of Water Resources (NDWR) may have non-potable construction water.

a. Contact:

1) Navajo Department of Water Resources
NDWR Technical Operations & Maintenance Branch Director
928-729-4146.

C. Use water which meets specified requirements for water used in concrete, soil-cement, masonry, grouting, and other permanent work.

D. Provide means of conveying water to points of use.

E. Remove temporary equipment and facilities upon completion of work under this contract.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 WATER USE

A. Measure water use with calibrated water meters.

END OF SECTION

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SECTION 01 55 00

VEHICULAR ACCESS AND PARKING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 REGULATORY REQUIREMENTS

A. Meet requirements established by jurisdictional authority for use of existing roadways and haul routes; including seasonal or other limitations or restrictions, payment of excess size and weight fees, and posting of bonds conditioned upon repair of damage.

B. Comply with applicable regulations for haul routes over public highways, roads, or bridges.

1.03 SITE CONDITIONS

A. Rights-of-way for access to work from existing roads will be established by the Government.

1. In accordance with the clause at FAR 52.236-10, Operations and Storage Areas, use only established roadways, parking areas, and haul routes; or temporary roadways, parking areas, or haul routes constructed by the Contractor when and as authorized by the CO.

2. Subject to the clause at FAR 52.249-10, Default (Fixed-Price Construction), unavailability of transportation facilities or limitations thereon shall not become a basis for claims for damages or extension of time for completion of work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials to maintain and repair existing roadways, parking areas, and haul routes: In accordance with requirements of jurisdictional authority.

B. Materials to construct, maintain, and repair temporary roadways, parking areas, and haul routes: As approved by the COR.

PART 3 EXECUTION

3.01 EXAMINATION

A. Investigate condition of available public or private roads for clearances, restrictions, bridge-load limits, bond requirements, and other limitations that affect or may affect access and transportation operations to and from the jobsite.

3.02 ESTABLISHED ROADWAYS AND PARKING AREAS

A. Established roadways and parking areas are available for the Contractor's use subject to existing restrictions and approval of the COR.

B. Do not use private driveways without permission from the property owner and COR.

3.03 HAUL ROUTES

A. Perform work on rights-of-way established by the Government as necessary to construct and maintain any roads, bridges, or drainage structures required for establishment and use of haul routes for construction operations.

B. Use existing available public highways, roads, or bridges as haul routes subject to applicable local regulations.

C. Minimize interference with or congestion of local traffic.

D. Provide barricades, flaggers, and other necessary precautions for safety of the public where haul routes cross public highways or roads.

3.04 MAINTENANCE

A. Maintain roadways, parking areas, and haul routes in a sound, smooth condition.

B. Maintain surfacing of gravel-surfaced roads and parking areas in a smooth condition until completion and acceptance of all work under this contract.

C. Snow removal for convenience of the Contractor or to facilitate work operations of the Contractor is considered to be normal required maintenance.

3.05 REPAIR

A. Promptly repair ruts, broken pavement, potholes, low areas with standing water, and other deficiencies to maintain road surfacing and drainage in original or specified condition.

3.06 REMOVAL

A. Remove materials used to construct temporary roadways, parking areas, and haul routes prior to contract completion. Recycle salvageable materials as approved by the COR.

END OF SECTION

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SECTION 01 55 20

TRAFFIC CONTROL

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work, except for watering for dust abatement.

B. See Section 31 02 10 – Water for Dust Abatement for measurement and payment of water for dust abatement.

1.02 REFERENCE STANDARDS

A. Federal Highway Administration, Department of Transportation

1. MUTCD, Part 6 — Part 6, Temporary Traffic Control, Manual on Uniform Traffic Control Devices, 2009 Edition, (http://mutcd.fhwa.dot.gov/kno_2009.htm)

1.03 PROJECT CONDITIONS

A. The project includes:

1. Installing several crossings under New Mexico State Highway 491.
2. Working in New Mexico Department of Transportation (NMDOT) ROW as shown on the drawings.

B. NMDOT has approved the project in concept, but the Government has not applied for or obtained permits for the work.

C. The Contractor shall obtain permits required by NMDOT.

D. The NMDOT Permit application for utility crossings is included in Section 51 00 10 – Permit Application. NMDOT may require more information than is shown on the permit applications.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 01 55 20-1, Traffic Control Plan.

C. RSN 01 55 20-2, Permit Applications:

1. Submit the completed NMDOT permit applications to the BOR for approval before submitting the permit to the NMDOT.

D. RSN 01 55 20-3, Permits:

1. Provide copy of signed and approved permits from NMDOT.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 TRAFFIC CONTROL

A. Meet requirements of NMDOT permit and MUTCD, Part 6.

B. Provide cones, delineators, concrete safety barriers, barricades, flasher lights, danger signals, signs, and other temporary traffic control devices as required to protect work and public safety.

C. Provide flaggers and guards as required to prevent accidents and damage or injury to passing traffic.

D. Do not begin work along public or private roads until proper traffic control devices for warning, channeling, and protecting motorists are in place in accordance with approved traffic control plan.

E. Maintain traffic flow and conduct construction operations to minimize obstruction and inconvenience to public traffic.

F. Provide unobstructed, smooth, and dustless passageway for one lane of traffic through construction operations.

G. Maintain convenient access to driveways, houses, and buildings along line of work.

H. Protect roads closed to traffic with effective barricades and warning signs. Illuminate barricades and obstructions from sunset to sunrise.

I. Remove traffic control devices when no longer needed.

END OF SECTION

SECTION 01 56 15

PROTECTION OF EXISTING UTILITIES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices, except for Underground Utility Line Investigations, offered in the schedule for other items of work.

B. Underground Utility Line Investigations:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (USBR)

1. RSHS-2009 Reclamation Safety and Health Standards

B. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE C2-2012 National Electric Safety Code (NESC)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 01 56 15-1, Utility Line Information:

1. Include the following information for each utility line as applicable:
    a. Owner company name, address, and telephone number.
    b. Utility line crossing location along pipeline alignment.
    c. Utility line material.
    d. Elevation.
    e. Diameter.
    f. Service restrictions.
    g. Powerline voltage.

C. RSN 01 56 15-2, Work Plan Within Utility Easements:

1. Proposed installation method including construction equipment.
2. Methods for protecting.

3. Approval of work plan from Utility owner.

1.04 PROJECT CONDITIONS

A. Drawings included in these specifications show existing utilities, but may not show all utilities existing at the jobsite.

B. Unknown existing utility lines may cross the pumping plant yard and pipeline alignment.

C. The Government does not represent that the location of known existing utilities shown on the drawings are exact. It is the Contractor's responsibility to determine the actual location of and make provision for all known and unknown utilities.

1. Verify exact locations, depths and clearances of both above and below ground utilities prior to excavation.

D. Ensure that each utility line is in service at all times as required by each utility owner.

E. The Contractor shall coordinate all work within existing pipeline and transmission line Rights-of-Way with the owners and shall be responsible for all costs associated with crossings. Obtain permission from the Utility owners before procuring materials to be installed in the Rights-of-Way.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor shall have New Mexico One Call locate utilities before doing underground work.

B. Navajo Tribal Utility Authority (NTUA) is not part of New Mexico One Call.

1. Contractor shall have NTUA locate utilities before doing underground work. Contact information:

Navajo Tribal Utility Authority
P.O. Box 170
Fort Defiance, AZ 86504
928-729-5721.

C. Investigation:

1. Determine height of overhead utility heights and clearances.

2. Determine, by potholing or test pits, the location, elevations, diameters, and materials of each underground utility line.

    a. Submit to COR before beginning preparation of pipelaying diagrams required by Section 33 11 10 – Pipeline General Requirements and excavation work.

    b. COR will determine if adjustment of pipeline grade and design is required and provide the Contractor with revised drawings.

3. Obtain permission from utility owner before performing physical utility investigation (potholing or test pits).

D. Coordinate with each utility line owner and schedule construction to adhere to each owner's in service, allowable out of service, and crossing requirements during construction.

E. Notify impacted property at least two working days before disturbing waterline that serves their property. Water service to property shall not be shut off for more than 8 hours.

F. No excavation will be permitted within 10 feet of gas lines when in service without written approval from gas company.

G. Protect and support existing utilities that intersect work area. Before commencing work, obtain approval and necessary permits from utility owners within the project ROW.

1. Protect overhead power facilities as required by Tucson Electric if working in their ROW.

2. Protect existing waterlines as required by City of Gallup when working within 100 feet of their lines.

H. Repair existing utilities damaged during construction as approved by COR and the utility owner.

3.02 CLEARANCE

A. Obtain clearances required for construction operations: The Contractor shall provide in accordance with RSHS.

3.03 INTERFERENCE WITH OPERATION OR MAINTENANCE

A. Do not interfere with operation or maintenance service on utilities, existing on date offers are received.

1. Provide for access to utilities in a manner satisfactory to owners and operators and the Government.

B. Provide required temporary structures; make necessary repairs, replacements, or similar operations; and furnish indemnity or other bonds.

END OF SECTION

SECTION 01 56 20
EXISTING FENCES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

PART 2 PRODUCTS

2.01 MATERIALS

A. Rebuild fence with new material unless approved by the COR.

B. Provide replacement materials similar to the material removed.

PART 3 EXECUTION

3.01 FENCE REMOVAL

A. Remove existing fences where necessary for performance of the work, only when authorized by the COR. Maintain fences, where designated, until work is completed or their removal is authorized.

3.02 TEMPORARY FENCES

A. Where fences are removed on rights-of-way, provide temporary fence protection for adjacent lands.

B. If the Contractor does not provide necessary temporary fencing or protection within a reasonable time after need for fencing or protection arises, the CO will cause the work to be performed and backcharge the Contractor for such work.

C. Remove temporary fences and protection as a part of cleanup operations prior to final acceptance of completed work.

3.03 FENCE REBUILDING

A. Where fences are removed to accommodate construction, rebuild at original locations.

B. Construct rebuilt fencing that is structurally sound and matches, or is better than, existing fencing installation.

END OF SECTION

SECTION 01 56 32

TEMPORARY SAFETY FENCE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in schedule for other items of work.

PART 2 PRODUCTS

2.01 SAFETY FENCE

A. Fence:

1. High-density polyethylene grid.
2. Minimum height: 48-inch.
3. Color: Safety orange.
4. Recovered material content:
   a. 90 to 100 percent.
5. Postconsumer content:
   a. 60 to 100 percent.

B. Posts: Steel fence posts.

PART 3 EXECUTION

3.01 INSTALLATION

A. Erect fence around the perimeter of the excavation and work areas at location approved by the COR.

1. Erect fence at the end of each work day.

B. Space posts 10 feet, maximum, on center.

C. Secure grid to posts.

3.02 MAINTENANCE AND REMOVAL

A. Maintain fence until work in area is complete and accepted by the COR.

B. Remove fence when no longer required.

END OF SECTION

SECTION 01 57 10
CROSS DRAINAGE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work, except as specified.

   a. Damage due to Contractor's negligence or lack of appropriate controls shall be repaired at the Contractor's expense.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 GENERAL

A. Flows from natural drainage channels intercepted by the work shall be controlled.

B. Provide and maintain temporary construction required to control, bypass, or otherwise cause flows to be harmless to the work and to public or private property.

C. Perform additional ditching and grading for drainage as directed by the COR.

D. Remove temporary construction and restore the site to its original condition, as approved by the COR, when the temporary construction is no longer needed and prior to acceptance of the work.

E. Return drainage to the original grade and slope once pipe in place and backfilled.

F. Reseed in accordance with Section 32 92 20 – Seeding.

G. Damage to work under these specifications and to public or private property shall be restored to its original condition, as approved by the COR, at the Contractor's expense.

END OF SECTION

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SECTION 01 57 20

ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the prices offered in the schedule for other items of work, except as specified.
2. Costs for damages and work stoppage are the Contractor's responsibility.

B. See Section 31 02 10 – Water for Dust Abatement, for measurement and payment for applying water used for dust abatement within the Rights-of-Way.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (USBR)

1. RSHS-2009 Reclamation Safety and Health Standards

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 01 57 20-1, Copy of Applicable Air Quality Permit.

1.04 REGULATORY REQUIREMENTS

A. Comply with Federal, State, Tribal and local laws and regulations.

B. Comply with RSHS.

C. Conform to most stringent requirement in cases of conflict between specifications, regulatory requirements, and RSHS.

D. Contractor shall be responsible for damages resulting from dust originating from Contractor operations in accordance with clause at FAR 52.236-7, Permits and Responsibilities.

E. The CO may stop construction activity in violation of Federal, State, Tribal or local laws and additional expenses resulting from work stoppage will be responsibility of Contractor.

1.05 DUST CONTROL

A. Provide dust control and abatement during performance of work.

B. Prevent, control, and abate dust pollution on rights-of-way provided by Government or elsewhere during performance of work.

C. Provide labor, equipment, and materials, and use efficient methods wherever and whenever required to prevent dust nuisance or damage to persons, property, or activities including, but not limited to, crops, orchards, cultivated fields, wildlife habitats, dwellings and residences, agricultural activities, recreational activities, traffic, and similar conditions.

D. Provide means for eliminating atmospheric discharges of dust during mixing, handling, and storing of cement, pozzolan, and concrete aggregate.

1.06 AIR POLLUTION CONTROL

A. Air Quality Permits are required for certain construction-related activities including, but not limited to, earthmoving, sandblasting, aggregate processing, welding, spray-coating operations, or other processes which discharge pollutants into the open air.

B. Air Quality Permits, and information concerning the requirements, are available from: Navajo Nation Environmental Protection Agency, 928-729-4246.

C. Use reasonably available methods and devices to prevent, control, and otherwise minimize atmospheric emissions or discharges of air contaminants.

D. Do not operate equipment and vehicles that show excessive exhaust gas emissions until corrective repairs or adjustments reduce such emissions to acceptable levels.

1.07 NOISE CONTROL

A. Only construction activities approved by COR will be allowed between dusk and dawn.

1.08 LIGHT CONTROL

A. Direct stationary floodlights to shine downward at an angle less than horizontal.

B. Shield floodlights so that floodlights will not be a nuisance to surrounding areas.

C. Direct lighting so that residences are not in direct beam of light.

D. Correct lighting control problems when they occur as approved by the COR.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 01 57 30

WATER POLLUTION CONTROL

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (USBR)

1. RSHS-2009 Reclamation Safety and Health Standards

B. Code of Federal Regulations (CFR)

1. 40 CFR, Part 112 Oil Pollution Prevention

C. Public Law

1. Sections 311, 402, and 404 Clean Water Act (Public Law 92-500, as amended)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 01 57 30-1, Updated Stormwater Pollution Prevention Plan:

1. Modifications to permit obtained by USBR. As required by the stormwater permit for discharges from construction sites.

2. Include copy of permits.

C. RSN 01 57 30-2, Spill Prevention, Control, and Countermeasure Plan (SPCC):

1. Submit when SPCC Plan is required in accordance with 40 CFR, Part 112.

   a. SPCC Plan is required where release of oil and oil products could reasonably be expected to enter into or upon navigable waters of the United States or adjoining shorelines in quantities that may be harmful (40 CFR, Part 110), and aggregate on site oil storage capacity is over 1,320 gallons. Only containers with capacity of 55 gallons and greater are included in determining on site aggregate storage capacity.

2. Reviewed and certified by a registered professional engineer in accordance with 40 CFR, Part 112, as required by section 311 of the Clean Water Act (Public Law 92-500 as amended).

3. Submit a spill prevention plan for oil storage less than 1,320 gallons. The spill prevention plan shall be certified by a professional engineer and include:

   a. Oil Storage Quantity.

   b. Drawings of containment system.

   c. Response plan to spill.

1.04 REGULATORY REQUIREMENTS

A. Construction Safety Standards:

1. Comply with sanitation and potable water requirements of section 7 of RSHS.

B. Laws, Regulations, and Permits:

1. Perform construction operations to comply, and ensure subcontractors comply, with:

   a. Applicable Federal, State, Navajo Nation and local laws, orders, regulations, and Water Quality Standards concerning control and abatement of water pollution; and terms and conditions of applicable permits issued by permit issuing authority.

   b. If conflict occurs between Federal, State, Navajo Nation and local laws, regulations, and requirements, the most stringent shall apply.

C. Contractor Violations:

1. If noncompliance should occur, immediately (verbally) report noncompliance to the CO. Submit specific written information within 2 days.

2. Violation of applicable Federal, Tribal, State, or local laws, orders, regulations, or Water Quality Standards may result in the CO stopping site activity until compliance is ensured.

3. The Contractor shall not be entitled to extension of time, claim for damage, or additional compensation by reason of such a work stoppage.

4. Corrective measures required to bring activities into compliance shall be at the Contractor's expense.

1.05 REQUIRED PERMITS

A. Wastewater Discharge Permit:

1. Permit:

   a. Prior to discharging wastewater or other pollutants, secure permit(s) to discharge pollutants as required under section 402 of the Clean Water Act (Public Law 92-500 as amended), and/or The New Mexico Environment Department, Surface Water Quality Bureau and/or the Navajo Nation Environmental Protection Agency.

b. Submit permit application(s) to USBR, for review before submitting to the agencies.

c. The USBR shall support the Contractor in obtaining permits, as deemed appropriate by the USBR.

2. Terms and Conditions: Comply with terms and conditions as stated in the permit.

3. Monitoring and Treatment:

a. Provide monitoring and water treatment, if necessary, to achieve compliance with permit conditions

b. Provide recordkeeping required of the permittee, as stated in the permits.

4. Sampling: Include sampling in monitoring required of the Contractor to meet section requirements, as well as required laboratory tests to determine effluent characteristics.

5. Monitoring Results:

a. Provide monitoring results to the appropriate agency as required by the permit.

b. Send copies of all information transmitted to the appropriate agency to the COR.

B. Stormwater Discharge Permit Associated With a Construction Site:

1. The Bureau of Reclamation has obtained a stormwater general permit to control stormwater discharges from the construction site as required under section 402 of the Clean Water Act (Public Law 92-500, as amended).

2. Pollution Prevention Plan:

a. The Bureau of Reclamation has prepared a Pollution Prevention Plan as required by the permit.

b. Comply with terms and conditions to maintain this stormwater discharge permit.

3. Monitoring and Water Treatment:

a. Provide monitoring and water treatment, if necessary, to achieve compliance with applicable Water Quality Standards.

b. Provide the recordkeeping required by the stormwater discharge permit associated with construction activity.

C. Stormwater Discharge Permit Associated With Industrial Activity:

1. Stormwater Discharge Permit:

a. If construction activities will entail the use of a mobile CLSM plant, concrete plant, or nonmetallic borrow areas, a stormwater discharge permit associated with industrial activity may be required.

2. Notice of Intent (NOI):

   a. Sign the NOI to obtain coverage under a stormwater general permit to control stormwater discharges from industrial activity at the construction site as required under section 402 of the Clean Water Act (Public Law 92-500, as amended) and/or The New Mexico Environment Department, Surface Water Quality Bureau and/or the Navajo Nation Environmental Protection Agency.

3. Terms and Conditions:

   a. Comply with terms and conditions to obtain and maintain the industrial stormwater discharge permit, including the preparation of a Pollution Prevention Plan.

4. Monitoring and Water Treatment:

   a. Provide monitoring and water treatment, if necessary, to achieve compliance with applicable Water Quality Standards.

   b. Provide monitoring results to the appropriate agency as required by the permit.

   c. Send copies of all information transmitted to the appropriate agency to the COR.

1.06 CONTRACTOR RESPONSIBILITIES

A. Permits:

1. Any permits obtained by the Bureau of Reclamation are exceptions to the clause at FAR 52.236-7, Permits and Responsibilities, which requires the Contractor to obtain necessary licenses and permits,

B. Monitoring:

1. Conduct monitoring in order to meet the requirements of the permits which may include:

   a. Sampling,

   b. Site inspections, and

   c. Required laboratory tests to determine effluent characteristics.

C. Reporting Results:

   a. Provide monitoring results to the appropriate agency as required by the permit.

   b. Send copies of all information transmitted to the appropriate agency to the COR.

D. Recordkeeping:

1. Retain records and data for the life of the project or as required by permits, whichever is longer.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 POLLUTION CONTROLS

A. Control pollutants by use of sediment and erosion controls, wastewater and stormwater management controls, construction site management practices, and other controls including State and local control requirements. As shown on the approved SWPPP and as necessary to control pollutants.

B. Sediment and Erosion Controls:

1. Establish methods for controlling sediment and erosion which address vegetative practices, structural control, silt fences, straw dikes, sediment controls, and operator controls as appropriate.

2. Institute stormwater management measures as required, including velocity dissipators, and solid waste controls which address controls for building materials and offsite tracking of sediment.

C. Wastewater and Stormwater Management Controls:

1. Pollution prevention measures:

a. Use methods of dewatering, unwatering, excavating, or stockpiling earth and rock materials which include prevention measures to control silting and erosion, and which will intercept and settle any runoff of sediment-ladened waters.

b. Prevent wastewater from general construction activities such as drainwater collection, aggregate processing, concrete batching, drilling, grouting, or other construction operations, from entering flowing or dry watercourses without the use of approved turbidity control methods.

c. Divert stormwater runoff from upslope areas away from disturbed areas.

2. Turbidity prevention measures:

a. Use methods for prevention of excess turbidity which include, but are not restricted to, intercepting ditches, settling ponds, gravel filter entrapment dikes, flocculating processes, recirculation, combinations thereof, or other approved methods that are not harmful to aquatic life.

b. Wastewaters discharged into surface waters shall meet conditions of the permit(s).

c. Do not operate mechanized equipment in waterbodies without having first obtained a section 404 permit, and then only as necessary to construct crossings or perform the required construction.

D. Construction Site Management:

1. Contractor construction operations:

a. Perform construction activities by methods that will prevent entrance, or accidental spillage, of solid matter, contaminants, debris, or other pollutants or wastes into streams, flowing or dry watercourses, lakes, wetlands, reservoirs, or underground water sources.

1) Pollutants and wastes include, but are not restricted to: refuse, garbage, cement, sanitary waste, industrial waste, hazardous materials, radioactive substances, oil and other petroleum products, aggregate processing tailings, mineral salts, and thermal pollution.

2. Stockpiled or deposited materials:

a. Do not stockpile or deposit excavated materials or other construction materials, near or on, stream banks, lake shorelines, or other watercourse perimeters where they can be washed away by high water or storm runoff, or can in any way encroach upon the watercourse.

3. Petroleum product storage tanks management:

a. Place oil or other petroleum product storage tanks at least 20 feet from streams, flowing or dry watercourses, lakes, wetlands, reservoirs, and any other water source.

b. Do not use underground storage tanks.

c. Construct storage area dikes at least 12 inches high or graded and sloped to permit safe containment of leaks and spills equal to storage tank capacity located in the area plus sufficient freeboard to contain the 25-year rainstorm.

1) Line diked areas with an impermeable barrier at least 50 mils thick.

d. Areas for refueling operations: Lined with impermeable barrier at least 10 mils thick covered with 2 to 4 inches of soil.

END OF SECTION

SECTION 01 57 40

PESTICIDES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work, except as specified.

2. The Contractor is responsible for damages resulting from use of pesticides under these specifications in accordance with the clause titled Permits and Responsibilities.

1.02 DEFINITIONS

A. Pesticides: Includes herbicides, insecticides, fungicides, rodenticides, piscicides, avicides, surface disinfectants, animal repellants, and insect repellants.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 01 57 40-1, Pesticide Use Plan:

1. Not required for insect repellant to be applied directly to clothing, or for small quantities of aerosol insecticides, such as fly and spider sprays, to be applied within or directly to offices or shop buildings.

2. Submit the pesticide use plan when chemicals or applications meet one or more of the following:

   a. Chemicals categorized by the EPA for restricted use.

   b. Chemicals applied to or that can reasonably be expected to contact water; except this requirement does not apply to Rodeo or copper sulfate used for control of noxious weeds.

   c. Chemicals expected to endanger threatened animal or plant species.

3. For each pesticide:

   a. Pesticide Use Proposal Form 7-2223.

      1) Completed by entity responsible for pesticide application.

      2) Form available from:

         a) Bureau of Reclamation, Attn: 86-68200, P.O. Box 25007, Denver, CO 80225-0007.

b. Complete label as defined by Federal Insecticide Fungicide Rodenticide Act of 1947, as amended in 1972 and 1978, containing the following:

1) Brand, common, and chemical names.

2) Ingredients and net contents.

3) Use classification and registered uses.

4) Name and address of manufacturer or registrant, EPA registration number, and the establishment number.

5) Directions for use, including safety information, warnings, and precautions.

c. Material Safety Data Sheet (MSDS).

1.04 DELIVERY, STORAGE, AND HANDLING

A. Comply with labeling and MSDS requirements when dealing with pesticides.

B. Keep records of pesticide types and amounts purchased, delivered, stored, mixed, and actually used, and disposal means of excess. Make records available for review by the COR upon request.

PART 2 PRODUCTS

2.01 PESTICIDES

A. Pesticides: Only those registered with EPA in compliance with the Federal Environmental Pesticide Control Act of 1972, or with State, Navajo Nation or local agencies.

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 57 50

TREE AND PLANT PROTECTION

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work, except as specified.
2. Costs for repair or treatment of injured vegetation and replacement of trees or shrubs are the Contractor's responsibility.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 01 57 50-1, Protection Plan:

1. Description of protective barriers or other methods used to protect vegetation from damage or injury caused by construction operations.

PART 2 PRODUCTS

2.01 REPLACEMENT TREES AND SHRUBS

A. Species: Same as removed tree or shrub or other species approved by the COR.

B. Size: Same size as removed tree or shrub, or maximum practicable size that can be planted and sustained in the particular environment as approved by the COR.

PART 3 EXECUTION

3.01 PRESERVATION AND PROTECTION

A. Preserve natural landscape and preserve and protect existing vegetation not required or otherwise authorized to be removed.

1. Submit requests to remove vegetation not specifically required to be removed to the COR.

B. Conduct operations to prevent unnecessary destruction, scarring, or defacing of natural surroundings in the vicinity of the work.

C. Move crews and equipment within the rights-of-way and over routes provided for access to the work in a manner to prevent damage to grazing land, crops, or property.

D. Protect vegetation from damage or injury caused by construction operations, personnel, or equipment by the use of protective barriers or other methods approved by the COR.

E. Minimize, to the greatest extent practicable, clearings and cuts through vegetation. Irregularly shape authorized clearings and cuts to soften undesirable aesthetic impacts.

F. Do not use trees for anchorages except in emergency cases or as approved by the COR.

1. For such use, wrap the trunk with a sufficient thickness of approved protective material before rope, cable, or wire is placed.

2. Submit requests to use trees for anchorage, except for emergencies. Include description of protective material.

G. Use safety ropes where tree climbing is necessary; do not use climbing spurs.

3.02 REPAIR, TREATMENT, OR REPLACEMENT

A. The Contractor is responsible for injuries to vegetation caused by Contractor operations, personnel, or equipment.

B. Employ the services of an experienced arborist or licensed tree surgeon to direct repair, treatment, and replacement of injured vegetation. Submit qualifications of experienced arborist or licensed tree surgeon to COR prior to employment.

C. Repair or treat injured vegetation without delay and as recommended by and under direction of an experienced arborist or licensed tree surgeon.

D. Remove and dispose of trees or shrubs not required or otherwise authorized to be removed that, in the opinion of the COR, are injured beyond saving.

E. Replace removed tree or shrub with tree or shrub approved by the COR.

1. For a period of 1 year, guy as required, water, and maintain replacement trees and shrubs.

2. Remove and replace any replacement tree or shrub that dies within the 1-year period, and maintain such replacements for a period of 1 year from the date of replacement.

END OF SECTION

SECTION 01 57 60
PROTECTED SPECIES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 PROJECT CONDITIONS

A. Certain native species in the State of New Mexico are protected plant or animal species under State law(s). The Government has ascertained that endangered Migratory Birds and the Mesa Verde Cactus may exist in the areas to be disturbed by construction activities.

B. This project is designed to comply with the Final Biological Opinion for the Navajo-Gallup Water Supply Project as issued by the U.S. Fish and Wildlife Service on February 26, 2009.

C. Migratory Birds:

1. May occur in area between March 15th and August 15th.

a. The Government will survey vegetated areas to be disturbed for endangered migratory birds. The evaluation shall be performed no more than 5 days before an area is to be disturbed.

b. Notify the COR 10 days before disturbing an area.

c. Do not disturb a nesting pair of endangered migratory birds with eggs.

1) Avoid the birds as directed by the COR.

D. Mesa Verde Cactus:

1. If the Mesa Verde Cactus is found in the construction area, the Government will monitor the work in these areas.

a. The Contractor shall coordinate work in these areas with the COR.

E. Insert this section in subcontracts which involve performance of work in areas where protected species may occur.

F. In accordance with State law, the Government may arrange for removal of protected species, and the Contractor shall cooperate with those performing such removal. If these species are not removed, cooperate with and abide by protection plans developed by appropriate State entities to avoid damage to or disturbance of protected species.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 57 90

PRESERVATION OF HISTORICAL AND ARCHAEOLOGICAL DATA

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Except as provided for an equitable adjustment, include in prices offered in the schedule for other items of work.

1.02 DEFINITIONS

A. Cultural Resources: Includes prehistoric, historic, architectural, and traditional cultural properties. These include, but are not limited to, human skeletal remains, archaeological artifacts, records, and material remains related to such property.

B. Cultural Items: Native American cultural items (i.e., funerary objects, sacred objects, objects of cultural patrimony, or human remains) for which protection is prescribed under the Native American Graves Protection and Repatriation Act (NAGPRA) - Public Law 101-601; 104 Stat. 3042, Section 3(d); and 43 CFR Part 10.4.

C. Human Remains: Physical remains of the body of a person.

D. Funerary Objects: Native American items that, as part of the death rite or ceremony of a culture, are reasonably believed to have been placed intentionally at the time of death or later with or near individual human remains.

E. Native American: Of, or relating to, a tribe, people, or culture that is indigenous to the United States.

F. Sacred Objects: Native American items that are specific ceremonial objects needed by traditional Native American religious leaders for the practice of traditional Native American religions by their present-day adherents. These items are specifically limited to objects that were devoted to a traditional Native American religious ceremony or ritual and which have religious significance or function in the continued observance or renewal of such ceremony.

G. Objects of Cultural Patrimony: Native American items having ongoing historical, traditional, or cultural importance central to the Indian tribe itself, rather than property owned by an individual tribal member. These objects are of such central importance that they may not be alienated, appropriated, or conveyed by an individual tribal member.

1.03 PROJECT CONDITIONS

A. The project site has been surveyed and an archeological clearance has been given for construction by the agencies having jurisdiction: Navajo Nation Historical Preservation Department (NNHPD) and State Historical Preservation Office (SHPO).

B. The Government will retain an Archeologist to monitor ground disturbing activity work.

1. The Contractor shall coordinate work with the COR and Government Archaeologist.

C. On-site contractor personnel shall undergo cultural resource awareness training.

1. The Government will provide the training. The training will take approximately 1 hour and USBR will work with the Contractor to schedule a convenient time.

2. Personnel shall complete training before initial groundbreaking takes place.

a. On-site personnel added after the initial cultural awareness training was offered shall complete the training before they will be allowed to work in the project area.

D. Federal legislation provides for protection, preservation, and collection of scientific, prehistorical, historical, and archeological data, including relics and specimens, which might otherwise be lost due to alteration of terrain as a result of Federal construction project.

E. Any person who, without permission, injures, destroys, excavates, appropriates, or removes any historical or prehistorical artifact, object of antiquity, or archeological resource on public lands of the United States is subject to arrest and penalty of law.

F. Comply with federal and state laws when operating on non-Federal and non-Indian lands.

G. Attend weekly coordination meetings. Refer to Section 01 31 19 – Project Management and Coordination.

H. Discovery of Resources:

1. When the Contractor, or Contractor's employees, or parties operating or associated with the Contractor, in performance of this contract discover cultural resources on ROW:

a. Immediately cease work at that location.

b. Provide immediate verbal notification to the CO, giving the location and nature of the findings.

c. Provide immediate verbal notification to the USBR staff archaeologist at 970-385-6540 and 970-385-6521 in Durango, Colorado.

d. Follow with written confirmation to the CO within 12 hours.

2. In addition to notifying the CO; where the discovery occurs on state, tribal, municipal, or private lands, notify the appropriate officials as prescribed by law or within two days, whichever is more stringent.

3. Exercise care so as not to disturb or damage cultural resources uncovered during construction activities and provide such cooperation and assistance as may be necessary to preserve the findings for removal or other disposition by the CO.

4. Do not resume work in the area of discovery until receipt of written notice to proceed from the CO.

I. Where appropriate by reason of discovery, the CO may order delays in time of performance or changes in work, or both. When such delays or changes are ordered, an equitable adjustment will be made in the contract in accordance with applicable clauses of the contract.

J. Mitigate cultural resources as directed by Government on lands outside of Permanent or Construction ROW, including private lands.

1. Coordinate Government cultural resource identifications and inspections.

a. Obtain permission for Government access in arrangements for use of lands outside of the ROW including private lands for use areas or borrow sources.

b. Inspections may take up to 4 months.

c. Obtain Government clearance before disturbing lands outside of the ROW.

K. Insert this section in subcontracts which involve performance of work on jobsite terrain.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 EXCLUSION ZONE

A. Cultural resources were found on the western edge of the site. Fence exclusion zones as directed by the COR and in accordance with 01 56 32 – Safety Fence.

END OF SECTION

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SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. When the schedule includes a separate item for furnishing a material, include cost of furnishing, hauling, storing, and handling in the price offered in the schedule for the item.

2. When the schedule does not included a separate item for furnishing a material, include cost of furnishing, hauling, storing, and handling in the price offered in the schedule for work for which the material is required.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME B1.1-2003(2008)	Unified Inch Screw Threads, (UN and UNR Thread Form)
2.	ASME B1.20.1-1983(2006)	Pipe Threads, General Purpose, Inch

B. Bureau of Reclamation (USBR)

1.	RSHS-2009	Reclamation Safety and Health Standards

1.03 DEFINITIONS

A. Essential Characteristics: As used in these specifications, the term "essential characteristics" is synonymous with the term "salient characteristics."

B. Salient Characteristics: Those qualities of an item that are essential to ensure that the intended use of the item can be satisfactorily realized.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Transport and handle manufactured products in accordance with manufacturer's instructions.

B. Store and protect manufactured products in accordance with manufacturer's instructions and RSHS. Obtain instructions from the manufacturer before delivery of materials to jobsite. Maintain a copy of instructions at jobsite.

C. Remove and replace damaged items with new items.

D. Protect materials subject to adverse effects from moisture, sunlight, ultraviolet light, or weather during storage at jobsite.

E. Store curing compounds, sealants, adhesives, paints, coatings, sealers, joint compounds, grouts, and similar products at the temperature and environmental conditions recommended by manufacturer.

1.05 MAINTENANCE

A. Extra Materials:

1. Furnish additional maintenance materials specified as "extra materials" in the specifications. Provide maintenance material identical to installed material and provide from the same manufacturer's production lot as installed material.

2. Package extra materials for storage and label with complete product identification on packaging.

3. Deliver extra materials to the Government at jobsite and place in storage as directed by the COR.

PART 2 PRODUCTS

2.01 MATERIALS

A. Provide materials required for completion of work.

B. Provide type and quality described in these specifications. Make diligent effort to procure specified materials from any and all sources.

C. Furnish new materials conforming to referenced standards unless otherwise specified.

D. For materials not covered by these or referenced specifications, furnish materials of standard commercial quality.

E. If materials to be used deviate from or are not covered by recognized specifications and standards, submit, for approval, justification for and exact nature of the deviation, and complete specifications for materials proposed for use.

F. Make parts accurately to standard gauge where possible.

1. Use unified screw threads conforming to ASME B1.1 or B1.20.1 for threads, including but not limited to those of bolts, nuts, screws, taps, pipes, and pipefittings.

2. For internal connections only, the Contractor may deviate from ASME standards, provided a complete set of taps and dies are furnished as required to facilitate repair or replacement.

G. Permanently mark fasteners with a symbol identifying the manufacturer and with symbol(s) indicating grade, class, type, and other identifying marks in accordance with reference or applicable standard.

2.02 SUBSTITUTIONS

A. If materials required by these specifications become unavailable, because of Government priorities or other causes, substitute materials may be used.

B. Obtain written approval to use substitute materials from the CO. State in the request for approval the amount of the adjustment, if any, to be made in favor of the Government.

C. The Government's determination as to whether substitution will be permitted and as to what substitute materials may be used, shall be final and conclusive.

D. If approved substitute materials are of less value to the Government or involve less cost to the Contractor than specified material, a contract adjustment will be made in favor of the Government. Where the amount involved or the importance of substitution warrants, a deductive modification to the contract will be issued.

E. No payments in excess of prices offered in the schedule will be made because of substitution of one material for another or because of use of one alternate material in place of another.

2.03 WORKMANSHIP

A. Accurately manufacture and fabricate materials in accordance with best modern practice and requirements of these specifications, notwithstanding minor errors or omissions therein.

B. Use liberal factors of safety and adequate shock-absorbing features in designs, especially for parts subjected to variable stress or shock, including alternating or vibrating stress or shock.

C. Include provisions which prevent components from loosening for shock-absorbing features and parts subject to vibration.

2.04 SOURCE QUALITY ASSURANCE

A. Materials will be subject to inspection in accordance with clause at FAR 52.246-12 "Inspection of Construction" at any one or more of the following locations, as determined by the CO:

1. At place of production or manufacture.
2. At shipping point.
3. At jobsite.

B. To allow sufficient time to provide for inspection, submit at time of issuance, copies of purchase orders, including drawings and other pertinent information, covering material on which inspection will be made as advised by the CO, or submit other evidence if such purchase orders are issued verbally or by letter.

C. Inspection of materials at any location specified above or waiving of inspection shall not be construed as being conclusive as to whether materials and equipment conform to contract requirements under the clause at FAR 52.246-12 "Inspection of Construction," nor shall the Contractor be relieved thereby of the responsibility for furnishing materials meeting the requirements of these specifications.

D. Acceptance of materials will be made only at the jobsite.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer’s recommendations unless otherwise specified.

3.02 FIELD QUALITY ASSURANCE

A. Final inspection and acceptance of materials will be made only at the jobsite after installation and testing.

END OF SECTION

SECTION 01 64 40

GOVERNMENT-FURNISHED PRODUCTS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Except as provided for backcharges and expenses to the Contractor, include cost of unloading, hauling, inspecting, storing, protecting, handling, and caring for products furnished by the Government in prices offered in the schedule for work in which products are to be used.

2. Include cost of handling and installing minor miscellaneous items of metal, timber, and other products for which specific prices are not provided in the schedule, in prices offered in the schedule for work to which they are appurtenant.

3. Pay demurrage charges incurred due to failure to promptly unload railroad cars or trucks.

B. Backcharges and Expenses to the Contractor:

1. The Contractor will be charged for, or required to replace, products lost or damaged after delivery and inspection.

2. The Contractor will be backcharged for products lost or damaged beyond repair after delivery and inspection or for products not incorporated in the work and not returned to the Government. The backcharge amount will be the initial Government product cost at point of delivery or the Government replacement cost at point of delivery, whichever is higher. This amount will include reasonable charges for Government warehousing and handling.

3. When directed by the CO to replace products lost or damaged by the Contractor, such replacement shall be at the Contractor's expense.

4. Repair of products damaged by the Contractor shall be at the Contractor's expense.

C. Estimated Costs:

1. Estimated costs listed in Table 01 64 40A - Government-Furnished Products are provided so that offerors may include in their offers applicable Federal, State, and local taxes and duties on Government-furnished products. These costs are not guaranteed, however, and the Government obligates itself only in that the costs are the Government's best estimates at time offers are received.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 01 64 40-1, Shortage Report:

1. Written report of shortage in or damage to Government-furnished products.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Products furnished by the Government will be available at the Four Corners Construction Office in Farmington, New Mexico.

B. Estimated delivery dates listed in Table 01 64 40A - Government-Furnished Products are provided so that offerors may develop a tentative construction program. These delivery dates are not guaranteed, however, and the Government obligates itself only to make reasonable efforts to secure delivery of items at times and in sequence to permit completion of work within time allowed under a reasonable and orderly construction program.

C. After delivery date, load and haul products from points of delivery to jobsite.

D. If directed by the CO during progress of work, replace products lost or damaged by the Contractor, with equivalent grades of products as approved by the CO and deliver products to the jobsite as directed.

E. Repair products damaged after delivery to the Contractor, which in the opinion of the CO can be repaired satisfactorily.

F. Government-furnished products may be furnished with spare parts and other extra products. Load, haul to jobsite, unload, and protect spare parts and deliver them to the Government at the location directed.

G. Provide warehouses or other means of protection for products which require storage or protection.

H. Provide protection for products that require storage including protection after being removed from indoor storage and before installation.

I. Protect products from distortion, dust, water, or other damage.

J. Place products on timber blocking furnished by the Contractor, if necessary, for proper protection of products.

K. Protect painted and coated surfaces from damage during transportation, inspection, handling, and storage. Protect exposed prime coats of paint or coatings from exposure to direct sunrays and from the weather.

L. Protect surfaces of products which are furnished unpainted.

M. The Government reserves the right to direct the Contractor to provide means of protection for Government-furnished products which reasonably might be required for their storage and care; however, the exercise of or failure to exercise this right shall not be deemed to relieve the Contractor of primary responsibility for protecting Government-furnished products

N. Return unused Government-furnished products to the Government at points convenient to the work, as directed.

1.04 ACCEPTANCE AT SITE

A. Load, transport, unload, uncrate, assemble, install, connect, and test new and existing products. The Contractor shall be responsible for damage sustained by products after Government delivery.

B. Report to the CO in writing, within 24 hours after unloading, shortage in or damage to products when delivered.

PART 2 PRODUCTS

2.01 PRODUCTS

A. The Government will furnish products listed in Table 01 64 40A - Government-Furnished Products.

Table 01 64 40A - Government-Furnished Products

Item No.	Description	Estimated quantity	Estimated delivery date	Estimated cost
1	Modicon M340 PAC/PLC with I/O and communication modules	Five total for pumping plant	90 days after request for delivery	$7,000 each
2.	GE MDS Radio Modem	One for pumping plant	90 days after request for delivery	$1,500 each

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 71 20
SURVEYING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

1. Submittals may be made electronically if approved by the COR. Also the COR will approve of electronic format.

B. RSN 01 71 20-1, Surveying Plan:

1. Describe work layout and survey methods.
2. Include surveying schedule.

C. RSN 01 71 20-2, Resume:

1. Proof of Registration as a licensed surveyor or engineer in New Mexico.

D. RSN 01 71 20-3, Accuracy Check Results:

1. Accuracy check of Government-established primary control.

E. RSN 01 71 20-4, Completed and Reduced Survey Notes:

1. Copy of completed and reduced survey notes for a survey or portion of survey.

F. RSN 01 71 20-5, Original Field Survey Books.

G. RSN 01 71 20-6, Quantity Survey Notes and Computations:

1. Copies required for progress payment. Include itemized statement for work covered by notes and computations.

H. RSN 01 71 20-7, Workday's Survey Notes:

1. Copies when requested by Government.

1.03 PRIMARY CONTROL

A. The Government has established primary control to be used for establishing work lines and grades.

B. Primary control consists of bench marks and horizontal control points in work vicinity.

C. The Government will provide complete listing and identification of primary control within 15 days after issuance of Notice to Proceed.

D. Check and verify primary control and resolve discrepancies with Government before beginning work.

E. Preserve and maintain primary control points until otherwise authorized. Government may reestablish damaged or destroyed primary control points and backcharge reestablishment cost to the Contractor.

1.04 QUALIFICATIONS

A. Surveyors: Experienced construction surveyors under supervision and direction of licensed surveyor with minimum of 5 years experience in charge of construction surveys for construction similar in nature to that required by this contract.

PART 2 PRODUCTS

2.01 SURVEYING MATERIALS AND EQUIPMENT

A. Provide materials and equipment required for surveying work, including, but not limited to, instruments, stakes, spikes, steel pins, templates, platforms, and tools.

B. Except as required to be incorporated in work or left in place, surveying materials and equipment will remain property of Contractor.

PART 3 EXECUTION

3.01 LAYOUT OF WORK SURVEYS

A. Establish lines and grades for work layout from Government- established primary control points.

B. Establish measurements required for work execution to specified tolerances.

C. Provide stakes, markers, and other survey controls necessary to control, check, and guide construction.

3.02 QUANTITY SURVEYS

A. Perform surveys and computations to determine quantities of work performed or placed during each progress payment period.

B. Perform surveys necessary for the Government to determine final quantities of work in place. Final payment quantities will be based on the Government's original terrain data and submitted survey notes and computations.

C. Perform quantity surveys in presence of an authorized Government representative, unless specifically waived. Notify the Government at least 24 hours before performing a quantity survey.

3.03 SURVEY REQUIREMENTS

A. Alignment and ROW Staking: Each 50 feet on tangent and each 25 feet on curves.

B. Slope Staking: Each 50 feet on tangent and each 25 feet on curves, restake every 10 feet in elevation.

C. Structures: Stake out of structures and checkouts before and during construction.

D. Roads: Blue tops each 50 feet on tangent and each 25 feet on curves.

E. Cross-sections: Original, final, and intermediate as required, for structure sites and other locations as necessary for quantity surveys. Survey borrow areas before and after removal of materials, but before final shaping.

F. As-builts: As required for structures and other features of work.

G. A licensed surveyor shall survey and stake the ROW boundaries.

3.04 ACCURACY

A. Degree of Accuracy:

1. Alignment of Tangents and Curves: Within 0.1-foot.
2. Structure Points: Set within 0.01-foot, except where installation or operation considerations require tighter tolerances.
3. Blue Tops: Set within 0.1-foot.
4. Cross-Section Points: Locate within 0.1-foot, horizontally and vertically.
5. Vertical Elevation Surveys: Close within 0.05-foot times the square root of the circuit length in miles.

3.05 FIELD RECORDS

A. Record original field notes, computations, and other surveying data in fieldbooks or approved electronic method.

B. Record survey data in accordance with recognized professional surveying standards.

1. Notes or data not in accordance with standard formats will be rejected.

2. Illegible notes or data or erasures on any page of a fieldbook will be sufficient cause for rejection of part or all of fieldbook.

3. Corrections by ruling or lining out errors will be permitted.

4. Copied notes or data will not be permitted.

5. Rejection of part or all of a fieldbook may necessitate resurveying.

C. Data and notes may be collected on electronic data collection devices with prior approval of the COR.

1. Electronic files of notes: In approved format.

2. Include electronic files and paper copies of notes in submittals.

END OF SECTION

SECTION 01 74 00

CLEANING AND WASTE MANAGEMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work except as specified.
2. Cost of environmental site assessments are the Contractor's responsibility.

1.02 REFERENCE STANDARDS

A. Bureau of Reclamation (USBR)

1.	RSHS-2009	Reclamation Safety and Health Standards

B. Code of Federal Regulations (CFR)

1.	40 CFR 261.3	Definition of Hazardous Waste
2.	40 CFR 700-799	Toxic Substance Control Act
3.	49 CFR 171-179	Transportation - Hazardous Waste Regulations

1.03 DEFINITIONS

A. Hazardous waste: Defined as hazardous by 40 CFR 261.3; or by other Federal, Tribal, State, or local laws or regulations.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 01 74 00-1, Waste Production and Disposal Records:

1. Include certifications that waste was properly disposed.

C. RSN 01 74 00-2, Hazardous Wastes Manifest.

D. RSN 01 74 00-3, Environmental Consultant Resume:

1. Describe experience on similar project.

E. RSN 01 74 00-4, Environmental Site Assessment.

1.05 QUALIFICATIONS

A. Environmental consultant: Minimum 2 years experience in conducting environmental site assessments for similar construction.

1.06 REGULATORY REQUIREMENTS

A. Comply with Federal, State, Navajo Nation and local laws and regulations.

B. Comply with RSHS.

C. Conform to most stringent requirement in cases of conflict between specifications, regulatory requirements, and RSHS.

D. Comply with local regulations for presuppression, suppression, and prevention of fires when burning wastes.

1.07 PROJECT CONDITIONS

A. Report waste materials discovered at jobsite to COR.

1. Cease work in areas where waste may be hazardous.
2. The Environmental Consultant shall investigate waste materials and make recommendations for continuing work. The Government shall review and approve of investigation and recommendations.
3. If waste is hazardous, the CO may order delays in time of performance or changes in work, or both.
4. If such delays or changes are ordered, an equitable adjustment will be made in the contract in accordance with applicable clauses of the contract.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 PROGRESS CLEANING

A. Keep work and storage areas free from accumulations of waste materials and rubbish.

3.02 FINAL CLEANUP

A. Remove temporary plant facilities, buildings, concrete footings and slabs, rubbish, unused materials, concrete forms, and other similar materials which are not part of permanent work.

3.03 DISPOSAL

A. Nonhazardous Waste Disposal:

1. Dispose by removal from jobsite.
2. Recycle at least 25 percent of waste materials. Submit documentation to COR. Documentation shall be in an approved form.
3. Dispose of nonhazardous waste materials that are not recycled at appropriately permitted disposal facilities.
4. Do not burn waste materials.
5. Do not bury waste materials.

B. Hazardous Waste Disposal:

1. Dispose by removal from jobsite.
2. Dispose of hazardous waste materials at appropriately permitted treatment or disposal facilities.
3. Transport hazardous waste in accordance with 49 CFR 171-179.

C. Certification: Certify that wastes are disposed of in accordance with Federal, State, and local regulations.

3.04 SITE ASSESSMENT

A. Upon completion of work, perform site assessment at following areas for work done under these specifications:

1. Hazardous waste accumulation areas.
2. Petroleum dispensing and storage areas.
3. Hazardous material storage areas.
4. Identified clean-up sites.

B. Inspect for 40 CFR 700-799 contaminates.

C. Employ qualified environmental consultant to perform assessments.

D. Demonstrate and document by appropriate analytical sampling that site contamination is less than regulator action cleanup levels. Submit written report with sampling locations, findings, manifests, photos and other pertinent information.

3.05 RECORDS

A. Keep records of types and amounts of waste materials produced.

B. Keep records of waste material disposal.

END OF SECTION

SECTION 01 78 30
PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 01 78 30-1, Final As-built Drawings:

1. Certified marked sets.

1.03 RECORD DRAWINGS

A. Maintain 2 sets of full-size prints of contract drawings marked to show accurate and complete records of as-built conditions. Keep drawings at the jobsite and mark as work progresses.

1. Mark and dimension to show variations between actual construction and that indicated or specified in contract documents.

a. Include buried or concealed construction and utilities.

b. Include existing items, topographic features, and utility lines revealed during construction which differ from those shown on contract drawings.

2. Mark to define construction actually provided where choice of materials or methods is permitted in specifications, or where variations in scope or character of work from that of the original contract are authorized.

B. Use standard drafting practice to represent changes and include supplementary notes, legends, and details necessary to clearly portray as-built construction.

C. Mark as-built drawings in the following colors:

1. Red - Additions to original drawings.

2. Green - Deletions to original drawings.

3. Blue - Notations necessary for explanation of as-built markings.

D. Allow the Government to review the drawings at all times.

E. Upon completion of work, sign marked prints as certified correct.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 80 15
COMMISSIONING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include cost in applicable prices offered in the schedule for those items requiring commissioning.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 01 80 15-1; Testing Procedures.

C. RSN 01 80 15-2; Calibration Certification Documents.

D. RSN 01 80 15-3; Test Reports.

1.03 COMMISSIONING

A. Following installation, adjustment, and calibration but prior to Government acceptance, conduct acceptance tests to verify proper operation of the auxiliary and mechanical systems listed below and mechanical equipment within them. Before the acceptance tests, complete the electrical system testing described in Division 26.

1. Plant unwatering system.
2. Domestic water and sanitary waste system.
3. Service and domestic water system.
4. Service air system.
5. Heating, ventilating, and air-conditioning system.
6. Sump pumps.
7. Air chamber compressors and systems.
8. Flow meters.
9. Generator.
10. Cranes.
11. Main pumping units.
12. Chlorine Disinfection System (typical test procedures are not available for review).

B. Typical acceptance test procedures are available for examination at FCCO. The test procedures are typical and may not contain all the information required for test procedures

C. Conduct testing required by the individual equipment and piping specifications sections prior to the acceptance tests required by this section.

D. If pressurization of any systems is required in the testing procedures or specifications include how the system will be pressurized, how the pressurized water or air will be discharged and where the water or air source will be obtained from. Any water system that is potable will be tested with potable water.

E. Do not schedule testing until procedures are approved

F. If references are used in the testing procedures, include a copy of the reference in the testing procedures.

1.04 NOTIFICATION

A. Notify COR in writing 14 days prior to performing each acceptance test.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 PREPERATION

A. Calibrate test equipment conducting tests including pressure gauges.

3.02 EQUIPMENT AND SYSTEMS TESTS

A. Perform equipment and systems tests in presence of COR. Obtain and record necessary data during tests. Make repairs or adjustments until operation of equipment is acceptable to COR.

B. Provide instrumentation, test equipment, and personnel necessary for performing tests.

END OF SECTION

SECTION 02 82 20

ASBESTOS-CEMENT PIPE REMEDIATION

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include cost in the lump sum prices offered in the schedule for Road Crossings.

1.02 REFERENCE STANDARDS

A. American Water Works Association (AWWA)

1. AWWA Work Practices for Work Practices for Asbestos-Cement Pipe - 1995

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 REMOVAL

A. If asbestos-cement pipe is encountered during excavation drilling for line pipe, follow safety practices outlined in AWWA Work Practices for Asbestos-Cement Pipe. Strictly adhere to “recommended practices” contained in AWWA Work Practices for Asbestos-Cement Pipe and make them “mandatory practices” for this work.

B. Remove abandoned asbestos-cement pipe across the entire length exposed resulting from pipe trench excavation or drilling operations.

C. Minimize exposure to asbestos particles by employing appropriate work practices in accordance with AWWA Work Practices for Asbestos-Cement Pipe.

3.02 DISPOSAL

A. Dispose of removed asbestos-cement pipe in accordance with Section 01 74 00 – Cleaning and Waste Management.

END OF SECTION

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SECTION 03 11 10

CONCRETE FORMING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include cost of furnishing and constructing forms in applicable prices offered in schedule for concrete items for which forms are required.

1.02 REFERENCE STANDARDS

A. American Concrete Institute

1. ACI 318-11 Building Code Requirements for Structural Concrete and Commentary

B. APA – The Engineered Wood Association (APA)

1. APA PS 1-09 Structural Plywood

C. Bureau of Reclamation (USBR)

1. RSHS-2009 Reclamation Safety and Health Standards

D. Western Wood Products Association (WWPA)

1. WWPA G5-2011 Western Lumber Grading Rules 2011

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 03 11 10-1, Formwork Design and Drawings:

1. Include design and drawings for:

a. Retaining Wall, Pump Station and Chlorine Feed Building foundations.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 FORM MATERIALS

A. Sheathing or Lining: Conform to Table 03 11 10A - Form Sheathing or Lining Materials, or provide other materials which will produce equivalent results.

Table 03 11 10A - Form Sheathing or Lining Materials

Finish	Wood sheathing or lining	Steel sheathing or lining
F1	Any grade common board or plywood	Steel sheathing permitted Steel lining permitted
F2	No. 2 common or better, shiplap, or plywood	Steel sheathing permitted Steel lining permitted if approved

B. Steel sheathing is steel sheets not supported by wood backing. Steel lining is thin sheets supported by wood backing.

C. Wood Sheathing or Lining: Softwood or plywood of such kind and quality and treated or coated so that deterioration or discoloration of formed concrete surfaces due to chemical action, contamination, or uneven absorption of water from concrete is prevented.

D. Plywood: APA PS 1, Exterior, Grade B-B Concrete Form, Class I, mill oiled and edge sealed.

E. Softwood Lumber:

1. Meet requirements of WWPA G5 for dressed lumber or worked lumber of specified grade.
2. Use common boards surfaced on both edges (S2E) in accordance with WWPA G5.
3. Use 6- or 8-inch wide lumber for shiplap forms.
4. Use same lumber width in forms for F2 finishes.

3.02 DESIGN

A. Design formwork for Retaining Walls, Pumping Plant and Chlorine Building foundations.

B. Design formwork in accordance with RSHS.

C. Designs and drawings performed by and stamped by a registered professional engineer.

3.03 INSTALLATION

A. Construct forms to confine and shape concrete to required lines so that completed work meets specified structural deviations, surface tolerances, and finish requirements.

B. Construct forms with sufficient strength to withstand pressure from placing and vibrating concrete. Maintain in proper position.

C. Adjust formwork design and concrete placing rate to compensate for hydraulic pressures exerted on forms by concrete with high fluidity.

D. Where form vibrators are to be used, construct forms with sufficient rigidity to effectively transmit energy from form vibrators to concrete without damaging formwork or altering form position.

E. Seal surfaces and joints of forms to prevent absorption of water into forms or loss of mortar from concrete.

F. Place chamfer strips in corners of forms and at tops of wall placements to bevel edges of permanently exposed concrete surfaces. Do not bevel interior angles of intersecting concrete surfaces and edges of construction joints except as indicated on drawings.

G. Install sufficient plumb and string lines to monitor formwork positions before concrete placement. Monitor plumb and string lines during concrete placement and correct deficiencies in formwork.

H. F2 Finish:

1. Use one type of form sheathing or lining material for exposed F2 surfaces.
2. Construct forms to produce a uniform and consistent texture and pattern on face of concrete. Metal patches on forms are not permitted.
3. Place form sheathing or lining so that horizontal form marks are continuous across entire surface.
4. For forms constructed of plywood form lining or shiplap panels, make vertical form marks continuous for entire height of surface.
5. For forms constructed of shiplap which is not paneled, cut boards square, stagger vertical joints in boards, and place vertical joints at studs.

I. Form Ties and Anchors:

1. Embed ties for holding forms.
2. Terminate ties not less than 2 diameters or twice minimum dimension of tie, whichever is greater, from formed surface of concrete, except where F1 finish is permitted.
3. Install ties so ends or end fasteners can be removed without causing spalling at face of concrete.

4. Provide form anchors as required to ensure that concrete surfaces will meet specified tolerances. Replace form anchors embedded in concrete which are loosened before placement of adjoining concrete with other supports firmly embedded in hardened concrete.

J. Cleaning and Oiling Forms:

1. Clean form surfaces of encrustations of mortar, grout, or other foreign material.

2. Coat form surfaces with a form oil which will prevent sticking and will not soften or stain concrete surfaces or cause concrete surface to become chalky or dust producing.

3.04 REMOVAL

A. Remove forms within 24 hours after concrete has gained sufficient strength to prevent damage by form removal.

1. Non-supporting forms such as sides of beams, walls, columns, and similar items: Remove after cumulatively curing at not less than 50 degrees Fahrenheit for 24 hours from time of concrete placement when:

a. Concrete is sufficiently hard so as not to sustain damage by form removal operations.

b. Curing protection is maintained.

2. Forms for elevated structural slabs or beams:

a. Remove in accordance with ACI 318, Chapter 6.

b. Do not remove forms until concrete has reached compressive strength of at least 80 percent of specified 28-day compressive strength, as determined by test cylinders.

3. Forms on upper sloping faces of concrete, such as forms on waterside of warped transitions: Remove as soon as concrete has attained sufficient stiffness to prevent sagging.

4. Wood forms for wall openings: Loosen as soon as loosening can be accomplished without damage to concrete to prevent excessive stress in concrete from swelling of forms. Construct forms for openings to facilitate loosening.

B. Do not remove forms until concrete strength is such that form removal will not result in perceptible cracking, spalling, or breaking of edges or surfaces, or other damage to concrete.

C. Remove forms in a manner which prevents damage to concrete.

D. Repair damaged concrete in accordance with Section 03 30 00 - Cast-In-Place Concrete.

E. Begin required repair and curing immediately after form removal.

END OF SECTION

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SECTION 03 15 12
PVC WATERSTOP

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for items of work requiring waterstop.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM D638 - 10	Tensile Properties of Plastics
2.	ASTM D746 - 07	Brittleness Temperature of Plastics and Elastomers by Impact
3.	ASTM D747 - 10	Apparent Bending Modulus of Plastics by Means of a Cantilever Beam
4.	ASTM D1203 - 10	Volatile Loss From Plastics Using Activated Carbon Methods

B. United States Army Corps of Engineers (COE)

1.	COE CRD-C-572-74	Polyvinylchloride Waterstop

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 03 15 12-1, Purchase Orders:

1. Copies of purchase orders for waterstop.

C. RSN 03 15 12-2, Certification:

1. Manufacturer's certification of physical property data for PVC compound used to fabricate waterstop.
    a. Tests shall be performed by manufacturer or other laboratory no more than 18 months before submittal.

D. RSN 03 15 12-3, Drawings:

1. Details of waterstops, including dimensions, shapes, and details of intersections, changes of direction, and splices.

E. RSN 03 15 12-4, Instructions:

1. Manufacturer’s recommendations for installing and splicing waterstop.

1.04 QUALIFICATIONS

A. Use skilled workmen to make splices.

B. Demonstrate to COR that workmen are sufficiently skilled to fabricate required splices.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store waterstop to protect, from oil, dirt, and sunlight.

PART 2 PRODUCTS

2.01 PVC WATERSTOPS

A. PVC Compound:

1. Domestic virgin PVC with additional resins, plasticizers, stabilizers, or other materials required to meet specified requirements.

2. Do not use reclaimed PVC or manufacturer's scrap.

B. Meet physical characteristic requirements specified in Table 03 15 12A - PVC Waterstop Physical Characteristics.

Table 03 15 12A - PVC Waterstop Physical Characteristics

Property	Test Method	Requirement
Tensile strength, minimum	ASTM D 638, specimen type IV, speed 20 in/min. (500 mm/min.)	2,000 lbs/in^2
Ultimate elongation, minimum	ASTM D 638, specimen type IV, speed 20 in/min. (500 mm/min.)	300 percent
Stiffness in flexure, minimum	ASTM D 747	600 lbs/in^2
Low temperature brittleness at -35 degrees Fahrenheit	ASTM D 746	No cracking or chipping
Volatile loss, change in weight, maximum	ASTM D 1203, method A, 0.08-inch-thick specimen	0.50 percent
Tensile strength after accelerated extraction test, percent of tensile strength before extraction test, minimum	COE CRD-C-572	80 percent

Table 03 15 12A - PVC Waterstop Physical Characteristics

Property	Test Method	Requirement
Ultimate elongation after accelerated extraction test, percent of ultimate elongation before extraction test, minimum	COE CRD-C-572	80 percent
Change in weight after effect of alkalies test	COE CRD-C-572	+0.25 percent -0.10 percent
Change in Shore durometer hardness after effect of alkalies test	COE CRD-C-572	±5 percent

C. Prepare test specimens in accordance with COE CRD-C-572.

2.02 FABRICATION

A. Mold or extrude so that cross section will be dense, homogeneous, and free from porosity and other imperfections.

B. Conform to detail dimensions and tolerances indicated on standard drawing 40-D-6463.

C. Fittings:

1. Intersections and changes of direction: Factory fabricated as recommended by manufacturer.

2.03 ACCESSORIES

A. Provide hog rings or brass grommets spaced at 12 inches along length of waterstop.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install waterstops at locations shown on drawings.

B. Install in accordance with manufacturer’s recommendations.

C. Position waterstop so that a continuous watertight diaphragm will be formed in joint.

1. Position waterstop so that one-half of waterstop width will be embedded on each side of concrete joint.

D. Protect waterstop during work.

1. Do not nail, puncture, or cut waterstop.

2. Protect waterstop from dirt, form release oil, oil, grease, and curing compound.

E. Secure and support waterstop to prevent movement during concrete placement.

1. Attach waterstop to rebar on 12-inch centers with wire ties.

F. Concrete Placement:

1. Remove large pieces of aggregate near waterstop by hand so that complete contact is achieved between waterstop and surrounding concrete.

2. Apply additional vibration to concrete surrounding waterstop so that waterstop is completely embedded in concrete, and concrete fills spaces between waterstop ribs.

3.02 FIELD SPLICES

A. Limited to straight butt joint splices.

B. Use a miter-box guide and portable saw to make cuts.

C. Make neat splices with waterstop ends joined in true alignment and contact maintained between joined surfaces.

D. Splice by heat sealing adjacent surfaces in accordance with manufacturer's recommendations.

1. Use a thermostatically controlled electric heat source.

2. Use correct temperature to melt material.

3. Do not char material.

E. Make splice so that cooled splice shows no sign of separation when bent by hand to as sharp an angle as possible.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Concrete Reinforcing:

1. Measurement: Weight of reinforcement placed as shown on drawings or directed by COR.
    a. Includes splices located as shown on drawings or relocated splices approved by COR. Does not include splices allowed for the convenience of the Contractor.
    b. Does not include weight of accessories.
2. Payment: Pound price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American Concrete Institute (ACI)

1.	ACI 315-99	Details and Detailing of Concrete Reinforcement (Part of SP-66-04 ACI Detailing Manual)

B. ASTM International (ASTM)

1.	ASTM A185 / A185M - 07	Steel Welded Wire Reinforcement, Plain, for Concrete
2.	ASTM A497 / A497M - 07	Steel Welded Wire Reinforcement, Deformed, for Concrete]
3.	ASTM A615 / A615M - 12	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
4.	ASTM A996 / A996M - 09b	Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 03 20 00-1, Reinforcement Diagrams and Lists:

1. Bar-placing diagrams, bar lists, and bar-bending diagrams required for reinforcement fabrication and placement.

a. Prepare bar-placing diagrams, bar lists, and bar-bending diagrams in accordance with ACI 315 and drawings.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid rusting.

B. Protect from contaminants such as grease, oil, and dirt.

C. Provide for identification after bundles are broken and tags removed.

PART 2 PRODUCTS

2.01 STEEL REINFORCING

A. Reinforcing Bars:

1. ASTM A615, Grade 60; or ASTM A996, Type A, Grade 60.
2. Deformed steel bar.

B. Reinforcing Fabric: ASTM A185 or ASTM A497, electrically-welded wire fabric.

C. Dowel Bar System:

1. Smooth Dowel Bars: ASTM A 615, Grade 50, plain round.
2. Speed Dowel System, as manufactured by Greenstreak, Inc. www.greenstreak.com or equal having the following essential characteristics:
   a. Manufactured to accept smooth bars.
   b. Two component system, including a closed end sleeve to allow for axial movement and a reusable attachment base.
   c. Compressibility of the system shall exceed 4500 lbs/in^2.

2.02 ACCESSORIES

A. Chairs, Hangers, Spacers, and Other Supports:

1. Material: Concrete, metal or other approved material.
   a. Compressive strength of precast concrete blocks: Equal to or greater than surrounding concrete.

PART 3 EXECUTION

3.01 INSTALLATION

A. Clean reinforcement surfaces of heavy, flaky rust; loose mill scale; dirt; grease; and other foreign substances before placement.

B. Field bending not allowed unless approved by COR.

1. Do not use heat to bend.

C. Do not use torch to cut.

D. Accurately Place Reinforcement:

1. Place reinforcement as shown on standard drawing 40-D-6263, unless otherwise shown on reinforcement design drawings.
2. Unless otherwise prescribed, placement dimensions shall be to the centerline of the bars.
3. Place reinforcement with a clear distance of 1-inch, minimum, between reinforcement and anchor bolts, form ties, or other embedded metalwork unless otherwise shown on drawings.

E. Splices:

1. Locate where shown on drawings, unless otherwise approved by COR.
2. Reinforcement may be spliced at additional locations for the convenience of the Contractor, subject to approval of COR

F. Do not weld or tack weld reinforcing bars.

G. Secure reinforcement in place so that it will not be displaced during concrete placement.

H. Do not disturb reinforcement in concrete that has been placed.

I. Tolerances:

1. Maintain concrete cover over reinforcement within 1/2-inch of specified cover where specified cover is greater than 2-1/2 inches.
2. Maintain concrete cover over reinforcement within 1/4-inch of specified cover where specified cover is 2-1/2 inches or less.
3. Maintain spacing of reinforcing bars within 1-inch of required spacing.

END OF SECTION

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SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Pump Station Concrete:

1. Measurement: Volume of concrete measured to structure neatlines shown on drawings.

   a. Where concrete is placed on or against excavated surfaces, measurement will be made to lines for which payment for excavation is made.

   b. Measurement of other concrete will be made to structure neatlines shown on drawings.

   c. Volume of openings, recesses, embedded pipes, and metalwork larger than 100 square inches in cross section will be deducted.

2. Payment: Cubic yard price offered in the schedule.

   a. Includes cost of work and materials for concrete except as specified.

   b. No payment will be made for concrete that is wasted; replacement of damaged or defective concrete; concrete used to fill overexcavated areas; and concrete placed by the Contractor in excavations intentionally performed to facilitate the Contractor's operations.

   c. Includes cost of cementitious materials.

B. Chlorine Feed Building Concrete:

1. Measurement and Payment: As detailed for Pump Station Concrete.

C. Vault Concrete:

1. Measurement and Payment: As detailed for Pump Station Concrete.

D. Retaining Wall Concrete:

1. Measurement and Payment: As detailed for Pump Station Concrete.

E. Concrete Lined Ditch:

1. Measurement and Payment: As detailed for Pump Station Concrete.

F. Cost:

1. Include the concrete for the following items, in the applicable prices offered in the schedule:

a. Encasements and blocking for Line Pipe and Manifolds.

b. Chain link fences.

c. Pads for the evaporative cooler(s), engine generator, switchgear, propane tank, fuel vaporizer and overflow apron.

d. Includes cementitious materials and reinforcing.

1.02 REFERENCE STANDARDS

A. American Concrete Institute (ACI)

1.	ACI 301-10	Structural Concrete
2.	ACI 304R-00(2009)	Guide for Measuring, Mixing, Transporting, and Placing Concrete
3.	ACI 305R-10	Hot Weather Concreting
4.	ACI 306.1-90(2002)	Cold Weather Concreting

B. ASTM International (ASTM)

1.	ASTM C 31 / C 31M - 12	Making and Curing Concrete Test Specimens in the Field
2.	ASTM C 33 / C 33M - 13	Concrete Aggregates
3.	ASTM C 39 / C 39M - 12a	Compressive Strength of Cylindrical Concrete Specimens
4.	ASTM C 42 / C 42M - 13	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
5.	ASTM C 94 / C 94M - 13	Ready-Mixed Concrete
6.	ASTM C 114 - 11b	Chemical Analysis of Hydraulic Cement
7.	ASTM C 117 – 13	Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
8.	ASTM C 136 - 06	Sieve Analysis of Fine and Coarse Aggregates
9.	ASTM C 138 / C 138M - 13	Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
10.	ASTM C 143 / C 143M - 12	Slump of Hydraulic-Cement Concrete
11.	ASTM C 150 / C 150M - 12	Portland Cement
12.	ASTM C 171 - 07	Sheet Materials for Curing Concrete
13.	ASTM C 231 / C 231M - 10	Air Content of Freshly Mixed Concrete by the Pressure Method
14.	ASTM C 260 / C 260M - 10a	Air-Entraining Admixtures for Concrete

15.	ASTM C 309 - 11	Liquid Membrane-Forming Compounds for Curing Concrete
16.	ASTM C 494 / C 494M - 13	Chemical Admixtures for Concrete
17.	ASTM C 595 / C 595M - 13	Blended Hydraulic Cements
18.	ASTM C 618 - 12a	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
19.	ASTM C 1017 / C 1017M - 07	Chemical Admixtures for Use in Producing Flowing Concrete
20.	ASTM C 1064 / C 1064M - 12	Temperature of Freshly Mixed Hydraulic-Cement Concrete
21.	ASTM C 1260 - 07	Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
22.	ASTM C 1293 - 08b	Determination of Length of Change of Concrete Due to Alkali-Silica Reaction
23.	ASTM C 1315 - 11	Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
24.	ASTM C 1567 - 13	Determining the Potential Alkali-Silica Reactivity of Combination of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
25.	ASTM C 1602 / C 1602M - 12	Mixing Water Used in the Production of Hydraulic Cement Concrete
26.	ASTM D 1751 – 04(2008)	Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
27.	ASTM D 1752 - 04a(2008)	Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

C. International Concrete Repair Institute (ICRI)

1.	ICRI 310.2-1997	Guide for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays (formerly No. 03732)

D. Bureau of Reclamation (USBR)

1.	USBR M-47	Standard Specifications for Repair of Concrete, August 1996 (Appendix A of "Guide to Concrete Repair" available at

		http://www.usbr.gov/pmts/materials_lab/repairs/guide.pdf)
2.	USBR Concrete Manual	Concrete Manual, Eighth Edition, Revised Reprint, 1981

1.03 ACRONYMS

A. NRMCA: National Ready Mixed Concrete Association.

1.04 DEFINITIONS

A. Supplementary Cementitious Materials (SCM): Cementitious materials other than portland cement.

1.05 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 03 30 00-1, Approval Data:

1. Mix Design: For each concrete mix.
    a. Mixture proportions.
    b. Material sources.
        1) Name and manufacturer of each cementitious material.
        2) Name of aggregate source(s).
        3) Product name and manufacturer of admixtures to be used in mix.
        4) The Government reserves the right to require submission of samples of concrete materials for testing before or during use in concrete.
        5) The Government reserves the right to require submission of manufacturer's test data and certification of compliance with specifications.
    c. Physical properties:
        1) Compressive strength:
            a) Field test data:
                i. Performed within 12 past months.
                ii. Field test data meeting requirements of ACI 301, paragraph 4.2.3.2.a.
            b) Trial mixtures:
                i. Incorporate admixtures that will be used in production mixes into trial mixes.

ii. Results from trial batches made within past 6 months.

iii. Trial mix test results, three six-inch diameter cylinders each at 7 and 28 days.

iv. Average compressive strength of trial batch cylinders plus 1200 pounds per square inch (psi) at specified design age.

d. Resubmit mix design for change in material source or type.

2. Name and manufacturer of curing compounds, and joint filler.

a. Include application instructions for curing compound.

3. Certifications and test reports:

a. Cementitious materials certifications and test reports:

1) Manufacturer's certification and test reports for each lot from which shipments are drawn.

a) Certify materials were tested during production or transfer in accordance with specified reference standards.

b. Aggregate certification:

1) Producer's physical property, gradation and ASR testing reports for each aggregate source, less than 6 months old.

c. Submittal of certifications and test reports shall not relieve Contractor of responsibility for furnishing materials meeting specified requirements.

C. RSN 03 30 00-2, Concrete Placement Drawings:

1. Drawings for individual concrete placements. More than one placement may be shown on a drawing.

a. An individual concrete placement is defined as a portion of concrete work placed in one continuous operation between specified lines or joints.

b. List contract drawing(s) from which details for placement were obtained.

c. Show locations, dimensions, blockouts, openings, recesses, waterstops, and finishes.

d. Show details of items embedded in or associated with placement except reinforcing steel.

e. Reference related reinforcement drawing(s) associated with placement.

2. Include separate drawing(s) showing placement sequence.

D. RSN 03 30 00-3, Concrete Placement Schedule:

1. Complete, detailed concrete placement schedule showing the Contractor's plan for individual placements including placement of reinforcement and embedded items.
2. Detail as necessary to show location, sequence, and date of concrete placements scheduled for each item of concrete work.
3. Show submittal schedule for placement and reinforcement drawings.

E. RSN 03 30 00-4, Certifications:

1. NRMCA Certification of Production Facilities
2. ACI Concrete Field Testing Technician certification(s).
3. Current calibration of scales, water meters, and admixture dispensers.

F. RSN 03 30 00-5, Test Reports:

1. Aggregate and concrete test reports.

G. RSN 03 30 00-6, Contractor Field Quality Test Results.

1.06 QUALIFICATIONS

A. Ready Mix Plant: Certified by NRMCA.

B. ACI Concrete Field Testing Technician: Grade I.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Furnish batch ticket with each batch of concrete in accordance with ASTM C 94. Deliver ticket to COR at jobsite during batch delivery.

B. Sponge Rubber Joint Filler Storage:

1. Store in protected area at temperature of 70 degrees Fahrenheit (21 degrees Celsius) or less.
2. Do not expose to direct sun.

PART 2 PRODUCTS

2.01 CEMENTITIOUS MATERIALS

A. Submit the following to the COR with cement and pozzolan shipments:

1. Manufactures Certification that the material meets applicable requirements of these specifications.
2. Type or class of material shipped.
3. Manufacturing locations and dates.
4. Lot (bin) number.

5. Date of shipment.

6. Quantity of material shipped.

B. Portland Cement:

1. ASTM C150, Type V:

a. Meet equivalent alkalies requirements of ASTM C 150 - Table 2.

1) Low-alkali limitation for Portland cement may be waived when tests of concrete aggregate source show that low-alkali cement is not required.

b. Meet false-set requirements of ASTM C 150 - Table 4.

C. Blended hydraulic cement: ASTM C 595, Type IP or IS.

1. Meet equivalent alkalies requirement of ASTM C 595, Table 2, Option G and Table 3.

D. SCM:

1. Pozzolan:

a. ASTM C618, Class F.

1) Except:

a) Sulfur trioxide, maximum: 4.0 percent.

b) Loss on ignition, maximum: 2.5 percent.

2) In addition:

a) Meets Effectiveness in Controlling Alkali-Silica Reaction in Table 3 Supplementary Optional Physical Requirements of ASTM C618. Use low-alkali cement for test.

b) Calcium oxide, maximum: 8.0 percent.

c) Pozzolan will have an "R" factor less than 2.5. Pozzolan with this "R" factor will not decrease sulfate resistance of concrete.

i. $R = (C-5)/F$.

ii. C: Calcium oxide content of pozzolan in percent determined in accordance with ASTM C114.

iii. F: Ferric oxide content of pozzolan in percent determined in accordance with ASTM C114.

2. Slag Cement:

a. ASTM C 989, Grade 100 or 120.

2.02 WATER

A. ASTM C1602, including optional requirements of Table 2.

2.03 AGGREGATE MATERIALS

A. Fine Aggregate: ASTM C33.

1. Percent material passing No. 200 sieve shall be less than 3 percent.

B. Coarse Aggregate: ASTM C33, Size No. 57, specified in Table 03 30 00A – Concrete Mixes.

C. Assure aggregates are not deleteriously alkali-silica reactive (ASR).

1. Test fine and coarse aggregates in accordance with ASTM C 1260 for potential deleterious alkali-silica reaction.

a. In accordance with ASTM C 1260, paragraph 9.3, continue readings for 28 days. Acceptance criteria specified below are based on 28-day readings.

b. Expansion is no greater than 0.10 percent:

1) Aggregates are acceptable.

c. Expansion is greater than 0.10 percent, but less than 0.20 percent:

1) Aggregates are acceptable if petrographic examination shows the expansion is not due to ASR.

2) Otherwise, test aggregates according to ASTM C 1567 using components (e.g., coarse aggregate, fine aggregate, cementitious materials, and specific reactivity reducing chemicals) in the proportions proposed for the mixture design and retest.

a) Expansion of the proposed mixture design test specimens, tested in accordance with ASTM C 1567 does not exceed 0.10 percent:

i. Aggregates are acceptable.

b) Expansion of the proposed mixture design test specimens is greater than 0.10 percent:

i. Aggregates are not acceptable unless adjustments to the mixture design can reduce the expansion to less than 0.10 percent, or testing by ASTM C 1293 indicates the aggregates will not experience deleterious expansion.

d. Expansion is greater than 0.20 percent:

1) Test aggregates according to ASTM C 1567 using components (e.g., coarse aggregate, fine aggregate, cementitious materials, and Alkali Silica Reaction (ASR) inhibiting admixtures) in the proportions proposed for the mixture design and retest.

a) For mixes using lithium admixtures, use test procedure COE CRD-C 662.

b) Expansion of the proposed mixture design test specimens, tested in accordance with ASTM C 1567 does not exceed 0.10 percent:

i. Aggregates are acceptable.

c) Expansion of the proposed mixture design test specimens is greater than 0.10 percent:

i. Aggregates are not acceptable unless adjustments to the mixture design can reduce the expansion to less than 0.10 percent, , or testing by ASTM C 1293 indicates the aggregates will not experience deleterious expansion.

2. ASTM C1293 test results may be substituted for ASTM C 1260 test results:

a. Average ASTM C1293 concrete prism expansion less than 0.04 percent at one year: Aggregates acceptable.

b. Average ASTM C1293 concrete prism expansion greater than 0.04 percent at one year: Aggregates not acceptable.

2.04 ADMIXTURES

A. Air-entraining Admixture:

1. ASTM C260.

B. Chemical Admixtures:

1. Do not use chemical admixtures which contain more than 0.1 percent chloride, by weight.

2. Admixtures shall be compatible with each other as certified by the manufacturers.

3. Allowable chemical admixtures:

a. ASTM C494, Type A, D, F, or G.

b. ASTM C1017, Type I or II.

c. ASTM C494, Type C and E, provided they do not contain chlorides.

4. Extended set control admixture:

a. Delvo Stabilizer manufactured by BASF Construction Chemicals, Inc., Website: www.basf-admixtures.com; or equal, with the following essential characteristics:

1) Meets ASTM C494, Type B.

2) Retards setting.

3) Does not reduce concrete strength.

b. To control cement hydration for concrete subjected to hauls in excess of 1-1/2 hours or concrete placements requiring specific delays in setting time.

c. Admixture quantity required to stabilize concrete shall be pre-determined using jobsite materials. Initial concrete setting time shall be monitored and adjusted during the project by a qualified concrete technician provided by the admixture supplier.

2.05 CURING MATERIALS

A. Water: ASTM C 1602, including optional requirements of Table 2.

B. Curing Compound: ASTM C 309

1. Except, moisture loss, maximum: 0.40kg/m^2 in 72 hours.

2. Meet Federal, state, and local regulations for VOCs.

C. Polyethylene film: ASTM C 171, white opaque.

D. White burlap-polyethylene sheeting: ASTM C 171.

2.06 ACCESSORIES

A. Sponge Rubber Joint Filler:

1. ASTM D1752, Type I, except:

a. Test specimen compression load: 50 to 150 lb/in^2.

2. Joint filler adhesive: Non-bituminous adhesive recommended by filler manufacturer.

B. Bituminous Joint Filler: ASTM D 1751.

C. Elastomeric Sealant: ASTM C 920, polyurethane, Use M, Grade NS, Class 25.

2.07 MIX

A. The Contractor shall design and adjust concrete mix.

1. The Government reserves the right to adjust mix proportions when need for adjustment is indicated by results of materials testing.

    a. When required, adjustment of mix proportions by the Government will be in accordance with USBR Concrete Manual.

B. Cementitious Materials Options:

1. Specified portland cement plus 20 percent plus or minus 5 percent by weight of total Cementitious (cement + pozzolan) specified pozzolan, in accordance with ACI 318.

2. Blended hydraulic cement meeting the percent replacement of pozzolan or slag cement specified above.

C. Net Water-cementitious Materials Ratio: 0.45, maximum, by weight.

D. Slump: In accordance with ASTM C 143. As noted in Table 03 30 00A – Concrete Mixes.

E. Compressive Strength:

1. At 28 days, minimum: 4500 lb/in^2.

    a. Acceptance criteria:

        1) In accordance with ASTM C 94, plus 90 percent of test cylinders exceed specified compressive strength at 28 days.

F. Air Entrainment: 5-7 percent air by volume of concrete as discharged at placement, in accordance with ASTM C 231.

G. Design concrete mixes in accordance with Table 03 30 00A – Concrete Mixes. General concrete mix shall be used for concrete unless otherwise specified.

Table 03 30 00A – Concrete Mixes

Mix No	Feature	f'c (lb/in^2)	Max. w/cm *	NMSA**	Percent SCM*** A: Class F Ash B: Slag Cement	Slump	Air Content (percent)	Notes
1	General Concrete	4500 @ 28 days	0.45	No. 57	A or B: 20 ± 5	2" – 4"	5-7	
2	Pumped Concrete	4500 @ 28 days	0.45	No. 57	A or B: 20 ± 5	6" max	5-7	1

*Maximum water/cementitious ratio
**Nominal Maximum Size Aggregate.
*** Percent of total cementitious material (cement + pozzolan), by weight.
NOTES:

1. Concrete with ASTM C 1017, Type I or II plasticizing admixtures, ASTM C 494, Type F, high-range water-reducing admixtures, or Type G, high-range water-reducing and retarding admixtures shall be incorporated into trial batch or historical data.

H. Net water-cementitious materials ratio is maximum, by weight. Cementitious material weight is cement plus SCM.

I. Slump: In accordance with ASTM C 143, as discharged at placement

J. Air Entrainment: Percent air by volume of concrete as discharged at placement, in accordance with ASTM C 231.

K. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field performance methods as specified in ACI 301. For the trial batch method, mix shall be proportioned and stamped by a professional engineer.

L. Concrete Trial Mixes:

1. Average compressive strength of trial batch cylinders at design age: Design strength plus 1,200 lbs/in^2, or field data meeting the over design requirements of ACI 318.

2. Admixtures to be used in mix shall be incorporated into mix design submitted for approval.

3. Air content: Within 1 percent of top of specified range.

4. Slump: Within 1 inch of top of specified range.

2.08 BATCHING, MIXING, AND TRANSPORTING

A. Batch plant shall be NRMCA certified

B. Manufacture and deliver in accordance with ASTM C 94 and ACI C304R.

1. Prepare batch ticket in accordance with ASTM C 94.

C. Provide uniform consistent concrete in each batch.

1. Adjust amount of water and aggregates to compensate for variations in moisture content or grading in the aggregates.

D. Inform COR prior to and after adjustments in batching equipment and control instrumentation.

E. Cold Weather: When air temperature has fallen to or is expected to fall below 40 degrees F, prepare ingredients and mix in accordance with ACI 306.1.

F. Hot Weather: When precautions are necessary, prepare ingredients and mix in accordance with ACI 305R.

1. Cool ingredients before mixing to maintain specified maximum concrete temperature at time of placement
2. Mixing water may be chilled or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
3. Ice replacing batch water must be melted prior to discharge.

G. Prevent appreciable segregation of ingredients.

H. Place concrete within 90 minutes from introduction of cement to water or aggregates.

1. For placing times exceeding 90 minutes, extended set control admixtures may be used when approved by COR.

I. Truck Mixers:

1. Equip truck mixer with dial or digital water meter accurate to within 1 percent of total mix water located between water supply and mixer.
2. Provide a revolution counter which indicates the total number of revolutions of the drum per batch.
    a. Visible from outside the truck.
    b. Reset to zero for each batch.
3. Attach metal plate attached in a prominent place on the mixer listing:
    a. Manufacturer's recommended drum capacity.
    b. Mixing and agitating speeds in accordance with ASTM C 94.
4. Initial mixing: Not less than 70 revolutions and not more than 100 revolutions after ingredients are in the drum.
5. Mix 30 revolutions after addition of tempering water.
6. Mix 10 to 12 revolutions after a prolonged period of agitation.
7. Discharge CLSM before 300 drum revolutions.

J. Manufacture and deliver in accordance with ASTM C 94.

1. In addition to the requirements of ASTM C 94, use a water meter approved by the COR to measure and record mix water for each batch.

K. Provide the following information to the COR.

1. A copy of current calibration of scales and water meters.
2. Mix water information.

2.09 CONCRETE TEMPERATURE

A. Concrete temperature at placing.

1. 50 to 85 degrees Fahrenheit.

2.10 CONTRACTOR BATCH PLANT QUALITY TESTING

A. Independent testing agency shall perform sampling, testing, and reporting as required in Table 03 30 00B - Contractor Batch Plant Quality Testing.

1. Independent testing agency shall meet requirements specified in Section 01 46 20 – Testing Laboratory Services.

2. Personnel conducting tests: Qualified as ACI Concrete Field Testing Technician, Grade 1; or equal.

B. Notify COR immediately of test results showing failure of materials to meet specifications. Notify COR within 2 hours of test results showing materials meet specifications. Submit reports of test results on a weekly basis.

Table 03 30 00B- Contractor Batch Plant Quality Testing

Tests Of	Test Standard	Standard Title	Requirement	Minimum Frequency Of Testing
Aggregate Gradation	ASTM C 136	Sieve Analysis of Fine and Coarse Aggregates	Fine and Coarse Aggregate meets sizing requirements per ASTM C 33.	At the beginning of the project. At the discretion of the Government.
Aggregate Fines content	ASTM C 117	Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing	Fine aggregate meet specified allowable fines content (material passing No. 200 sieve)	At the beginning of the project. At the discretion of the Government before critical concrete placements.
Aggregate moisture content	ASTM C 566	Total Evaporable Moisture Content of Aggregate by Drying	Verify that moisture meter at batch plant is accurate with the material batched.	At the beginning of the project. At the discretion of the Government before critical concrete placements.

2.11 BATCH PLANT QUALITY ASSURANCE

A. The Government will perform, as a minimum, Quality Assurance tests listed in Table 03 30 00C - Batch Plant Quality Assurance Testing. This testing is in addition to the Contractors Quality Control program and does not relieve the Contractor of performing adequate Quality Control testing. The list of Quality Assurance tests is provided only to alert the Contractor to potential impacts to work scheduling.

B. Government testing frequency is at the discretion of the COR. Greater frequency testing is normally performed at the beginning of new work, new crew, or new equipment.

Table 03 30 00C - Batch Plant Quality Assurance Testing

TESTS OF	TEST STANDARD	STANDARD TITLE
Aggregate Gradation	ASTM C 136	Sieve Analysis of Fine and Coarse Aggregates
Aggregate Fines content	ASTM C 117	Materials Finer than 75-μm (No. 200) Sieve in Mineral Aggregates by Washing
Aggregate moisture content	ASTM C 566	Total Evaporable Moisture Content of Aggregate by Drying

C. In addition to specified Contractor Quality Testing, the Government may also perform the tests listed in Table 03 30 00B - Contractor Batch Plant Quality Testing.

D. Enclosed Building:

1. Not less than 200 square feet at location approved by COR.
2. Minimum height: 8 feet.
3. Ventilated.
4. Provide a minimum of one 20-amp, 120-volt outlet.
5. Used to safely procuring and handling representative concrete samples.

PART 3 EXECUTION

3.01 PREPARATION

A. Remove standing water, mud, and debris from foundation surfaces to be covered by concrete.

B. Prepare rock surfaces free from oil, objectionable coatings, and loose, semidetached, and unsound fragments. Immediately before placement of concrete, wash rock surfaces with an air-water jet and dry to a uniform surface-dry condition.

C. Prepare earth foundations free from frost or ice.

D. Subgrade temperature shall be above 32 degrees Fahrenheit.

E. Preheat subgrade and reinforcement for cold weather placements.

F. Thoroughly moisten surfaces of absorptive foundations to be covered with concrete so that moisture will not be drawn from fresh concrete. Keep subgrade moisture uniform without puddles or dry areas.

G. Clean, roughen, and surface dry surfaces of construction joints and existing concrete to be covered with fresh concrete.

1. Remove laitance, loose or defective concrete, coatings, sand, curing compound, and other foreign material.
2. Sandblast, steel shotblast, or high-pressure water jet surfaces, or use other method approved by COR to create a surface equivalent to or larger than CPS 5 in accordance with ICRI 310.2.
3. Wash surface thoroughly, and surface dry immediately before placement of adjoining concrete.
4. Construction joints shall be approved by Inspector.

H. Cover reinforcing steel with water soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedding in concrete.

I. Fog spray forms, reinforcing steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without puddles or dry areas.

3.02 PLACING

A. Notify COR at least 24 hours before batching concrete. Include:

1. Quantity of concrete for each daily placement.
2. Batch concrete in presence of COR, unless waived.

B. Do not place concrete without approval of the COR.

C. Place concrete in presence of COR.

D. Allow at least 7 days between adjacent placements, or as approved by COR.

E. Do not use aluminum pipes and chutes for placing or pumping concrete.

F. Adding water to concrete batch at the site will be allowed only once and only when approved by the COR.

1. Additional water shall be added before concrete is discharged.
2. Do not exceed specified water to cement ratio.
3. After water is added, concrete shall be mixed for at least 30 revolutions of the mixer drum at mixing speed.
4. Record added water on the batch ticket to nearest gallon.

G. Adding air entraining admixtures to concrete batch at the site will be allowed only once when approved by the COR.

1. After air entraining admixture is added, concrete shall be mixed for a minimum of 30 revolutions of the mixer drum at mixing speed.
2. Contractor quality testing and Government quality assurance tests will be taken after air-entraining admixture addition and additional revolutions.
3. Record added air entraining admixture on the batch ticket to nearest ounce.

H. Do not use concrete which has become so stiff that concrete cannot be properly placed.

I. Place formed concrete in continuous, approximately horizontal layers. Do not exceed 20 inches in depth of layers.

J. Vibrate concrete until concrete has been consolidated to maximum practical density, is free from pockets of coarse aggregate, and closes snugly against surfaces of forms and embedded materials.

K. Hot Weather:

1. Place concrete in accordance with ACI 305R.

L. Cold Weather:

1. Place concrete in accordance with ACI 306.1
2. Do not place concrete on frozen subgrade or subgrade containing frozen materials.

3.03 FINISHING

A. Notify COR before finishing concrete.

B. Finish concrete in presence of Government inspector unless inspection is waived in each specific case.

C. Finish surfaces as specified in Table 03 30 00H – Formed Surfaces and Table 03 30 00I – Unformed Surfaces.

D. Where finishes are not specified or shown on drawings for a particular surface, finish concrete as specified for similar work.

E. Formed Surfaces:

1. Finish class is designated by symbols F1 and F2.
2. Finish F1:
   a. Applies to formed surfaces to be covered by fill material, grout, or concrete, and construction joint surfaces as specified in Table 03 30 00H – Formed Surfaces.
   b. Protect form tie rod ends on surfaces in contact with fill material from moisture where they will be below the water table or waterline.

1) Recess tie rod ends and fill recess with dry pack or other material approved by COR.

c. Cut off flush with formed surface form tie rod ends on surfaces in contact with concrete or fill material and above maximum water table or waterline elevation.

3. Finish F2:

a. Applies to exposed formed surfaces not permanently concealed by fill material, grout, or concrete, and to contraction joint surfaces and expansion joint surfaces as specified in Table 03 30 00H – Formed Surfaces.

1) Recess tie rod ends and fill recess with dry pack or other material approved by COR.

F. Unformed Surfaces:

1. Do not use dry Portland cement or additional water during finishing.

2. Do not use “jitterbugs” or other tools to force coarse aggregate away from surface.

3. Finish class is designated by symbols U1, U2, U3, or broom finish.

4. Finish U1 (Screeded Finish):

a. Applies to unformed surfaces to be covered by fill material, grout, or concrete as specified in Table 03 30 00I - Unformed Surfaces..

b. Use as first stage of finish U2 and U3.

c. After concrete is placed and consolidated, strike off and level concrete to produce even uniform surface.

5. Finish U2 (Floated Finish):

a. Applies to unformed surfaces not permanently concealed by fill material, grout, or concrete, and not required to receive finish U3, as specified in Table 03 30 00I – Unformed Surfaces.

b. Begin floating as soon as screeded surface has sufficiently stiffened and bleed water sheen has disappeared.

c. Use hand- or power-driven equipment.

d. Finish surface with minimum floating necessary to produce a surface that is free of screed marks and is uniform in texture.

e. Use as second stage of finish U3. Floating shall bring a small amount of mortar without excess water to the surface, so as to permit effective troweling.

6. Finish U3 (troweled finish):

a. Applies to unformed surfaces where appearance and porosity is considered by Government to be of special importance as specified in Table 03 30 00I – Unformed Surfaces.

b. Begin steel troweling after bleed water has disappeared and floated surface has sufficiently hardened to prevent an excess of fine material from being drawn to surface.

c. Trowel with firm pressure to flatten sandy texture of floated surface.

d. Trowel to a dense uniform surface free from blemishes and trowel marks. Do not excessively trowel surface.

7. Slope interior surfaces for drainage where shown on drawings or as directed by COR. Slope surfaces exposed to the weather for drainage as directed by COR.

8. Slope narrow surfaces, such as tops of walls and curbs, approximately 3/8-inch per foot of width, unless use of other slopes or level surface is indicated on drawings or is directed by the COR.

9. Slope broader surfaces; such as walks, platform, and decks; approximately 1/4-inch per foot unless use of other slopes or level surfaces is indicated on drawings or is directed by the COR

3.04 JOINTS AND EDGES

A. Construction joints (CJ):

1. Construction joints are joints which are purposely placed in concrete to facilitate construction, reduce initial shrinkage stresses and cracks, allow time for installation of embedded metalwork, or allow for subsequent placing of other concrete.

2. Bond is required at construction joints regardless of whether or not reinforcement is continuous across joint.

3. Locate construction joints where shown on drawings or approved by COR.

4. Relocation, and or addition, of construction joints will be subject to approval by COR.

5. Clean, roughen, and surface dry surfaces of construction joints to be covered with fresh concrete. See Preparation article.

6. Do not use a mortar layer on construction joints.

B. Control joints (Ct.J):

1. Control joints are joints placed in concrete to provide for control of initial shrinkage stresses and cracks of monolithic units.

2. Construct control joints so no bond exists between concrete surfaces forming the joint.

a. Construct control joints by placing concrete on one side of joint and allowing it to set before concrete is placed on other side of joint.

b. Coat surface of concrete first placed at control joint with curing compound that prevents bond before placing concrete on other side of joint.

3. Reinforcement is continuous across control joints.

C. Contraction joints (Cr.J):

1. Contraction joints are joints placed in concrete to provide for volumetric shrinkage of a monolithic unit or movement between monolithic units.

2. Construct contraction joints so no bond exists between concrete surfaces forming the joint.

a. Construct contraction joints by placing concrete on one side of joint and allowing it to set before concrete is placed on other side of joint.

b. Coat surface of concrete first placed at contraction joint with curing compound that prevents bond before placing concrete on other side of joint.

3. Except as provided for dowels, reinforcement is not continuous across a contraction joint.

D. Expansion joints (EJ):

1. Form in concrete. Do not saw cut.

2. Cut sponge rubber joint filler to size and shape of joint surface to receive filler.

3. Adhere filler to concrete in accordance with adhesive manufacturer's recommendations.

4. Butt sections of filler with tight-fitting butt joints to prevent mortar from seeping through joint.

E. Saw cut joints:

1. Saw cuts are only permitted when reinforcement cover is sufficient.

2. Saw cut joints shall be completed within 24 hours following concrete placement.

3. Joints shall have straight, sharp edges and cut to the minimum width possible with the type of saw used.

4. The minimum depth of saw cuts shall be 1/4 of the depth of the concrete unless otherwise indicated on the drawings.

F. Edges:

1. Permanently exposed concrete, except slabs and top edges of curbs: Chamfer edges with a 45 degree bevel 3/4-inch by 3/4-inch; unless otherwise shown on drawings.

2. Exposed edges of slabs and top edges of curbs: Tool to a radius of 1/4-inch.

G. Preformed joints consisting of plastic or metal strips not allowed.

3.05 STRUCTURAL DEVIATIONS AND SURFACE TOLERANCES

A. Structural deviations are defined as allowable variations from specified lines, grades, and dimensions.

B. Surface tolerances are defined as maximum allowable magnitude of surface irregularities.

C. Specified structural deviations and surface tolerances are consistent with modern construction practice and governed by effects that permissible variations may have upon a structure. COR reserves the right to diminish specified structural deviations and surface tolerances where such variations impair structural action, operational function, or architectural appearance of a structure or portion of structure.

D. Construct concrete within stated variations even though more than one may be specified.

1. Specified variation for one element of a structure will not apply when it will permit another element of same structure to exceed its allowable variation.

2. Where variations are not specified or shown on drawings for a particular structure, variations shall be those specified for similar work. As an exception to clause at FAR 52.236-21 “Specifications and Drawings for Construction,” specific tolerances shown on drawings in connection with any dimension shall govern.

E. Structural deviations:

1. Check variations from specified lines, grades, and dimensions in hardened concrete to determine that structures are within tolerances specified in Table 03 30 00D- Deviations from Specified Lines, Grades, and Dimensions.

2. Variation is distance between actual position of structure or any element of structure and specified position in plan for structure or particular element.

a. Plus or minus variations, shown as (∀), indicate a permitted actual position up or down and in or out from specified position in plan.

b. Variations not designated as (+) or (-) indicate maximum deviation permitted between designated successive points on completed element of construction.

3. Specified position in plan is defined as lines, grades, and dimensions described in these specifications, shown on drawings, or prescribed by COR.

Table 03 30 00D - Deviations from Specified Lines, Grades, and Dimensions

BUILDINGS			
1.	Footings:		
	(a)	Variation in length and width dimensions from those specified	-1/2 inch +2 inches
	(b)	Horizontal misplacement or eccentricity:	2 percent of footing width in direction of misplacement, but not more than 2 inches
	(c)	Reduction in thickness	5 percent of specified thickness
2.	Variation of horizontal dimensions at all floor and roof levels from specified position in plan:		
	(a)	Overall building dimensions	±1/2 inch per 100-foot length with maximum for entire length of ∀1 inch
	(b)	Overall bay dimensions as limited by 2(c)below but not to exceed	±3/8 inch
	(c)	Intermediate dimensions for column, wall, and partition locations:	
		(1) For dimensions less than 10 feet	±1/4 inch
		(2) For dimensions equal to or greater than 10 feet but less than 20 feet	±3/8 inch
		(3) For dimensions 20 feet or more	±1/2 inch

Table 03 30 00D - Deviations from Specified Lines, Grades, and Dimensions

3.	Variation of vertical dimensions from specified position in plan:	
	(a) Overall building dimensions	±1/2 inch
	(b) Overall story height as limited by 3(c)below but not to exceed	±3/8 inch
	(c) Intermediate dimensions:	
	(1) Less than 10 feet	±1/4 inch
	(2) 10 to 20 feet, inclusive	±3/8 inch
	(3) 20 feet or more	±1/2 inch
4.	Variation from plumb or specified batter for lines and surfaces of columns, piers, walls, and for arrises:	
	(a) When overall height of line or surface is:	
	Less than 10 feet	±1/4 inch
	10 to 20 feet, inclusive	±3/8 inch
	More than 20 feet, but less than 40 feet	±1/2 inch
	40 feet or more	±1 inch
	(b) For any two successive intermediate points on the line or surface separated by:	
	10 to 20 feet, inclusive	1/4 inch
	More than 20 feet	3/8 inch
5.	Variation from plumb for lines and surfaces of corner columns, control joint grooves, and other conspicuous lines:	
	(a) When overall height of line or surface is:	
	Less than 10 feet	±1/4 inch
	10 to 20 feet, inclusive	±3/8 inch
	More than 20 feet	±1/2 inch
	(b) For any two successive intermediate points on the line or surface separated by:	
	10 to 20 feet, inclusive	1/4 inch
	More than 20 feet	3/8 inch

Table 03 30 00D - Deviations from Specified Lines, Grades, and Dimensions

6.	Variation from level or established grades for floors, roof decks, ceilings, beam soffits, and arrises:	
	(a) When overall length of line or surface is:	
	Less than 10 feet	±1/4 inch
	10 to 20 feet, inclusive	±3/8 inch
	More than 20 feet, but less than 40 feet	±1/2 inch
	40 feet or more	±3/4 inch
	(b) For any two successive intermediate points on the line or surface separated by:	
	10 to 20 feet, inclusive	1/4 inch
	More than 20 feet	3/8 inch
7.	Variation from level or specified grades for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:	
	(a) When overall length of line or surface is:	
	Less than 10 feet	±1/4 inch
	10 to 20 feet, inclusive	±3/8 inch
	More than 20 feet	±1/2 inch
	(b) For any two successive intermediate points on the line or surface separated by:	
	10 to 20 feet, inclusive	1/4 inch
	More than 20 feet	3/8 inch
8.	Variation in location from specified position in plan of sleeves and wall openings	±1/2 inch
9.	Variation in sizes from those specified for sleeves, floor openings, and wall openings, except wall openings for swinging doors	±1/4 inch
10.	Variation in sizes from those specified for wall openings for swinging doors	-0 inch +1/4 inch
11.	Variation in cross-sectional dimensions from those specified for columns and beams and in thicknesses from those specified for slabs and walls	-1/4 inch +1/2 inch

Table 03 30 00D - Deviations from Specified Lines, Grades, and Dimensions

12.	Variation in rise and tread of steps from that specified:	
	(a) Flight of stairs:	
	Rise	±1/8 inch
	Tread	±1/4 inch
	(b) Consecutive steps:	
	Rise	1/16 inch
	Tread	1/8 inch
13.	Variation from level or specified grades for slabs, beams, soffits, horizontal joint grooves, and arrises:	
	(a) Exposed construction:	
	(1) When overall length of line or surface is:	
	Less than 10 feet	±1/4 inch
	10 feet or more	±1/2 inch
	(2) For any two successive points on the line or surface separated by:	
	10 to 20 feet, inclusive	1/4 inch
	More than 20 feet	1/2 inch
	(b) Buried construction:	
	(1) When the overall length of line or surface is:	
	Less than 10 feet	±1/2 inch
	10 feet or more	±1 inch
	(2) For any two successive points on the line or surface separated by:	
	10 to 20 feet, inclusive	1/2 inch
	More than 20 feet	1 inch
14.	Variation in the thickness of slabs, walls, arch sections, and similar members from that specified	-1/4 inch +1/2 inch
15.	Variation in location from specified position in plan of sleeves, floor openings, and wall openings	∀1/2 inch
16.	Variation in sizes from those specified for sleeves, floor openings, and wall openings	±1/4 inch

F. Surface Irregularities:

1. Bulges, depressions, and offsets are defined as surface irregularities or roughness.

2. Surface irregularities are classified as “abrupt” or “gradual” and allowable tolerances are specified in Table 03 30 00E - Surface Tolerances.

   a. A surface tolerance is designated by a capital “T” followed by a number 1 through 5.

   b. Surface tolerance designations are separate from surface finishes and structural deviations.

3. Abrupt surface irregularities:

   a. Abrupt surface irregularities are defined as offsets such as those caused by misplaced or loose forms in which maximum dimension of irregularity perpendicular to surface is greater than maximum dimension of irregularity in plane of surface.

   b. Abrupt surface irregularities include all incidences of isolated surface irregularities which exceed specified gradual irregularities.

4. Gradual surface irregularities:

   a. Gradual surface irregularities are defined as bulges and depressions resulting in gradual changes on surface.

   b. Gradual surface irregularities are further defined as isolated undulations on surface. Maximum dimension of undulation perpendicular to surface is small relative to maximum dimension of undulation in plane of surface.

5. Check magnitude of surface irregularities of formwork and finished surfaces to ensure that surfaces are within specified tolerances.

G. Surface Tolerances:

Table 03 30 00E - Surface Tolerances

Concrete surface	Maximum allowable surface irregularity tolerance	
	Abrupt	Gradual
T1	1 inch	1/4 inch/inch
T2	1/2 inch	1/8 inch/inch
T3	1/4 inch	1/16 inch/inch
T4	1/8 inch	1/32 inch/inch
T5	1/32 inch	1/120 inch/inch

H. Repair of hardened concrete not within specified tolerances.

1. Repair hardened concrete which is not within specified tolerances to bring it within those tolerances.

2. Perform repair after consultation with a Government inspector regarding method of repair. Notify COR as to time when repair will be performed.

3. Repair concrete which will be exposed to view in a manner which will result in a concrete surface with uniform appearance.

   a. When grinding surfaces exposed to view, limit depth of grinding such that no aggregate particles are exposed more than 1/16-inch in cross section at finished surface.

   b. Where grinding has caused or will cause exposure of aggregate particles greater than 1/16-inch in cross section at finished surface, repair concrete by excavating and replacing concrete.

I. Field Verification of Surface Tolerances:

1. Determine compliance of a surface with specified surface tolerances.

2. Evaluate surface roughness.

   a. Measure roughness height or depth and check for compliance with values specified in Table 03 30 00E - Surface Tolerances and Table 03 30 00D - Deviations from Specified Lines, Grades, and Dimensions.

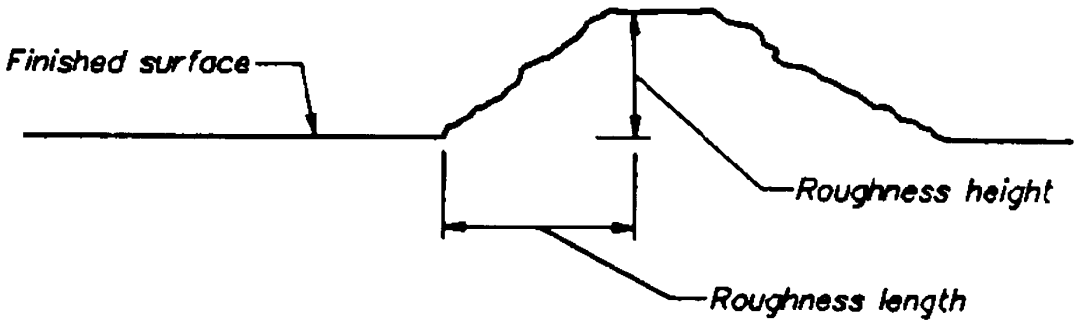
   b. When measured height or depth of roughness is less than value in abrupt tolerance specification and height or depth of roughness does not cause structure to exceed any applicable value specified in Table 03 30 00D - Deviations from Specified Lines, Grades, and Dimensions, surface roughness is acceptable.

   c. When roughness height or depth exceeds abrupt tolerance specification, determine roughness slope for comparison to gradual tolerance specification.

      1) Measure roughness length and determine roughness slope by dividing roughness height or depth by roughness length (see Figure 1).

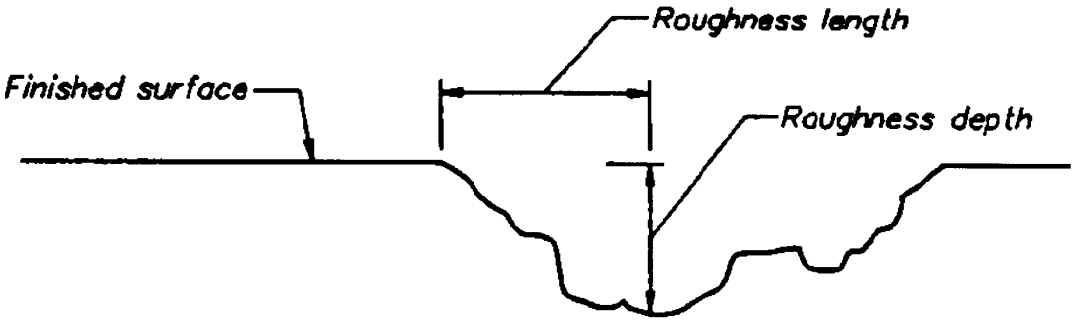
      2) When roughness slope is greater than slope specified by gradual tolerance specification, surface roughness is unacceptable.

      3) When roughness slope is less than gradual slope specified and gradual roughness does not cause structure to exceed allowable structural deviations, surface roughness is acceptable.



$$\text{Roughness slope ratio} = \frac{\text{Roughness height}}{\text{Roughness length}}$$

CASE 1 = Offset on the Surface



$$\text{Roughness slope ratio} = \frac{\text{Roughness depth}}{\text{Roughness length}}$$

CASE 2 = Offset into the Surface

FIGURE 1

J. Prevention of repeated failure to meet tolerances.

1. When concrete placements result in hardened concrete which does not meet specified tolerances, submit to COR an outline of preventive actions such as modifications to forms, modified procedure for setting screeds, and different finishing techniques to be implemented to avoid repeated failures. Submit when requested by COR.

2. Government reserves the right to delay concrete placements until preventive actions which have been approved by COR are implemented.

3.06 CURING

A. Water Curing:

1. Keep concrete surface wet for 14 days, minimum, from time concrete has attained sufficient set to prevent detrimental effects to surface.

2. Cure methods:

a. Water-saturated material.

b. System of perforated pipes, mechanical sprinklers, or porous hose.

c. Other methods which will keep surfaces wet.

d. Subject to approval by COR.

B. Curing with Curing Compound:

1. Apply to concrete surface to provide a water-retaining film. Reapply as necessary to maintain a continuous, water-retaining film on surface for 28 days.

2. Thoroughly mix compound and spray apply in one coat to provide a continuous, uniform film over surface.

3. Do not exceed coverage rate recommended by curing compound manufacturer. Decrease coverage rate on rough surfaces as necessary to obtain required continuous film.

4. Ensure ample coverage on edges, corners, and rough surfaces.

5. Use spray equipment recommended by curing compound manufacturer.

C. Sheet Material Curing:

1. Includes curing with polyethylene film or white burlap-polyethylene sheet.

2. Thoroughly moisten concrete surface by lightly spraying with water as soon as concrete has hardened sufficiently to prevent damage.

3. Completely cover concrete surface with sheet material to provide an airtight, water-retaining film over entire surface.

4. Lap edges of sheet material to seal adjacent sheets.

5. Place tightly against concrete surface at extreme edge of curing area.

6. Secure sheet material to withstand wind and prevent circulation of air inside sheet material.

7. Keep surface covered for 14 days, minimum.

3.07 CONTRACTOR FIELD QUALITY TESTING

A. Independent testing agency shall perform sampling, testing, and reporting as required in Table 03 30 00F - Contractor Field Quality Testing.

1. Independent testing agency shall meet requirements specified in Section 01 46 20 – Testing Laboratory Services.

2. Personnel conducting tests: Qualified as ACI Concrete Field Testing Technician, Grade 1; or equal.

B. Notify COR immediately of test results showing failure of materials to meet specifications. Notify COR within 2 hours of test results showing materials meet specifications. Submit reports of test results as specified.

Table 03 30 00F - Contractor Field Quality Testing

Tests Of	Test Standard	Standard Title	Minimum Frequency Of Testing
Fresh Concrete Properties - tests performed at site	ASTM C 143	Slump of Hydraulic-Cement Concrete	1 set of tests per load for first two loads. When tested concrete meets specifications, perform one set of tests each day of placement for each mixture for the first 50 or less cubic yards, and 1 set of tests for each additional 100 cubic yards of concrete. Perform a minimum of one set of tests per hour during placements. When concrete does not meet specifications, perform tests until 2 consecutive loads meet specifications, then resume testing frequency specified above. Note: Density (Unit Weight) and yield do not have acceptance criteria, but are requested for information only.
	ASTM C 231	Air Content of Freshly Mixed Concrete by the Pressure Method (alternative to ASTM C 138 gravimetric method)	
	ASTM C 1064	Temperature of Freshly Mixed Hydraulic-Cement Concrete	
	ASTM C 138	Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete	

Table 03 30 00F - Contractor Field Quality Testing

Tests Of	Test Standard	Standard Title	Minimum Frequency Of Testing
Compressive Strength,	ASTM C 31 ASTM C 39	Making and Curing Concrete Test Specimens in the Field Compressive Strength of Cylindrical Concrete Specimens	Collect 1 set of samples for each day of placement for each mixture for the first 50 or less cubic yards, and 1 set of samples for each additional 100 cubic yards of concrete. A minimum of 5 samples for strength testing shall be made each time strength samples are collected. Collect 2 additional test cylinders during placement in adverse (hot or cold) weather. Cure these samples on jobsite under the same conditions as the concrete the cylinders represent for a minimum of 7 days, then transfer to the testing laboratory until testing at strength design days. Test 2 cylinders each at 7 days age and 2 cylinders at strength design age. Maintain the last cylinder for testing in the event that the strength design age test results fall below the required strength.
Concrete Cores	ASTM C 42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete	At discretion of the Government when cylinder strengths fail to meet minimum requirements. The Contractor shall obtain core specimens in accordance with ASTM C 42 at locations directed by COR, at no additional cost to the Government. The Contractor shall repair the core holes in accordance with USBR M-47 as directed by COR

C. Acceptance Criteria:

1. Cylinder compressive strength:

   a. In accordance with ASTM C 94, except as follows:

      1) 90 Percent of test cylinders exceed specified compressive strength at design age.

      2) Average compressive strength of any six consecutive test cylinders exceeds specified compressive strength at design age.

      3) No individual strength test falls below specified compressive strength by more than 500 lb/in^2.

2. Drilled concrete cores:

   a. Concrete in placement represented by core tests will be considered structurally adequate when average compressive strength of three cores is

equal to at least 85 percent of the specified compressive strength and no single core has a compressive strength of less than 75 percent of the specified compressive strength.

3.08 FIELD QUALITY ASSURANCE

A. The Government will perform, as a minimum, Quality Assurance tests listed in Table 03 30 00G - Field Quality Assurance Testing. This testing is in addition to the Contractors Quality Control program and does not relieve the Contractor of performing adequate Quality Control testing. The list of Quality Assurance tests is provided only to alert the Contractor to potential impacts to work scheduling.

B. Government testing frequency is at the discretion of the COR. Greater frequency testing is normally performed at the beginning of new work, new crew, or new equipment.

Table 03 30 00G - Field Quality Assurance Testing

Tests Of	Test Standard	Standard Title
Fresh Concrete - Tests performed at site	ASTM C 143	Slump of Hydraulic-Cement Concrete
	ASTM C 231	Air Content of Freshly Mixed Concrete by the Pressure Method (alternative to ASTM C 138 gravimetric method)
	ASTM C 1064	Temperature of Freshly Mixed Hydraulic-Cement Concrete
Compressive Strength	ASTM C 31	Making and Curing Concrete Test Specimens in the Field
	ASTM C 39	Compressive Strength of Cylindrical Concrete Specimens

C. Compressive Strength Acceptance Criteria:

1. In accordance with ASTM C 94, plus the following:

   a. 90 Percent of test cylinders exceed specified compressive strength at design age.

   b. Average compressive strength of any six consecutive test cylinders exceeds specified compressive strength at design age.

   c. No individual strength test falls below specified compressive strength by more than 500 lb/in^2.

D. When cylinder compressive strengths fail to meet minimum requirements, the Government may test concrete core compressive strengths in accordance with ASTM C 42. The Contractor shall obtain core specimens in accordance with ASTM C 42 at locations directed by the COR, at no additional cost to the Government. The Contractor shall repair the core holes in accordance with USBR M-47 as directed by the COR.

1. Concrete in placement represented by core tests will be considered structurally adequate when average compressive strength of three cores is equal to at least 85 percent of the specified compressive strength and no single core has a compressive strength of less than 75 percent of the specified compressive strength.

2. Concrete in placement represented by core tests will be considered adequate for durability when average compressive strength of three cores is equal to at least 100 percent specified compressive strength at design age.

E. In addition to specified Contractor Quality Testing, the Government may also perform the tests listed in Table 03 30 00F - Contractor Field Quality Testing.

3.09 PROTECTION

A. Protect concrete from damage until final acceptance by Government.

1. Do not load, remove forms or shoring, or backfill against concrete until concrete has gained sufficient strength to safely support its weight and imposed loads.

2. Protect fresh concrete against erosion from rain, hail, sleet, or snow; contamination from foreign materials; and damage from foot traffic until the concrete has hardened.

3. Protect concrete from heavy foot traffic and other construction activities by covering with plywood or other suitable material. Remove and dispose of temporary covering when no longer required.

B. Protect concrete when freezing temperatures are imminent.

1. Maintain concrete at a temperature of 50 degrees Fahrenheit (10 degrees Celsius) or greater for 72 hours, minimum, after placement. Vent heater and prevent concrete from drying where artificial heat is employed.

2. Protect concrete from freezing during water curing. After discontinuance of water curing, maintain at a temperature of 50 degrees Fahrenheit (10 degrees Celsius) or greater for next 72 hours.

3. Discontinue protection against cold weather such that the drop in temperature of the concrete will be gradual and will not exceed 5 degrees Fahrenheit per hour and 40 degrees Fahrenheit in 24 hours.

3.10 REPAIR

A. Repair concrete in accordance with USBR M-47.

B. Use repair or replacement method directed by COR.

3.11 FINISH, SURFACE TOLERANCES, AND CURING SCHEDULES

Table 03 30 00H - Formed Surfaces

Surface	Finish	Tolerances	Acceptable Curing Methods
Surfaces upon or against which fill material will be placed	F1	T1	Water White wax-base, or white water-emulsified resin-base curing compound
Surfaces not permanently concealed by fill material or concrete where appearance is not critical	F2	T2 and T3	Water White wax-base, or white water-emulsified resin-base curing compound

Table 03 30 00I - Unformed Surfaces

Surface	Finish	Maximum Allowable Tolerances	Acceptable Curing Methods
Surfaces to be covered by fill material or concrete	U1	T1	Water White wax-base or white water-emulsified resin-base curing compound Polyethylene film
Surfaces to be covered by grout	U1	T3	Water White wax-base or white water-emulsified resin-base curing compound
Outdoor entrance slabs, walks, and stoops	U2	T3	White wax-base or white water-emulsified resin-base curing compound
Outdoor curbs and gutters	U2	T3	White wax-base or white water-emulsified resin-base curing compound
Outdoor decks and roofs	U2	T5	White wax-base or white water-emulsified resin-base curing compound
Outdoor equipment slabs and foundations	U2	T4	White wax-base or white water-emulsified resin-base curing compound
Tops of walls not prominently exposed to public view	U2	T4	Water Polyethylene film

Table 03 30 00I - Unformed Surfaces

Surface	Finish	Maximum Allowable Tolerances	Acceptable Curing Methods
Floors of vaults, sumps, pullboxes, and entry boxes	U2	T3	Water White wax-base or white water-emulsified resin-base curing compound
Subfloor surfaces not otherwise listed	U2	T5	Water Polyethylene film
Indoor subfloors to receive finish flooring	U3	No abrupt irregularities allowed. Maximum allowable gradual irregularity: 1/240 inch/inch.	Polyethylene film
Interior floors	U3	T5	Polyethylene film
Indoor curbs	U2	T5	Polyethylene film
Masonry substrate	U2	T5	Water Polyethylene film
Indoor trench drain bottoms	U3	No abrupt irregularities allowed. Maximum allowable gradual irregularity: 1/240 inch/inch.	Polyethylene film

END OF SECTION

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SECTION 03 48 00

PRECAST CONCRETE STRUCTURES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Precast Concrete Structures:

1. Payment: Lump sum price offered in the schedule.

a. Includes:

1) Air valve manhole.

2) Chlorine sample tap manhole.

3) Pullbox PB-1.

4) Pullbox PB-2.

5) Blowoff.

1.02 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO)

1.	AASHTO SSHB-02	Standard Specifications for Highway Bridges, Seventeenth Edition

B. ASTM International (ASTM)

1.	ASTM C 33/C 33M-13	Concrete Aggregates
2.	ASTM A 123/A 123M-12	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
3.	ASTM C 478-13	Precast Reinforced Concrete Manhole Sections
4.	ASTM C 858-10	Underground Precast Concrete Utility Structures

1.03 SUBMITTALS

A. Submit the following in accordance with 01 33 00 – Submittals.

B. RSN 03 48 00-1, Product Approval Drawings and Data:

1. Shop drawings and product data for precast vaults including blackouts, sections, joints and joint sealant.

2. Manufacturer's certification of compliance.

3. Manufacturer’s installation instructions.

1.04 SYSTEM DESCRIPTION

A. A plan view showing the locations of the precast concrete manholes is provided on drawing 1695-D-99. Conceptual layouts of the manholes are shown on drawings 1695-D-126 and 1695-D-192.

B. A plan view showing approximate locations of the precast concrete pullboxes is provided on drawing 1695-D-175.

C. Vault for the blowoff is shown on drawing 1695-D-201.

D. Design:

1. Precast concrete structures capable of withstanding HS 20-44 loads as defined in AASHTO SSHB.
2. Covers capable of withstanding HS 20-44 loads as defined in AASHTO SSHB.
3. Contractor shall design precast concrete structures.
4. Block outs as required.

PART 2 PRODUCTS

2.01 CONCRETE MANHOLE SECTIONS

A. Concrete manhole conforming to ASTM C 478, class II.

1. Bell and spigot joints.
2. No elliptical reinforcement allowed.
3. Rubber gasket not required.

B. Joint Sealant: As recommended by manufacturer.

C. Furnish concrete manhole for air valves and blowoff as shown in the drawings.

D. Furnish equivalent size prefabricated lids as shown on drawings.

E. Furnish pipe access manhole frames and covers in accordance with Section 05 50 00 – Metal Fabrications.

F. Ladder Rungs:

1. In accordance with 29 CFR 1910.27.
2. Cast iron, galvanized steel, stainless steel, or polypropylene coated steel.

2.02 RECTANGULAR CONCRETE PULLBOXES

A. Concrete pullbox conforming to ASTM C 858.

B. Joint Sealant: As recommended by manufacturer.

C. Furnish 3-feet 6-inch tall by 4-feet wide, by feet 4-feet long long (inside dimensions), open bottom concrete vault for chlorine system piping as shown in the drawings.

D. Furnish and install equivalent size, HS-20 traffic rated, flush mounted cover..

E. Hot-dipped galvanized steel cover sections fabricated from structural steel and steel plate with raised diamond pattern.

1. Galvanizing: ASTM A 123.

F. Cover sections suitable for manual handling.

2.03 BEDDING

A. ASTM C 33, coarse aggregate, Size No. 57.

PART 3 EXECUTION

3.01 PLACEMENT

A. Place a minimum of 6 inches of aggregate bedding below the Rectangular Concrete Pullboxes, in accordance with Section 31 23 02 – Compacting Earth Materials.

B. Erect precast concrete structures per manufacturer’s recommendations and as located on drawings.

C. Thoroughly clean pipe ends with a wire brush prior to ends being joined (if required). Place bell end down.

D. Place lids and grout any openings as shown on the drawings or directed by the COR.

END OF SECTION

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SECTION 03 63 00
EPOXY GROUT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for items of work requiring epoxy grout.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM C 579-01 (2012)	Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing and Polymer Concretes
2.	ASTM C 580-02 (2008)	Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes
3.	ASTM D 638-10	Tensile Properties of Plastics
4.	ASTM D 696-08	Coefficient of Linear Thermal Expansion of Plastic Between -30 degree C and 30 degree C with a Vitreous Silica Dilatometer

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 03 63 00-1, Approval Data:

1. Grout manufacturer’s product data.
2. Grout manufacturer’s environmental, product storage, preparation, mixing, installation and curing instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver epoxy materials to jobsite in manufacturer’s original unopened packaging with labels and seals intact.

B. Store epoxy materials in protected area in accordance with manufacturer’s instructions.

PART 2 PRODUCTS

2.01 EPOXY GROUT

A. Three-part flowable epoxy grout; resin, hardener, and aggregate filler.

1. CHOCKFAST RED manufactured by ITW Polymer Technologies, 130 Commerce Drive, Montgomery PA or equal, having following essential characteristics:
    a. ASTM C 579 Compressive Strength: Minimum of 15,000 pounds per square inch (psi).
    b. ASTM C 579 Compressive Modulus: 2,000,000 psi.
    c. ASTM D 696 Coefficient of Linear Thermal Expansion:
        1) 11.2×10^{-6}/Degrees F.
    d. ASTM C 580 Flexural Strength: Minimum 4,000 psi.
    e. ASTM D 638 Tensile Strength: Minimum 1,800 psi.
    f. Service temperature: Up to 140 degrees Fahrenheit.
    g. Pot life: Approximately 3 hours at 70 degrees Fahrenheit.
    h. Shelf life: 2 years in dry storage.

B. Aggregate filler as recommended by manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Mix and install grout in accordance with manufacturer's instructions to completely fill space to be grouted.

1. Concrete shall be a minimum of 28 days old.
2. Clean and roughen concrete surfaces.
3. Remove dirt, dust, oil, grease, debris, paint, curing compounds, sealers, and unsound concrete.
4. Mechanically prepare concrete surfaces in accordance with manufacturer's instructions to give surface profile of a minimum of 1/8-inch (3 mm) and expose coarse aggregate of concrete.
5. Concrete shall have an open surface texture.

B. Placement:

1. Place grout at air temperature recommended by manufacturer.
2. Bring materials to be epoxied as close to 70 degrees Fahrenheit as possible.

3. Do not place grout over frozen concrete.
4. Hold grout in place with forms. Prepare forms to prevent sticking of grout.
5. Minimum 3/4-inch x ¾-inch, 45 degree chamfer.
6. Mix grout components in accordance with manufacturer's instructions and technical data sheet.
7. Place grout in accordance with manufacturer's instructions.
8. Finish surface of grout in accordance with manufacturer's instructions.
9. Smooth sharp edges.

C. Protection:

1. Protect placed grout from damage during construction.
2. Maintain grout at a temperature of 50 degrees Fahrenheit or greater for 72 hours, minimum, after placement unless otherwise recommended by manufacturer.
3. Discontinue protection against cold weather such that the drop in temperature of the grout will be gradual and will not exceed 5 degree Fahrenheit per hour and 40 degree Fahrenheit in 24 hours.
4. The more stringent of the grout manufacturer's recommendation or these specifications shall apply.
5. Initial loading:
    a. Loads shall not be applied to the epoxy grout sooner than 72 hours after placement and shall be applied only after the epoxy grout has attained a compressive strength of at least 3,000 pounds per square inch.
    b. The time required for the epoxy grout used to attain this strength will be determined by the COR.
    c. Care shall be taken when applying loads on the hardened epoxy grout, and the Contractor shall be responsible for any damage thereto resulting from impact loads when positioning equipment or metalwork.

D. Protect from movement until grout has fully cured.

END OF SECTION

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SECTION 04 22 10

REINFORCED CONCRETE UNIT MASONRY ASSEMBLIES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Reinforced Concrete Unit Masonry Assemblies:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A 82/A82M-07	Steel Wire, Plain, for Concrete Reinforcement
2.	ASTM A 153/A 153M-09	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
3.	ASTM A 615/A 615M-12	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
4.	ASTM A 951/A 951M-11	Steel Wire for Masonry Joint Reinforcement
5.	ASTM C 90-12	Loadbearing Concrete Masonry Units
6.	ASTM C 140-13	Sampling and Testing Concrete Masonry Units and Related Units
7.	ASTM C 144-11	Aggregate for Masonry Mortar
8.	ASTM C 150/C 150M-12	Portland Cement
9.	ASTM C 207–06(2011)	Hydrated Lime for Masonry Purposes
10.	ASTM C 270–12a	Mortar for Unit Masonry
11.	ASTM C 404-11	Aggregates for Masonry Grout
12.	ASTM C 426-10	Linear Drying Shrinkage of Concrete Masonry Units
13.	ASTM C 476-10	Grout for Masonry

B. International Code Council (ICC)

1.	IBC	2009 International Building Code

C. Masonry Industry Council (MIC)

1.	MIC Manual	Hot and Cold Weather Masonry Construction Manual, 1999

D. Maintain a copy of MIC Manual at jobsite during work.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 04 22 10-1, Approval Data:

1. Manufacturer's product data for each masonry unit, joint reinforcement, and accessory material.

a. Include test results which show minimum compressive strength and maximum water absorption for masonry units.

C. RSN 04 22 10-2, Sample Kit:

1. Manufacturer’s color sample kit for color selection.

D. RSN 04 22 10-3, Certifications:

1. Manufacturer's certification that masonry units meet specified requirements. Attach results from specified source sampling and testing to each certification.

2. Manufacturer's certification that Portland cement and lime meet specified requirements.

E. RSN 04 22 10-4, Mix Design:

1. Mortar mix design indicating type and proportions of ingredients in compliance with the proportion specifications of ASTM C 270.

2. Grout mix design indicating type and proportions of ingredients in compliance with the proportion specification of ASTM C 476.

F. RSN 04 22 10-5, Instructions:

1. Manufacturer's instructions for cleaning masonry units.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store materials off ground and under cover to prevent contact with moisture.

1.05 AMBIENT CONDITONS

A. Comply with recommended practices of MIC Manual for hot and cold weather masonry.

PART 2 PRODUCTS

2.01 MASONRY UNITS

A. ASTM C 90, lightweight, hollow and solid units.

B. Finish: As indicated on the drawings

C. Nominal Size:

1. As indicated on the drawings.

2. Furnish necessary shapes and sizes, bond-beam units, lintel units, and corner units as required to satisfy conditions indicated on the drawings. Include half-size units where required.

D. Color: Selected by Government from manufacturers standard chart in accordance with the Samples and Colors Submittals Article in Section 01 33 00 – Submittals.

2.02 MORTAR MATERIALS

A. Portland Cement: ASTM C 150; Type I, II, or III; standard gray color.

B. Hydrated Lime: ASTM C 207, Type S.

C. Aggregate: ASTM C 144.

D. Water: Clean water free of detrimental amounts of silt, organic matter, alkali, salts, and other impurities.

E. Color: Selected by Government from manufacturers standard chart in accordance with the Samples and Colors Submittals Article in Section 01 33 00 – Submittals.

2.03 GROUT MATERIALS

A. Portland Cement: ASTM C 150; Type I, II, or III.

B. Aggregate: ASTM C 404.

C. Water: Clean water free of detrimental amounts of silt, organic matter, alkali, salts, and other impurities.

2.04 REINFORCEMENTS

A. Joint Reinforcements:

1. ASTM A 951, Ladder Type, with deformed longitudinal wires butt welded to cross wires at 16-inch intervals.

2. Material: ASTM A 82 steel wire.

3. Wire size: No. 9 gage longitudinal and cross wires.

4. Finish: ASTM A 153, Class B-2, hot-dipped zinc coating applied after fabrication.

5. Width: 2 inches less than nominal wall thickness.

6. Provide prefabricated corner and tee sections at wall corners and intersections.

B. Reinforcing Bars: ASTM A 615, Grade 60, deformed steel bar, uncoated.

2.05 CONTRACTOR SOURCE QUALITY TESTING

A. Sample and test masonry units in accordance with ASTM C 140 and ASTM C 426 before shipment to jobsite.

2.06 MORTAR MIX

A. Type: ASTM C 270, Type S, proportion specification using specified materials.

B. Do not add calcium chloride or anti-freeze compounds.

C. Retemper mortar in accordance with ASTM C 270 except use and place mortar within 1-1/2 hours after mixing.

2.07 GROUT MIX

A. Coarse Grout: ASTM C 476, proportion specification using specified materials.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean and roughen concrete substrate surfaces to be in contact with mortar or grout. Remove curing compounds, laitance, efflorescence, loose or defective concrete, sand, dirt, and foreign material.

B. Clean top of unfinished masonry of loose mortar and foreign material before resuming work.

C. Lay concrete masonry units dry. Do not prewet.

D. Clean excess concrete and loose rust from dowel bars to be embedded in masonry.

E. Clean loose rust and coatings from reinforcing bars, joint reinforcements, and metal items to be embedded in masonry.

3.02 COURSING

A. Place masonry plumb, level, and true to required lines.

B. Maintain masonry courses to uniform width.

C. Make vertical and horizontal joints equal and of uniform thickness.

D. Lay units in running bond except as indicated on drawings. Course one unit and one mortar joint to equal nominal unit dimension.

E. Form concave mortar joints.

3.03 PLACING AND BONDING

A. Lay masonry with completely filled mortar joints. Buttering corners of joints and deep or excessive furrowing of mortar joints are not permitted.

B. Do not shift or tap units after mortar has taken initial set. Remove and replace with fresh mortar where adjustment must be made.

C. Keep concrete foundation surfaces to be in contact with grout free of mortar.

D. Keep cells to be grouted free of mortar.

E. Keep wall cavities free of mortar.

F. Remove excess mortar.

G. Saw cut to form straight unchipped edges where jobsite cutting is required. Cut units dry.

3.04 TOLERANCES

A. Variation from unit to adjacent unit: 1/32-inch, maximum.

B. Variation from plane of wall: 1/4-inch in 10 feet and 1/2-inch in 20 feet or more.

C. Variation from plumb: 1/4-inch per story noncumulative, 1/2-inch in two stories or more.

D. Variation from level coursing: 1/8-inch in 3 feet; 1/4-inch in 10 feet; 1/2-inch, maximum.

E. Variation of joint thickness: 1/8-inch in 3 feet.

F. Maximum variation from cross sectional thickness of walls: Plus or minus 1/4-inch.

3.05 REINFORCEMENT INSTALLATION

A. Joint Reinforcements:

1. Place so that longitudinal wires are fully embedded in mortar.
2. Lap ends 6 inches, minimum, at joints between reinforcement sections.

B. Reinforcing Bars:

1. Place reinforcing bars supported and secured against displacement.
2. Maintain position within 1/2-inch of true dimension.
3. Lap bar splices 48 bar diameters, minimum.

3.06 GROUTING

A. Place and consolidate grout fill without disturbing reinforcements.

B. Maintain grout thickness of 1/2-inch, minimum, between bar and masonry units.

C. Place grout in lifts of 4 feet, maximum, as wall is built.

D. Stop grout 1-1/2 inches below top of masonry when grouting is stopped for 1 hour or more.

E. Agitate to consolidate grout and fill space.

F. Grout all reinforced masonry cells.

G. Grout unreinforced masonry cells as indicated on the drawings.

3.07 BUILT-IN WORK

A. Build in steel doorframes and other built-in items.

B. Build in items plumb and level.

C. Bed doorframe anchors in mortar joints.

D. Fill doorframes solid with mortar.

E. Rake joint between doorframes and masonry to 1/4-inch depth for sealant installation.

3.08 CUTTING AND FITTING

A. Cut and fit for pipes, conduits, sleeves, and similar items. Provide correct size, shape, and location.

3.09 POINTING AND CLEANING

A. Cut out and replace defective mortar. Match adjacent work.

B. Remove excess mortar and mortar and grout smears.

C. Clean soiled surfaces.

D. Clean masonry in accordance with manufacturer's instructions. Do not mottle, discolor, stain, damage, or acid burn masonry.

E. Obtain approval of each cleaning method from COR at jobsite before using method on work.

3.10 PROTECTION

A. Provide temporary bracing during erection to support finished work and withstand wind loads. Maintain bracing until structure provides permanent support.

B. At workday's end, cover unfinished work with secure waterproof covers to prevent moisture infiltration. Keep unfinished work covered during work shutdown.

3.11 CONTRACTOR FIELD QUALITY TESTING

A. Complete a Level 1 special inspection of the construction of the masonry walls that is in compliance with the 2009 International Building Code Sections 1704 through 1708.

END OF SECTION

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SECTION 05 12 10
STRUCTURAL STEEL

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Structural Steel:

1. Payment: Lump sum price offered in the schedule.

a. Includes the following items for the pumping plant:

1) Structural steel framing.

2) Structural steel cross bracing.

3) Five-ton crane runway girders.

4) Steel connections and all accessories required for the erection of the structural steel.

b. Includes the following items for the chlorine feed building and outdoor storage:

1) Structural steel framing.

2) Structural steel cross bracing.

3) Two-ton monorail beam.

4) Steel connections and all accessories required for the erection of the structural steel.

1.02 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO):

1.	AASHTO M251	Plain and Laminated Elastomeric Bridge Bearings

B. American Institute of Steel Construction (AISC)

1.	AISC 303-05	Code of Standard Practice for Steel Buildings and Bridges
2.	AISC 325-05	Steel Construction Manual, 13th Edition
3.	AISC 360-05	Specifications for Structural Steel Buildings
4.	AISC RCSC-04	RCSC (Research Council of Structural Connections) Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts (available at www.boltcouncil.org)

C. American Society of Civil Engineers (ASCE)

1.	ASCE Crane Rail	40-lb Carbon Steel Crane Rail

D. American Society of Mechanical Engineers (ASME)

E.	ASME B 18.2.1-2012	Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)

F. ASTM International (ASTM)

1.	ASTM A 1 - 00(2010)	Carbon Steel Tee Rails
2.	ASTM A 36/A 36M-12	Carbon Structural Steel
3.	ASTM A 108-07	Steel Bar, Carbon and Alloy, Cold-Finished
4.	ASTM A 123/A 123M-12	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
5.	ASTM A 153/A 153M-09	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
6.	ASTM A 307-12	Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
7.	ASTM A 325-10	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
8.	ASTM A 385-11	Providing High-Quality Zinc Coatings (Hot-Dip)
9.	ASTM A 500/A 500M–10a	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
10.	ASTM A 563-07a	Carbon and Alloy Steel Nuts
11.	ASTM A 572/A 572M-12a	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
12.	ASTM A 668/A 668M-13	Steel Forgings, Carbon and Alloy, for General Industrial Use
13.	ASTM A 780–09	Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
14.	ASTM A 992/A 992M-11	Structural Steel Shapes
15.	ASTM D 412-06a(2013)	Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
16.	ASTM D 2240-05(2010)	Rubber Property – Durometer Hardness
17.	ASTM E 165/E 165M-12	Liquid Penetrant Examination for General Industry
18.	ASTM E 709-08	Magnetic Particle Texting
19.	ASTM F 436-11	Hardened Steel Washers

20.	ASTM F 844-07a	Washers, Steel, Plane (Flat), Unhardened for General Use
21.	ASTM F 1554-07a	Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

G. American Welding Society (AWS)

1.	AWS D1.1/D1.1M-10	Structural Welding Code - Steel

H. Commercial Item Description (CID)

1.	CID A-A-1923A	Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)

I. Society of Protective Coatings (SSPC)/NACE International (NACE)

1.	SSPC-SP 6/NACE 3-07	Commercial Blast Cleaning
2.	SSPC-SP7/NACE 4-06	Brush-Off Blast Cleaning

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

1. Except as specified, submit drawings and data for each type of steel structure.

B. RSN 05 12 10-1, Dimensional Drawings:

1. Show geometric arrangements and controlling dimensions including anchor bolt and embedded material dimensions.
2. Obtain approval before detailing steel structures.

C. RSN 05 12 10-2, Detail Drawings and Data:

1. Erection Drawings:
    a. Include controlling dimensions, anchor bolt locations, marking and position of each member in structure, number, size, and length of bolts for each joint, and number and thickness of fills for each joint and size, type, location, and special requirements for field welds including filler metal data and required shielding gases or fluxes.
    b. Keep member designations to minimum practicable.
2. Shop Drawings:
    a. Detail members and connections.
    b. Include anchor bolts and embedded materials.
    c. Show controlling dimensions for each structure and type and grade of material and type of finish, and edge planning and preparation details for all shop and field welds.

3. Bill of Materials:

   a. Show number of pieces required in structure; description of each piece including mark number, size, length, and weight; and drawing number for shop detail of that piece.

   b. Summarize weights into a subtotal for structural components; a subtotal for bolts, nuts, locknuts, and fills; and a total weight for structure.

   c. Submit new or original positive reproducible detail drawings and data. Sepia reproducibles are not acceptable.

D. RSN 05 12 10-3, Test Reports:

1. Certified mill test reports of chemical analyses and physical tests of structural steel and bolts for Government review and use.

E. RSN 05 12 10-4, Final Drawings and Data:

1. Submit final drawings and data consisting of detail shop drawings, erection drawings, and bills of material.

2. Show revisions and changes made up to time fabrication is completed.

3. Sepia reproducibles are not acceptable.

F. RSN 05 12 10-5, Fabrication Data for Crane Girders:

1. Method of fabrication.

2. Procedure to meet tolerances shown on drawings.

1.04 QUALIFICATIONS

A. Qualify welding process and operators welds in accordance with AWS D1.1.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Transport and handle in a manner which prevents bending or damage.

B. Prevent damage to zinc and paint coatings.

C. Redip materials on which zinc coating has been damaged unless damage is local and can be field repaired as specified.

D. Repaint materials on which paint coating has been damaged in accordance with Section 09 96 20 - Coatings.

E. Place steel items on timber blocking to prevent ground or surface water contact during storage.

PART 2 PRODUCTS

2.01 MATERIALS

A. Government inspection of materials at mill will be waived subject to Section 01 60 00 - Product Requirements.

B. Structural Steel:

1. W and WT sections: ASTM A 992, Grade 50.
2. Shapes, except W and WT sections: ASTM A 36.

C. Plates and Bars: ASTM A 572, Grade 50.

D. Hollow Structural Shapes (HSS):

1. Tubing 2 inches and larger: ASTM A 500, Grade B.

2.02 ACCESSORIES

A. High-strength and Erection Bolts:

1. ASTM A 325.

B. Anchor Bolts:

1. ASTM F 1554, Grade 36.
2. Unless otherwise shown on the drawings, provide length of bolt threads in accordance with ASME B 18.2.1, Class 2 free-fit, American National coarse thread series.

C. Nuts:

1. ASTM A 563 for ASTM A 325 bolts and ASTM F 1554 anchor bolts.

D. Eyebolts:

1. ASTM A 668, Class C, forged steel.

E. Studbolts:

1. Standard commercial quality.
2. Provide studbolts with flux-filled ends suitable for arc welding to steel with automatically timed stud-welding equipment.

F. Stud Anchors and Headed Shear Connectors:

1. ASTM A 108.
2. Flux-filled ends suitable for arc welding to steel with automatically timed stud-welding equipment.

3. Stub angle shear connectors:
    a. Diameter: 3/4-inch.
    b. Length after welding: 2-1/2 to 3 inches.
    c. Heads: 1-1/4-inch diameter and 3/8-inch minimum thickness.

G. Washers:
1. ASTM F 436 for ASTM A 325 bolts, and ASTM A 668 eyebolts.
2. ASTM A 36 for ASTM F 1554 anchor bolts.
3. Unhardened for general use: ASTM F 844

H. Expansion Anchors:
1. CID A-A-1923, Type 4.
2. Bolt Length: 3-1/2 inches, minimum, embedment length except as indicated on drawings.
3. Expansion Anchors to be in Water: Stainless steel.

I. Locknuts:
1. Deformed-thread one-piece nuts.
2. ASTM A 563.

J. Crane Rails: ASTM A 1 and/or manufacturer's specifications and tolerances.

K. Splice Bars, Bolts, and Accessories for Crane Rails:
1. Commercial quality free from scale and rust which can be removed by firm rubbing with burlap or equivalent treatment.
2. Punch splice bars for tight rail joints.

L. Crane Rail Pads and Washers:
1. Resilient pad Mark 7 manufactured by Gantrex Corporation, Curry Hollow Road, Pittsburgh, PA 15236; or equal, having the following essential characteristics:
    a. Synthetic rubber pad reinforced with a high-strength steel strip.
    b. Shore A hardness: 75 plus or minus 5.
    c. Tensile strength, after aging, minimum: 2,175 pounds per square inch (psi).
    d. Elongation, after aging, minimum: 240 percent.
        1) Permanent set, maximum: 5 percent.
        2) Rebound resilience, minimum: 27 percent.

2. Washers:

   a. Layers of tightly twisted, closely woven, lightweight cotton duck thoroughly impregnated with a rubber compound and vulcanized together.

   b. Fabric:

      1) Retains substantially its original length and width under compression and impact

      2) Withstand loads up to 10,000 pounds per square inch before breakdown.

      3) Damping ratio: 1.6:1.

      4) Does not distort or deteriorate with age, dampness, or atmospheric temperature changes.

M. Bearing Pads: AASHTO M251 Elastomeric bearing pad having the following essential characteristics:

1. Hardness: ASTM D 2240, durometer 60, plus or minus 6.

2. Tensile Strength: ASTM D 412, 2500 psi minimum.

3. Ultimate Elongation: ASTM D 412, 350 percent minimum.

4. Bond gasket to metal with manufacturer's standard adhesive.

N. Crane Rail Clips: Stelcam 4 manufactured by Gantrex Corporation, Curry Hollow Road, Pittsburgh, PA 15236; or equal, having following essential characteristics:

1. Attached to crane runway girder with laterally adjustable rail clips.

2. ASTM A 325 bolts.

3. Minimum lateral force: 1,500 pounds.

4. Dimensions compatible with rail size, 40- pounds ASTM A 1.

5. Constrain rail in vertical and lateral planes while allowing controlled movement in axial direction.

O. Filler Metal and Shielding Gases or Fluxes:

1. AWS D1.1.

2. Use filler metal and shielding gases suitable for base materials, positions, and other conditions.

3. Use filler metal with a minimum tensile strength of 70,000 lb/in^2 for steel.

P. Neoprene Gaskets:

1. Hardness: ASTM D 2240, durometer 60 plus or minus.

2. Tensile strength: ASTM D 412, 1,200 psi minimum.

3. Ultimate Elongation: ASTM D 412, 300 percent minimum.

4. Bond gasket to metal with manufacturer's standard adhesive.

2.03 FABRICATION

A. Where details of design or fabrication are not specified or indicated on drawings, fabricate in accordance with AISC 303 or AISC 360.

B. Edge plane or flame-cut plates of built-up members with mechanically guided torches and grind smooth.

1. Provide square and true plates after the above operation.

2. Edges of web plates may be flame-cut and ground where edge planning is indicated or noted on drawings.

C. Fabricate straight and free from sharp kinks and bends.

D. Remove rust and dirt.

E. Do not injure metal when straightening is necessary.

F. Shearing and Cutting:

1. Shear and cut accurately.

2. Neatly finish work to be exposed to view.

3. Fillet copes and reentrant cuts before cutting.

G. Holes:

1. Holes not shown on drawings or approved shop drawings are not permitted.

2. Structural steel less than 13/16-inch thick: Holes may be punched to full size except as noted on drawings.

3. Structural steel 13/16-inch or more in thickness: Drill or subpunch and ream.

4. Holes shown on drawings as drilled holes: Drill or subpunch and ream.

5. Holes:

a. Cylindrical.

b. Perpendicular to member.

c. Clean-cut without torn or ragged edges.

d. Remove burrs resulting from reaming or drilling with a tool making a 1/16-inch bevel.

H. Punching:

1. Full size punching:

a. Punch diameter: Nominal diameter of hole.

b. Die diameter: Not more than 1/16-inch larger than diameter of punch.

2. Subpunching:

a. Punch diameter: 1/4-inch smaller than nominal diameter of hole.

b. Die diameter: Not more than 3/32-inch larger than diameter of punch.

c. Use subpunch for reamed work so that no punched surface will appear in periphery of hole after reaming.

I. Accuracy of Punching, Reaming, and Drilling:

1. Space holes accurately in accordance with drawings and locate on gauge lines.

2. Do not exceed 1/32-inch variation in hole spacing from spacing indicated on drawings for bolt holes.

J. Welding:

1. Perform welding and related work in accordance with AWS D1.1.

2. Interpret welding terms in accordance with AWS definitions. Use welding symbols shown on shop drawings that comply with AWS symbols.

3. Process: Shielded arc-welding.

4. Welds:

a. As shown on drawings.

b. Continuous unless otherwise noted.

c. In such a manner that residual shrinkage stresses will be reduced to a minimum.

d. Full penetration through material except as indicated on drawings.

5. Stress-relieving treatment: Not required.

K. Measuring:

1. Use a steel tape or rule.

2. Make measurements when steel members and steel tape or rule are within 10 degrees Fahrenheit of ambient temperature.

L. Marking:

1. Mark anchor bolts and embedded material with designations on drawings.

2. Mark individual pieces with designations on approved erection diagrams.

3. Stamp markings before galvanizing or painting.

4. Numerals or letters:

a. Height, minimum: 1/2-inch.

b. Clearly legible after galvanizing or painting.

c. Circle or bracket with black paint.

5. Anchor bolts may be identified by tagging.

M. Baseplates:

1. Fabricate straight and true with square cuts.

2. Grind edges cut by torch straight and smooth.

N. Finish:

1. Where finish type is not specified, use the type of finish most suitable for the part to which it applies.

2. Average Finish:

a. For surfaces in permanent contact where a tight joint is required.

b. Produce smooth surfaces.

c. Slight toolmarks are permitted.

3. Rough Finish:

a. For machine surfaces not requiring average finish.

b. Rough machine sufficient to produce a plane surface true to dimensions.

4. Where finish is indicated on drawings, finish members true to line and free from twists, bends, and open joints, in accordance with noted degree of finish.

O. Compression Joints: Face surfaces of compression joints depending on contact bearings so as to have full contact bearing when aligned and welded.

2.04 SHOP ASSEMBLY

A. Shop assemble a structure structural steel frame of each superstructure to ensure correct fit of parts, adequate bolt lengths, and proper field erection.

1. Pumping Plant:

a. Frame shall consist of a single structural steel braced bay, including columns, beams and bracing.

2. Outdoor Chlorine Storage:

a. Frame shall consist of a single structural steel braced bay, including columns, beams and bracing.

B. Do not ream or elongate mismatched holes.

1. Reasonable amount of drifting is permitted. "Reasonable amount of drifting" is defined as drifting without causing hole elongation or deformation of members.
2. Repair galvanizing damaged during drifting as specified below.

C. Dismantle shop-assembled parts before shipment.

D. Designate members and bolts used in shop assembly by sizes and lengths indicated on approved shop drawings and erection diagrams.

E. Should any part prevent proper assembly, determine correction required and submit revised detail drawings and data.

F. Match mark shop-assembled parts so they may be reassembled in the same position.

G. Coordinate assembly of crane rails, pad, and rail clips with rail manufacturer.

2.05 GALVANIZING AND SHOP PAINTING

A. Cleaning:

1. After shopwork completion, clean materials of rust, loose scale, dirt, oil, grease, slag from welded areas, and other foreign substances.
2. Clean surfaces of metalwork in contact with or embedded in concrete or grouting mortar in accordance with SSPC-SP 6/NACE No. 3.

B. Structural Steel:

1. Pumping Plant
   a. Paint in accordance with Section 09 96 20 – Coatings.
2. Chlorine Feed Building and Outdoor Storage
   a. Galvanize structural steel in accordance with ASTM A 123 and A 385.

C. Anchor bolt, embedded material, plate, and shapes:

1. Galvanize anchor bolts, embedded material, plates, and shapes designated on the drawings for galvanizing after fabrication.
2. After cleaning, zinc coat materials in accordance with ASTM A 123.
3. Where member lengths prevent dipping in one operation, exercise care to prevent warping.
4. Provide finished compression members with lateral variations not greater than 1/1000 the axial length between the points which are to be supported laterally.
5. After galvanizing, remove excess spelter from holes.

D. Hardware:

1. Pumping Plant:
    a. Paint in accordance with Section 09 96 20 – Coatings, except for eyebolts.
    b. Galvanize eyebolts in accordance with ASTM A 153.
        1) Remove excess spelter by centrifugal spinning.
2. Chlorine Feed Building and Outdoor Storage:
    a. Galvanize bolts, nuts, and washers in accordance with ASTM A 153.
        1) Remove excess spelter by centrifugal spinning.
        2) Do not galvanize erection bolts and nuts.

E. Straightening After Galvanizing:
1. Straighten items which have been warped by the galvanizing process by rerolling or pressing.
2. Do not hammer or otherwise straighten material in a manner that will damage the protective coating.
3. Material which has been bent beyond yield point, or which has warped to the extent that it cannot be straightened without damage to the galvanized coating will be rejected.

F. Fabricator's Galvanizing Repair:
1. Redip material with damaged galvanizing unless damage is local and can be repaired by two component epoxy zinc primer.
2. If the galvanized coating becomes damaged after being dipped twice, the material will be rejected.
3. Where local repair is authorized:
    a. Repair damage to galvanizing, including damage due to drifting, repair operations, in accordance with Section 09 96 20 - Coatings.

2.06 CONTRACTOR SOURCE QUALITY TESTING

A. Inspect component parts and welds to determine conformance to drawings, procedures, overall workmanship, weld contour, weld size, and any other pertinent items.
1. Inspect component parts for dimensional compliance.
2. Matchmark mating parts.

B. Shop Welds:
1. Perform inspections and tests in presence of COR and in accordance with AWS D1.1. Notify COR 14 days in advance of test.
2. All welds: Visually inspect entire length in accordance with AWS D1.1.

3. Complete-joint-penetration welds:
    a. Test entire length.
    b. Ultrasonic or radiographic testing: AWS D1.1.
4. Partial-joint-penetration welds and fillet welds:
    a. Test entire length of welds that fail visual inspection.
    b. Magnetic particle or dye penetrant:
        1) Magnetic particle testing technique and procedure: ASTM E 709.
        2) Dye penetrant technique and procedure: ASTM E 165
5. Standards of acceptance: AWS D1.1.
6. When welds are found to be defective, repair welds in accordance with AWS D1.1 and reexamine welds to ensure adequacy of repairs.

C. Maintain permanent information records of component parts such as material specifications, mill test reports, welding procedures, welder's, tacker's, and inspector's identification and qualifications, types of inspections, inspector's test results and records of visual nondestructive testing.

D. Inspect component parts and welds to determine conformance to drawings, procedures, overall workmanship, weld contour, weld size, and any other pertinent items.

1. Inspect component parts for dimensional compliance.
2. Matchmark mating parts.

PART 3 EXECUTION

3.01 ERECTING STEEL STRUCTURES

A. Erect steel structures as specified and as shown on the drawings.

1. Erect by bolting, and in accordance with approved erection diagrams and bills of material.
2. Reasonable amount of drifting allowed.
3. Reaming or elongating of mismatched holes: Not permitted.
4. Holes more than 1/8-inch off in concentric after the connection is temporarily assembled shall be reported to the COR and approval of method of correction shall be obtained.
5. Place bolts with tightened and locked nuts within the shortest practicable time after members have been placed.
6. Where incomplete bolting is determined to be a major factor in structure damage, repair or replace the structure.

7. If shop errors in structure materials are discovered, submit revised shop drawings for approval of proposed field correction or return materials to the manufacturer for correction or replacement.

B. Galvanizing and Painting Repair:

1. Repair damage to galvanizing and/or painting, including damage due to drifting, repair operations, or field drilling for sign attachment, in accordance with Section 09 96 20 - Coatings.

C. Anchor Bolts, Embedded Material, Stubs, and Footings:

1. Set and hold anchor bolts, embedded material, stub angles, or tees in correct position and alignment during the placing and setting of the concrete in concrete footings.

2. Protect contact faces and bolt holes from damage and thoroughly clean them of any contamination prior to assembly.

3. Do not erect any structure on concrete footings until 7 days after the last placement of concrete in those footings, or until all backfill has been placed and compacted where and as required around those footings.

4. Unless specified otherwise, use metal braces, supports, and other items to position and align embedded metalwork, and which will also be embedded in concrete. Do not use wooden braces, supports, or other items to position and align embedded metalwork.

5. Construct suitable blockouts in concrete where required for installation of the metalwork. After installation of the metalwork, fill blockouts with concrete or grout as shown on the drawing.

6. Drill, or drill and tap as required, holes in metalwork required for installation of metalwork.

7. Where shown on the drawing, fill spaces under metalwork completely as required with grout in accordance with Section 03 63 00 – Epoxy Grout.

D. Erection:

1. Steel structures may be erected by assembling sections on the ground and hoisting successive sections into place, or by being built up in place with individual members.

2. If erected in sections, perform initial bolting adequate for dead and live loads and erection stresses, but not so tight as to prevent aligning and fitting adjacent sections or members.

3. Correct misalignment or misfit attributable to the method of erection corrected by adjusting erection methods as necessary to eliminate the problems.

4. Erect crane girder/rail assembly to meet elevation alignment tolerances shown on the drawings.

5. Perform field welding, including welding processes and welding operators, conforming to the requirements of article titled Quality Assurance. Inspect field welds in accordance with article titled Nondestructive Testing of Welds.

6. Tighten A 325 bolts in accordance with AISC RCSC. Bring bolts to the fully tensioned condition.

7. Torque rail clip bolts to 110 ft-lbs.

8. Clean field welds by sandblasting or power grinding. Remove foreign material which may have adhered to steel and would be detrimental to the final appearance of the completed structure.

9. Install and automatically end weld all studbolts in the field with a stud welding gun.

10. Leave unpainted in the shop, or remove paint or other material that would prevent proper welding or produce objectionable fumes while welding from surfaces within 2 inches of any field weld location. After welding, paint in accordance with section 09 96 20 - Coatings.

E. Cleaning: Clean structures of foreign matter that will tend to permanently adhere, with special attention to corrosive salts or substances.

3.02 INSPECTION AND NONDESTRUCTIVE TESTING OF WELDS

A. Field Welds:

1. Perform inspections and tests in presence of COR and in accordance with AWS D1.1.

2. All welds: Visually inspect entire length in accordance with AWS D1.1.

3. Complete-joint-penetration welds:

   a. Test entire length.

   b. Ultrasonic or radiographic testing: AWS D1.1.

4. Partial-joint-penetration welds and fillet welds:

   a. Test entire length of weld that fails visual inspection.

   b. Magnetic particle or dye penetrant:

      1) Magnetic particle testing technique and procedure: ASTM E 709.

      2) Dye penetrant technique and procedure: ASTM E 165

5. Standards of acceptance: AWS D1.1.

6. When welds are found to be defective, repair welds in accordance with AWS D1.1 and reexamine welds to ensure adequacy of repairs.

END OF SECTION

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SECTION 05 15 24

SECONDARY METAL FRAMING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Secondary Metal Framing:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American Iron and Steel Institute (AISI)

1.	AISI S100-07	North American Specification for the Design of Cold-Formed Steel Structural Members

B. ASTM International (ASTM)

1.	ASTM A 653/A 653M-11	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
2.	ASTM A 1011/A 1011M-12b	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
3.	ASTM A 1039/A 1039M–13	Steel, Sheet, Hot Rolled, Carbon, Commercial, Structural, and High-Strength Low-Alloy, Produced by Twin-Roll Casting Process
4.	ASTM E 488/E 488M-10	Strength of Anchors in Concrete and Masonry Elements
5.	ASTM E 1190-11	Strength of Power-Actuated Fasteners Installed in Structural Members

C. American Welding Society (AWS)

1.	AWS A2.4-12	Standard Symbols for Welding, Brazing, and Nondestructive Examination
2.	AWS D1.3/D1.3M-08	Structural Welding Code - Sheet Steel

D. International Code Council (ICC)

1.	IBC	2009 International Building Code

E. Metal Building Manufacturers Association

1.	MBMA Manual	2006 MBMA Metal Building Systems Manual
2.	MBMA Manual Supplement	The 2010 Supplement to the 2006 Metal Building Systems Manual

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 05 15 24-1, Approval Drawings and Data:

1. Project-specific shop drawings.
    a. Show framing plans, elevations, sections, layout, sizes, and dimensions. Include type, grade, size, and thickness of materials, including fasteners.
    b. Welding symbols: In accordance with AWS A2.4.
    c. Project-specific drawings except as permitted for details. Manufacturer's standard or typical drawings may be included to show details. Mark standard or typical drawings to indicate details relevant to project.
    d. Sign and seal by design engineer.
2. Manufacturer's product data.
    a. Include complete descriptions of and specifications for metal framing, fasteners, accessories, and materials.

C. RSN 05 15 24-2, Certifications:

1. Letter of design certification for secondary framing system.
2. Include manufacturer's order number.
3. List design criteria including codes, standards, and loads.
4. Certify structural design complies with specified design requirements.
5. Sign and seal by design engineer.

D. RSN 05 15 24-3, Erection Plans and Manual:

1. Manufacturer's erection plans and manual for framing system.
2. Include manufacturer's instructions for field "touch-up" of finishes.

E. RSN 05 15 24-4, Documentation:

1. Written evidence that building erector is authorized as specified.

1.04 QUALIFICATIONS

A. Designer: Professional engineer registered in State of New Mexico.

B. Erector: Authorized by manufacturer to erect secondary framing system.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver metal framing to jobsite in manufacturer's unopened containers or bundles identified with brand, type, and gage.

B. Protect metal framing from damage and corrosion during storage and handling at jobsite.

1. Store metal framing with sufficient clearance around materials to permit access for inspection and handling.
2. Store and handle metal framing in a manner that will not cause distortion.
3. Store off ground in dry ventilated space.
4. When materials are stored outdoors, store materials off ground, supported on a level platform, and protected from weather as approved by COR.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Secondary Framing System: Purlins, girts, eave struts, base framing and other accessories required for installation or recommended by manufacturer.

1. Purlins: 'Z' shaped cold-formed horizontal structural members which support roof coverings.
2. Girts: 'Z' shaped cold-formed horizontal structural members that support vertical panels.
3. Eave Struts: Unequal flange, cold-formed "C" sections or LBS purlins.
4. Base Framing: Base members to which the base of the wall covering may be attached to the perimeter of the slab or supporting wall. Secured to the concrete slab or masonry wall with mechanical anchors.

2.02 DESIGN REQUIREMENTS

A. Design in accordance with AISI S100, MBMA and IBC.

B. Provide secondary framing system capable of withstanding structure dead loads and loads shown on drawings.

C. Roof heights of adjacent buildings shall be equal.

D. Support collateral loads imposed by doors, ventilating equipment, and other equipment and accessories to be supported by structure.

E. Provide rough framing for louvers, doors, and openings as shown on the drawings.

F. Deflection Limits shall be in accordance with the applicable provisions of the MBMA Manual.

1. Vertical deflections:

a. Roof Secondary (Purlins): L/150.

2. Horizontal deflections:

a. Wall Secondary (Girts): L/90.

3. Vertical and horizontal deflection limits apply for the loads shown on the drawings.

G. Design framing system to provide for movement of components without damage, overstress, buckling, sheathing failure, connection failure, undue stress on fasteners and anchors, or other detrimental effects when subject to temperature range of +/- 50 degrees Fahrenheit.

H. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary structure.

I. Bolting: In accordance with AISI S100.

2.03 MATERIALS

A. Secondary Framing System:

1. All shapes for the pumping plant must conform to the requirements of ASTM A 1011, or ASTM A 1039 Grade 55.

2. All shapes for the outdoor chlorine storage must conform to the requirements of ASTM A 653, Grade 55, Class 2, with a G90 galvanized finish.

3. Purlins and girts:

a. Cold-formed "Z" sections with stiffened flanges.

1) Flange stiffeners shall be sized to comply with the requirements of the latest edition of AISI.

2) Flanges shall be unequal in width to allow for easier nesting during erection.

3) Flanges shall be pre-punched at the factory to provide for field bolting to the primary steel frames.

4. Eave struts:

a. Unequal flange, cold-formed “C” sections.

5. Base framing:

a. Formed base girt with flashing.

2.04 ANCHORS, CLIPS, AND FASTENERS

A. Per secondary framing system manufacturer's recommendations.

1. Painted in accordance with Section 09 96 02 – Coatings for the installation of cold formed metal framing for the pumping plant.

2. Galvanized for the installation of cold formed metal framing for the outdoor chlorine storage.

2.05 WELDING MATERIALS

A. In accordance with AWS D1.3.

2.06 FABRICATION

A. General:

1. Shop-fabricate all framing members for field bolted assembly. The surfaces of the bolted connections must be smooth and free from burrs or distortions.

B. Secondary Framing:

1. Zee purlins:

a. Fabricate purlins from cold-formed "Z" sections with stiffened flanges. Size flange stiffeners to comply with the requirements of the latest edition of AISI. Connection bolts will install through the webs, not the flanges.

2. Girts:

a. Girts must be simple or continuous span as required by design. Connection bolts will install through the webs, not the flanges.

2.07 SHOP PAINTING

A. Pumping Plant:

1. Paint in accordance with Section 09 96 02 – Coatings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify floor slab, masonry, mechanical and electrical utilities, and abutting structural framing are in correct position. Correct unsatisfactory conditions before proceeding with framing installation.

3.02 INSTALLATION

A. The erection of the secondary framing system shall be performed by a qualified erector, in accordance with the approved erection drawings, erection guides and/or other

documents furnished by manufacturer, using proper tools, equipment and safety practices. Install framing in accordance with approved shop drawings and fabricator's erection plans and manual.

B. Erection practices shall conform to "Common Industry Practices", Section 6, MBMA (LR)-Building Systems Manual.

C. There shall be no field modifications to primary structural members except as authorized and specified by the COR.

3.03 REPAIR

A. Galvanizing and Painting Repair:

1. Repair damage to galvanizing and/or painting in accordance with Section 09 96 20 - Coatings.

END OF SECTION

SECTION 05 21 00

STEEL JOISTS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Steel Joists:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A 36-08	Carbon Structural Steel
2.	ASTM A 123/A 123M-12	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
3.	ASTM A 153/A 153M-05	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
4.	ASTM A 307-12	Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
5.	ASTM A 325-10	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
6.	ASTM A 563-07a	Carbon and Alloy Steel Nuts
7.	ASTM A 780/A 780M-09	Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
8.	ASTM F 436-11	Hardened Steel Washers

B. American Welding Society, Inc. (AWS)

1.	AWS D1.1/D1.1M-10	Structural Welding Code – Steel
2.	AWS D1.3/D1.3M-08	Structural Welding Code – Sheet Steel

C. The Society for Protective Coatings (SSPC)/NACE International (NACE)

1.	SSPC-SP 6/NACE 3-07	Commercial Blast Cleaning
2.	SSPC-SP 7/NACE 4-06	Brush-Off Blast Cleaning

D. Steel Joist Institute (SJI)

1. Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders, 43rd Edition
2. Standard Specifications for Open Web Steel Joists, K-Series

3. Technical Digest No. 8, "Welding of Open-web Steel Joists and Joist Girders"

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 05 21 00-1, Approval Drawings and Data:

1. Manufacturer's product for each distinct type of joist accessories, and product specified.

2. Detailed shop and erection drawings.

a. Show layout of joist units, anchorage details, splice and connection details, bracing, bridging, accessories, and attachments to other work. Include mark, number, type, location and spacing of joists and bridging.

1) Indicate locations and details of anchorage devices and bearing plates to be embedded in other construction.

3. Manufacturer's certification that joists comply with SJI "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders."

C. RSN 05 21 00-2, Welder Qualifications:

1. Provide certification that welders to be employed in work comply with the requirements specified in Quality article.

2. Provide written welding procedure specification (WPS) document per AWS Code requirements.

D. RSN 05 21 00-3, Inspection Reports.

1.04 QUALITY

A. Manufacturer Qualification: Manufacturer shall be a member of the Steel Joist Institute.

B. SJI Design Standard: Comply with recommendations of SJI's "Standard Specification Load Tables and Weight Tables for Steel Joists and Joist Girders," applicable to types of joists indicated.

C. Welder qualification: Welders shall be certified in accordance with AWS D1.1 and D1.3 within the last 12 months. All welding shall comply with the applicable provisions of AWS D1.1 and D1.3. Maintain permanent records of all pertinent information.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site at such intervals to ensure uninterrupted progress of work. Inspect the joists for damage before unloading and note any permanent bend or deformation or broken welds on the receiving documents.

B. Store materials to permit easy access for inspection and identification. Keep joist members off ground using pallets, skids, platforms or other supports.

C. Protect steel members from corrosion and damage.

D. Store packaged materials in original unbroken package or container.

E. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures.

F. Replace damaged shapes or members as required.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel: Comply with requirements of Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders" and "Standard Specifications for Open Web Steel Joists, K-Series".

B. Welding Electrodes: Comply with AWS D1.1 and D1.3.

2.02 FABRICATION

A. Manufacture steel joists of type indicated in accordance with SJI specification. All material shall be clean and straight.

B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" with steel-angle or steel-channel members.

C. Comply with AWS D1.1 and D1.3 requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

D. Bridging: Provide horizontal or diagonal type bridging as required by "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders" or as indicated on Drawings for type of joist, chord size, spacing and span.

E. Top Chord Extensions: Provide top chord extensions on joists as indicated on the drawings. The extensions shall be capable of withstanding the full uniform load of the joist. The extensions shall be attached to the embedded anchor plates as indicated on the Drawings.

F. End Anchorage: Embedded anchor plates shall be used to secure joist to supports as indicated on the drawings.

2.03 ACCESSORIES

A. Bridging: Schematically indicated. Detail and fabricate according to SJI Specifications. Furnish additional erection bridging if required for stability.

B. Provide accessories, including splice plates, reinforcing angles and bolts as required to complete the joist installation while complying with SJI Specifications and Drawings.

C. Threaded Fasteners: ASTM A 307, Grade A, Galvanized.

D. High-Strength Bolts: ASTM A 325, Galvanized.

E. Nuts: ASTM A 563, Galvanized.

F. Washers: ASTM F 436, Galvanized.

2.04 GALVANIZING

A. Cleaning:

1. After shopwork completion, clean materials of rust, loose scale, dirt, oil, grease, slag from welded areas, and other foreign substances.
2. Clean surfaces of metalwork in contact with or embedded in concrete or grouting mortar in accordance with SSPC-SP6/NACE 3 and SSPC-SP7/NACE 4.

B. Steel Joists:

1. Galvanize steel joists as designated on the drawings for galvanizing.
2. After cleaning, zinc coat materials in accordance with ASTM A 123.
3. Where member lengths prevent dipping in one operation, exercise care to prevent warping.
4. Provide finished compression members with lateral variations not greater than 1/1000 the axial length between the points which are to be supported laterally.
5. After galvanizing, remove excess spelter from holes.

C. Hardware:

1. Galvanize threaded fasteners, high-strength bolts, nuts, and washers in accordance with ASTM A 153.
    a. Remove excess spelter by centrifugal spinning.

D. Fabricator’s Galvanizing Repair:

1. Redip material with damaged galvanizing unless damage is local and can be repaired by two component epoxy zinc primer.

2. If the galvanized coating becomes damaged after being dipped twice, the material will be rejected.

3. Where local repair is authorized:

   a. Repair damage to galvanizing, including damage due to drifting, repair operations, in accordance with Section 09 96 20 - Coatings.

2.05 INSPECTIONS AND TESTS

A. Joist manufacturer shall inspect in accordance with the SJI Standard Specifications.

B. Materials, fabrication, and welds may be visually inspected by the Government in the manufacturer's factory. The Government may perform additional inspections and non-destructive tests on work that is questionable or suspect.

C. The Contractor shall bear the cost for the Government's inspection and tests, if such inspections and tests reveal failure of portions of the work to comply with requirements indicated in these Specifications. The Contractor shall bear costs made necessary by such failures including those of repeated testing and inspections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to installation of steel joists and accessories.

1. Examine supporting substrates, embedded bearing plates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of joists.

   a. Verify all elevation locations and dimensions of surfaces to receive steel joist.

   b. Furnish plates, angles and other accessories as required to secure joists.

   c. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Erection:

1. Place and secure steel joists in accordance with SJI Specifications, approved shop drawings.

2. Placing joists: Do not place steel joists until supporting work is in place and secured. Place joists on supporting work, adjust and align in accurate locations and spacing before permanently fastening.

3. Bridging: Install bridging simultaneously with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords where

terminating at walls or beams. Comply with OSHA requirements for bolted bridging to be in place before slackening lines on joist longer than 40 feet.

4. Fastening joists: Field weld joists to embedded anchor plates in accordance with SJI Specifications for type of joists used.

   a. Comply with AWS requirements and procedures for welding, appearance and quality of welds and methods used in correcting welding work.

   b. Coordinate welding sequence and procedure with placement of joists.

   c. The lengths of welds applied to the top and bottom chords of joist shall not exceed half the width of the member.

5. Repair damaged galvanized coatings on exposed surfaces in accordance with Section 09 96 20 – Coatings.

3.02 REPAIRS

A. Repair damage as directed by COR.

END OF SECTION

SECTION 05 30 00
METAL ROOF DECK

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Metal Roof Deck:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American Institute of Steel Construction (AISC)

1.	AISC 325-05	Steel Construction Manual, 13th Edition

B. American Institute and Steel Institute (AISI)

1.	AISI S100-07	North American Specification for the Design of Cold-Formed Steel Structural Members

C. ASTM International (ASTM)

1.	ASTM A 653/A653M-11	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process
2.	ASTM A 780/A 780M-09	Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
3.	ASTM A 924/A 924M-13	General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
4.	ASTM A 1008/A 1008M-12a	Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

D. American Welding Society, Inc. (AWS)

1.	AWS D1.1/D1.1M-10	Structural Welding Code - Steel
2.	AWS D1.3/D1.3M-08	Structural Welding Code - Sheet Steel

E. Steel Deck Institute (SDI)

1.	SDI 31-2007	Design Manual for Composite Decks, Form Decks and Roof Decks

2. SDI MOC2-2006 Manual of Construction with Steel Deck

1.03 PERFORMANCE REQUIREMENTS

A. Design the attachment of metal roof deck to roof framing according to SDI 33 as required and per manufacturer's recommendations.

B. Structural Performance: Design the metal roof deck attachment to withstand specified design loads within and under conditions required.

1. Design loads: As specified on drawings.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 05 30 00-1, Approval Drawings and Data:

1. Metal deck manufacturer's product data.

a. Include complete descriptions of, specifications and installation instructions for the roof metal deck, and accessories. Include material type, grade, metal thickness, and finish.

2. Detailed shop and erection drawings.

a. Show deck section layout and attachment to the steel roof joists and structural steel, including unit dimensions and sections.

b. Show type and number of deck units and the type, location and method of attachment.

c. Show all accessories and details required for proper installation of metal roof decks as specified on drawings.

C. RSN 05 30 00-2, Welder Qualifications:

1. Welder's and tacker's identification and qualifications.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Member of Steel Deck Institute.

B. Welder Qualifications: Qualify in accordance with AWS D1.1 and D1.3. Maintain permanent records of all pertinent information.

C. Visually inspect all puddle welds.

1.06 DELIVERY, SRORAGE, AND HANDLING

A. Deliver, store and handle metal roof deck in a manner to protect it from corrosion, deformation, and other types of damage.

B. Do not bend metal roof decking. Exercise care not to damage the material or overload the decking during the construction period.

C. Maximum uniform distributed storage load shall not exceed the design live load.

D. Stack decking on platforms or pallets and cover with watertight ventilated covering. Elevate one end during storage to provide for drainage. Maintain deck finish at all times to prevent the formation of rust.

E. Replace damaged material.

PART 2 PRODUCTS

2.01 METAL ROOF DECK

A. 1.5B22 Metal deck manufactured by Vulcraft, 1875 West Highway 13 South, Brigham City, UT 84302, Telephone: 435-734-9433; or equal, having the following essential characteristics:

1. Conform to SDI 31 and SDI DDM03.
2. Nominal depth: 1.5 inches.
3. Thickness before coating: 22 gage nominal, 0.0295 inches, minimum.
4. Section modulus: 0.186 in^3/ft, minimum.
5. Moment of inertia: 0.155 in^4/ft, minimum.
6. ASTM A 1008, Grades C and D, or ASTM A 653, Structural Quality
   a. Yield Strength: 33,000 pounds per square inch, minimum.
7. Steel Materials Content:
   a. If manufactured in a Basic Oxygen Furnace:
      1) Minimum post consumer content: 16 percent.
      2) Minimum total recovered materials: 25 to 30 percent.
   b. If manufactured in an Electric Arc Furnace:
      1) Minimum post consumer content: 67 percent.
      2) Minimum total recovered materials: 100 percent.
8. Metal deck shall be galvanized.
   a. Galvanizing shall conform to ASTM A 924 with a minimum coating class of G30 as defined in ASTM A 653.
9. Panel Length: To span from end support to end support.

2.02 ACCESSORIES

A. Provide accessories required for fastening and a finished installation of metal deck in accordance with SDI 31 and SDI MOC2.

B. Accessories shall be galvanized.

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to installation of decking units and accessories, examine worksite to verify that structure will permit installation of decking system without modification and supporting members are in correct layout and alignment.

3.02 PREPARATION

A. Check surfaces to receive the decking and assure they are free of debris.

3.03 INSTALLATION

A. Install steel deck units and accessories in accordance with approved shop drawings, SDI MOC2, and manufacturer's recommendations.

B. Place units on structural supports, properly adjusted, leveled, aligned side laps, and aligned at right angles to supports.

C. Align steel deck units before permanently anchoring. Locate deck ends over supports only.

D. Bearing Length: 2-1/2 inches, minimum.

E. Attachment: Immediately after placement and alignment, and after correcting inaccuracies, permanently fasten metal deck units to structural supports and to adjacent deck units as shown on shop drawings.

1. Clamp or weight deck units to provide firm contact between deck units and structural supports while performing welding.
2. Attachment of adjacent deck units by button-punching is prohibited.
3. Location, size, and spacing of fastening shall be as indicated on the approved shop drawings.

F. Welding: Perform welding in accordance with AWS D1.3 using methods and electrodes recommended by the manufacturer of the base metal alloys being used.

1. Ensure only operators previously qualified by tests prescribed in AWS D1.1 and AWS D1.3 perform welds.

2. Immediately clean welds by chipping and wire brushing.

3. Heavily coat welds, cut edges and damaged portions of coated finish in accordance with section 09 96 20 - Coatings.

G. Cutting and Fitting: Cut and fit deck units and accessories around projections through roof with neat, square, and trim cuts. Do not use cutting torches where a neat appearance is required.

3.04 REPAIRS

A. Repair damaged galvanized coatings on exposed surfaces in accordance with Section 09 96 20 – Coatings.

B. Repair damage as directed by COR.

END OF SECTION

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SECTION 05 40 00

COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cold-Formed Metal Framing:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American Iron and Steel Institute (AISI)

1.	AISI S100-07	North American Specification for the Design of Cold-Formed Steel Structural Members

B. ASTM International (ASTM)

1.	ASTM A 36/A 36M-12	Carbon Structural Steel
2.	ASTM A 123/A 123M-12	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
3.	ASTM A 153/A 153M-09	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
4.	ASTM A307 - 12	Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
5.	ASTM A 653/A 653M-11	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process
6.	ASTM C 645-11a	Nonstructrural Steel Framing Members
7.	ASTM C 754-11	Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
8.	ASTM C 955-11c	Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases
9.	ASTM E 488/E 488M-10	Strength of Anchors in Concrete Elements
10.	ASTM E 1190-11	Strength of Power-Actuated Fasteners Installed in Structural Members

C. American Welding Society (AWS)

1.	AWS A2.4-12	Standard Symbols for Welding, Brazing, and Nondestructive Examination

2. AWS D1.3/D1.3M-08 Structural Welding Code - Sheet Steel

D. International Code Council (ICC)

1. IBC 2009 International Building Code

1.03 SYSTEM DESCRIPTION

A. Type of Metal Framing:

1. Cold form metal framing for structural support of wall and roof panels, gypsum board.

2. Non-structural framing for gypsum board.

1.04 DESIGN REQUIREMENTS

A. Design in accordance with AISI S100 and IBC.

B. Provide cold-formed metal framing capable of withstanding structure dead loads and loads shown on drawings.

C. Support collateral loads imposed by doors, ventilating equipment, and other equipment and accessories to be supported by structure.

D. Provide rough framing for louvers, doors, and openings as shown on drawings.

E. Deflection Limits:

1. Exterior Load Bearing Wall Framing: Horizontal deflection of 1/360 of wall height. Design wall framing to resist horizontal deflection without contribution from wall sheathing.

2. Exterior Non-Load Bearing Wall Framing: Horizontal deflection of 1/360 of wall height. Design wall framing to resist horizontal deflection without contribution from wall sheathing.

3. Interior Load Bearing Wall Framing: Horizontal deflection of 1/360 of wall height under a horizontal load of 5 pounds per square foot (lb/ft^2).

4. Interior Non-Load Bearing Wall Framing: Horizontal deflection of 1/360 of wall height under a horizontal load of 5 lb/ft^2.

5. Roof Trusses: Vertical deflection of 1/360 of span.

6. Roof Rafter Framing: Vertical deflection of 1/360 of horizontally projected span.

F. Design framing system to provide for movement of components without damage, overstress, buckling, connection failure, undue stress on fasteners and anchors, or other detrimental effects.

G. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary structure.

H. Bolting: In accordance with AISI S100.

1.05 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 05 40 00-1, Approval Drawings and Data:

1. Shop drawings:

a. Show framing plans, elevations, sections, layout, sizes, and dimensions. Include type, grade, size, and thickness of materials, including fasteners.

b. Welding symbols: In accordance with AWS A2.4.

c. Project-specific drawings except as permitted for details. Manufacturer's standard or typical drawings may be included to show details. Mark standard or typical drawings to indicate details relevant to project.

d. Sign and seal by design engineer.

2. Manufacturer's product data:

a. Include complete descriptions of and specifications for metal framing, fasteners, accessories, and materials.

C. RSN 05 40 00-2, Certifications:

1. Affidavit certifying that sheet steel complies with specified quality, grade, and zinc coating.

D. RSN 05 40 00-3, Erection Plans and Manual:

1. Fabricator's erection plans and manual for framing system.

1.06 QUALIFICATIONS

A. Designer: Professional engineer registered in State of New Mexico.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver metal framing to jobsite in manufacturer's unopened containers or bundles identified with brand, type, and gage.

B. Protect metal framing from damage and corrosion during storage and handling at jobsite.

1. Store metal framing with sufficient clearance around materials to permit access for inspection and handling.

2. Store and handle metal framing in a manner that will not cause distortion.

3. Store off ground in dry ventilated space.

4. When materials are stored outdoors, store materials off ground, supported on a level platform, and protected from weather as approved by COR.

PART 2 PRODUCTS

2.01 MATERIALS

A. Sheet Steel for Studs, Runners, and Trusses and Accessories:

1. 16-gage and heavier: ASTM A 653, structural steel, G60 zinc coating, with a minimum yield strength of 50,000 pounds per square inch (lb/in^2).
2. 18-gage and lighter: ASTM A 653, structural steel, G60 zinc coating, with a minimum yield strength of 33,000 lb/in^2.

2.02 METAL FRAMING

A. Provide metal framing systems complete with studs, top and bottom runners (tracks), bridging, strapping, and other accessories as recommended by manufacturer for type, size, and length.

B. Conform to ASTM C 955 for structural metal framing.

C. Conform to ASTM C 645 and ASTM C 754 for non-structural metal framing for non-structural framing for the gypsum board.

D. Furnish members and accessories from single manufacturer.

2.03 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips:

1. ASTM A 36.
2. Zinc coated in accordance with ASTM A 123.

B. Anchor Bolts and Studs Embedded in Concrete:

1. ASTM A 307, Grade A.
2. Zinc coated in accordance with ASTM A 153.

C. Mechanical Fasteners:

1. Corrosion-resistant coated, self drilling, self-threading steel drive screws.
2. Low-profile head beneath sheathing. Manufacturer's standard screw head elsewhere.

2.04 WELDING MATERIALS

A. In accordance with AWS D1.3.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify foundation, floor slab, mechanical and electrical utilities, and abutting structural framing are in correct position. Correct unsatisfactory conditions before proceeding with framing installation.

3.02 INSTALLATION

A. Install framing in accordance with approved shop drawings and fabricator's erection plans and manual.

B. Framing may be prefabricated into panels prior to erection. Fabricate panels plumb, square, true to line, and braced to prevent racking.

C. Cut framing components squarely or as required for attachment.

1. Cut framing members by sawing or shearing.
2. Do not torch cut.

D. Maintain members in correct position until fastened.

E. Fasten framing members by welding or screw fastening as standard with fabricator.

1. Perform welding and related work in accordance with AWS D1.3. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used to correct welding work.
2. Locate mechanical fasteners and install according to cold-formed metal framing manufacturer's instructions with screw penetrating joined members by not less than 3 exposed screw threads.
3. Wire tying of framing is not permitted.

F. Handle and lift prefabricated panels in a manner to prevent damage and distortion of members.

G. Securely anchor tracks to supports.

H. At butt joints, securely anchor two pieces of track to same supporting member or butt weld joints or splice with stud inserts.

I. Plumb, align, and securely attach studs to flanges or webs of both upper and lower tracks.

J. Align axially loaded members vertically to allow for full transfer of loads to foundation.

K. Install jack studs above and below openings as required to furnish support. Securely attach jack studs to supporting members.

L. Install headers in openings that are larger than stud spacing of wall.

M. Attach bridging for studs in a manner that prevents stud rotation.

N. Install studs in one piece for their entire length. Splices are not permitted.

O. Provide a load distribution member at top of track where joist or truss is not located directly over bearing stud.

P. Provide end blocking where joist ends are not restrained from rotation.

Q. Provide temporary bracing and leave in place until framing is permanently stabilized.

R. Fasten reinforcement plate over web penetrations that exceed size of manufacturer's standard punched openings.

S. Fasten framing members together by using self-drilling or self-tapping screws.

T. Provide accurately aligned runners at top and bottom of partitions.

U. Provide at least two studs at jambs of doors and other openings which are 24 inches wide or wider.

V. Provide triple studs at corners, positioned to receive interior and exterior finishes.

W. Fasten studs to top and bottom runners by welding or screwing both flanges to runners.

X. Repair:

1. Touch-up repair damaged shop-applied protective coatings after installation in accordance with Section 09 96 20 - Coatings.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Metal Fabrications:

1. Payment: Lump sum price offered in the schedule.

a. Includes:

1) Trench gratings and supports.

2) Sump gratings and supports.

3) Ladders and ladder extensions.

4) Pipe guard posts.

5) Channel supports for chlorine control panel.

6) Electrical Equipment supports.

7) Channel bases for electrical power equipment.

8) Aluminum valve cover with rigid insulation.

9) Embedded anchor plates.

10) Manhole frames and covers for pipe access manholes.

11) Fasteners for complete installation of metalwork.

1.02 REFERENCE STANDARDS

A. Aluminum Association (AA)

1. AA ADM-105 Aluminum Design Manual - 2010

B. American Institute of Steel Construction (AISC)

1. AISC 325-05 Steel Construction Manual - 13th Edition

C. American National Standards Institute (ANSI)

1. ANSI A14.3-2008 Ladders – Fixed – Safety Requirements

D. American Society of Mechanical Engineers (ASME)

1. ASME B1.1-2003 Unified Inch Screw Threads (UN and UNR Thread Form)

2.	ASME B18.2.1-2012	Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)

E. ASTM International (ASTM)

1.	ASTM A 36/A 36M-12	Carbon Structural Steel
2.	ASTM A 48/A 48M-03(2012)	Gray Iron Castings
3.	ASTM A53/A 53M-12	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
4.	ASTM A 108-07	Steel Bar, Carbon and Alloy, Cold-Finished
5.	ASTM A 123/A 123M-12	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
6.	ASTM A 153/A 153M–09	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
7.	ASTM A 307-12	Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
8.	ASTM A 385/A 385M-11	Providing High-Quality Zinc Coatings (Hot-Dip)
9.	ASTM A 563-07a	Carbon and Alloy Steel Nuts
10.	ASTM A 615/A 615M-12	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
11.	ASTM A 780-09	Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
12.	ASTM B 209-10	Aluminum and Aluminum-Alloy Sheet and Plate
13.	ASTM B 221-12	Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
14.	ASTM B 632/B 632M-08	Aluminum-Alloy Rolled Tread Plate
15.	ASTM C 578-12b	Rigid, Cellular Polystyrene Thermal Insulation
16.	ASTM F 467-13	Nonferrous Nuts for General Use
17.	ASTM F 844-07a	Washers, Steel, Plain (Flat), Unhardened for General Use

F. American Welding Society, Inc. (AWS)

1.	AWS D1.1/D1.1M-10	Structural Welding Code – Steel
2.	AWS D1.2/D1.2M-10	Structural Welding Code – Aluminum

G. Commercial Item Description (CID)

1.	CID A-A-1923A	Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)

H. International Code Council (ICC)

1.	ICC ES AC 308	Acceptance Criteria for Post-Installed AdhesiveAnchors in Concrete, November 2009
2.	ICC IBC – 2009	International Building Code

I. National Association of Architectural Metal Mfrs. (NAAMM)

1.	NAAMM 531-09	Metal Bar Grating Manual

J. Society of Protective Coatings (SSPC)/NACE International (NACE)

1.	SSPC-SP 6-07/NACE 3-2007	Joint Surface Preparation Standard - NACE No. 3/ SSPC-SP 6 – Commercial Blast Cleaning

1.03 DEFINITIONS

A. Miscellaneous metalwork: Where either shown on the drawings or specified elsewhere in this section or these specifications means metal fabrications as used in this section.

1.04 QUALIFICATIONS

A. Qualify welders in accordance with AWS D1.1 and AWS D1.2 using procedures, materials, and equipment of the type required for the work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect from corrosion, deformation, and other types of damage.

B. Store items in an enclosed area free from contact with soil and weather.

C. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aluminum: ASTM B 209, alloy 6061-T6 (plates) and ASTM B 221, alloy 6061 (bars).

B. Aluminum Floor Plate: ASTM B 632, alloy 6061-T6.

C. Arc-Welding Electrodes:

1. Use filler metal and shielding gases suitable for base materials, positions, and other conditions.
2. Filler metal and required shielding gases or fluxes: AWS D1.1 and AWS D1.2.
3. Use filler metal with a minimum tensile strength of 70,000 pounds per square inch (psi) for steel.
4. Aluminum alloy filler metal: AWS classification 4043.

D. Bolts, Threaded Rods, Nuts, And Washers:

1. Bolts:
   a. ASTM A 307.
   b. Length of bolt threads: ASME B18.2.1.
   c. Thread class: Two free-fit, American National coarse-thread series.
2. Threaded Rod:
   a. ASTM B 221.
   b. Thread class: Two free-fit, American National coarse-thread series.
3. Nuts:
   a. Steel: ASTM A 563.
   b. Aluminum: ASTM F 467.
4. Washers:
   a. Steel: ASTM F 844, unhardened for general use.
   b. Aluminum: ASTM B 209.

E. Expanded Metal: ASTM B 209.

F. Grating: NAAMM 531 galvanized steel.

1. Welded grating.
2. Where safety grating is required, provide serrated-edge grating.
3. Banding bar: Unless otherwise shown on the drawings, provide same size as bearing bars, where required.

G. Steel Pipe: ASTM A 53, type E or S, grade B.

1. Unless otherwise shown on drawings, provide standard-weight, black, steel pipe.
2. Government inspection at the mill and hydrostatic tests will not be required.

H. Structural Steel:

1. Shapes except wide flange sections: ASTM A 36.

2. Bars and Plates: ASTM A 36.

I. Rigid Insulation:

1. ASTM C 578, Type IV.

2.02 LADDERS

A. Metal Safety Steps for Ladders:

1. "Tread-Grip" No. 11-gauge sheet steel ladder rungs as manufactured by Morton Manufacturing Company, 700 Liberty Drive, Libertyville, IL 60048; "Grip Strut One-Diamond Ladder Rung" as manufactured by Cooper B-Line, 509 West Monroe Street, Highland, IL 62249; 1-inch-square "Mebac" solid ladder rungs as manufactured by Harsco Industrial IKG, 143 Wadsworth, Houston, TX 77015, or equal, having the following essential characteristics:

a. Concentrated design load at center of rung: 200 pound.

b. Raised button, serrated-edge, or metal bonded encapsulated grit surface.

B. Safety Posts:

1. "Ladder-Up" ladder extensions as manufactured by The Bilco Company, P.O. Box 1203, New Haven, CT 06505, or equal, having the following essential characteristics:

a. High-strength galvanized steel.

b. Tubular section that provides upward and downward movement and locks automatically when fully extended in up position.

c. Upward and downward movement controlled by stainless steel springs.

d. Operates in corrosive environment.

2. Attach securely to ladder rungs.

3. Extend a minimum of 42 inches above walking surface.

2.03 MANHOLE FRAMES AND COVERS FOR PIPE ACCESS MANHOLES

A. Manhole Frames and Covers:

1. ASTM A 48, class 358.

2. Size: As indicated on the drawings.

2.04 CHANNEL SUPPORTS FOR CHLORINE CONTROL PANEL

A. Type P1000 channel as manufactured by Unistrut Corporation, 35660 Clinton Street, Wayne, MI 48184, or equal, having the following essential characteristics:

1. Channel: 1-5/8-inch wide by 1-5/8-inch deep with 7/8-inch opening.

2. Thickness, minimum: 12 gauge (0.105 inches).

3. Hot-dipped galvanized.

4. Bolts, nuts, and washers: Hot-dipped galvanized.

2.05 ELECTRICAL EQUIPMENT SUPPORTS

A. Metal Framing:

1. Combination channels as manufactured by Unistrut Corporation, 35660 Clinton Street, Wayne, MI 48184; Cooper B-Line, 509 West Monroe Street, Highland, IL 62249; or equal, having the following essential characteristics and accessories:

a. Combination channels: Cooper B-Line B12A, Unistrut P5501; or equal, having the following essential characteristics:

1) No. 12 gauge steel.

2) Channel: 1-5/8-inch wide by 4-7/8-inch deep with 7/8-inch opening.

3) Hot-dipped galvanized.

b. Connection plates: Cooper B-Line B532, Unistrut P1726; or equal, having the following essential characteristics.

1) Thickness: 1/4-inch.

2) Hole spacing (from end): 13/16-inch.

3) Hole spacing (on center): 1-7/8-inch.

4) Width: 1-5/8-inch.

5) Hole diameter: 9/16-inch.

6) Hot-dipped galvanized.

c. Bolts, nuts, and washers:

1) Bolts: ASTM A 307.

2) Nuts: Spring nuts, suitable for channel strut attachments.

3) Washers: ASTM F 844.

4) Hot-dipped galvanized.

B. Fabricated Plates:

1. ASTM A 36 steel, galvanized.

2.06 ANCHORS

A. Adhesive Anchors: Drilled type, installed with a chemical adhesive system.

1. Seismic qualified per ICC IBC and ICC AC 308 for seismic design category A through F and cracked concrete conditions.
2. Adhesive: HIT-RE 500-SD epoxy adhesive manufactured by HILTI, P.O. Box 21148, Tulsa, OK 74121; or equal, having the following essential characteristics:
    a. Injectable two-component epoxy adhesive.
    b. Dual packaging system designed for automatic mixing during injection.
    c. Weathering resistant.
    d. Resistant against high temperatures.
    e. Suitable for use in diamond cored or pneumatic drilled holes.
    f. Extended temperature range from 41 degrees Fahrenheit to 120 degrees Fahrenheit.
3. Threaded carbon steel anchor rod: HAS Super rod manufactured by HILTI, P.O. Box 21148, Tulsa, OK 74121; or equal, having the following essential characteristics:
    a. Rod material: ASTM A 193, Grade B7.
    b. Thread: ASME B1.1, continuously threaded (all-thread).
    c. Fabricate with 45-degree chisel point on one end to facilitate insertion into adhesive-filled hole.
    d. Hot-dip galvanized.
4. Nuts and washers: As recommended by anchor manufacturer.
5. One capsule length minimum bolt length, unless indicated otherwise on the drawings.

B. Expansion Anchors: Kwik Bolt 3 torque controlled expansion anchor body, wedge, nut, and washer as manufactured by HILTI, P.O. Box 21148, Tulsa, OK 74121; or equal, having the following essential characteristics:
1. Meets the requirements of CID A-A-1923A, Type 4.
2. Anchor body and wedge: Carbon steel.
3. Nuts and washers: As recommended by anchor manufacturer.
4. Bolt length: As shown on drawings. If not shown, provide bolt length with 3-1/2-inch minimum embedment.

C. Headed Concrete Anchors (HCA): H4L headed concrete anchor as manufactured by Nelson Stud Welding, Incorporated, 9008 S. Thomas Avenue, Bridgeview, IL 60455; or equal, having the following essential characteristics:
1. ASTM A 108.

2. Flux-filled ends suitable for end welding to steel with automatically timed stud-welding equipment.

2.07 GUARD POSTS

A. Steel Pipe: ASTM A 53, type E or S, grade B.

1. Unless otherwise shown on drawings, provide standard-weight, black, steel pipe.
2. Government inspection at the mill and hydrostatic tests will not be required.

B. Concrete:

1. In accordance with the applicable requirements of Section 03 30 00 – Cast-In-Place Concrete.
2. 3/4-inch maximum size aggregate.
3. Minimum compressive strength of 2,500 pounds per square inch at 28 days.

C. Reinforcing Bars:

1. ASTM A 615, Grade 60.
2. Deformed steel bar.

D. Painting:

1. In accordance with Section 09 96 20 – Coatings.

2.08 CHANNEL BASES FOR ELECTRICAL POWER EQUIPMENT

A. Structural Steel:

1. C Shape: ASTM A 36.
2. Size: As indicated on the drawings.

B. Expansion Anchors: As indicated on the drawings.

C. Grout:

1. In accordance with the applicable requirements of Section 03 63 00 – Epoxy Grout.

2.09 CHANNEL BASES FOR ELECTRICAL POWER EQUIPMENT

A. Structural Steel:

1. C Shape: ASTM A 36.
2. Size: As indicated on the drawings.

B. Expansion Anchors: As indicated on the drawings.

C. Grout:

1. In accordance with the applicable requirements of Section 03 63 00 – Epoxy Grout.

2.10 ALUMINUM VALVE COVER WITH RIGID INSULATION

A. Construct aluminum valve cover with rigid insulation as shown on drawing 1695-D-194.

1. Rigid insulation shall be adhered to the aluminum valve cover and secured to the valve cover using expanded metal and fastening system as described on the drawing.

a. Adhesive: Solvent-dispersed, rubber-based, compatible with insulation for bonding insulation, as recommended by insulation manufacturer.

b. Follow manufacturer's safety instructions for storage, handling and use of adhesive.

2.11 FABRICATION

A. Fabricate metalwork in accordance with AISC 325, AA ADM-105, and these specifications.

1. Perform welding and related work in accordance with AWS D1.1 and AWS D1.2.

2. Grind all welds on ladders smooth.

B. If straightening is necessary, use methods that will not injure the metal.

C. After shop work completion and before galvanizing, if required, clean material of rust, loose scale, dirt, oil, grease, slag from welded areas, and other foreign substances.

D. Ladders:

1. Fabricate from standard weight pipe with diameter shown on drawings, or round HSS of the same outside diameter and minimum wall thickness of 0.132 inches. Meet the applicable requirements of ANSI A14.3.

E. Galvanizing:

1. Galvanize items of metalwork as specified or shown on drawings. Use hot-dip galvanizing, where required after fabrication, in accordance with ASTM A 123 and ASTM A 385.

2. Galvanize bolts, nuts, washers, and locknuts in accordance with ASTM A 153. Remove excess spelter by centrifugal spinning.

3. Fabricator's Galvanizing Repair:

a. Redip material with damaged galvanizing unless damage is local and can be repaired by two component epoxy zinc primer.

b. If the galvanized coating becomes damaged after being dipped twice, the material will be rejected.

c. Where local repair is authorized:

1) Repair damage to galvanizing in accordance with Section 09 96 20 – Coatings.

PART 3 EXECUTION

3.01 PREPARATION

A. Where locations and dimensions of miscellaneous metalwork shown on drawings are dependent upon existing equipment and/or equipment furnished, confirm locations and dimensions prior to fabrication of miscellaneous metalwork.

3.02 INSTALLATION

A. Embedded Metalwork:

1. Accurately locate metalwork to be embedded in concrete. Hold metalwork in correct position and alignment and protect metalwork from damage and displacement during placing and setting of concrete.
2. Unless otherwise specified, use only metal braces, supports, and other items to position and align embedded metalwork, which will be embedded in concrete. Do not use wooden braces, supports, or other items to position and align embedded metalwork if they will also be embedded in concrete.
3. Clean surfaces of metalwork to be in contact with or embedded in concrete grouting mortar in accordance with SSPC-SP 6/ NACE 3.

B. Anchors:

1. Drill holes for anchors straight and true and of diameter recommended by anchor manufacturer.
2. Install anchors in accordance with manufacturer's recommendations.
3. Follow manufacturer’s recommendations when embedded steel or reinforcement is encountered during drilling for anchors.
4. When drilling water is used, clean surfaces of concrete to remain exposed immediately to prevent discoloration.
5. Following drilling, clean holes with water to remove cuttings, followed by air to ensure holes are dry.

C. Guard Posts:

1. Install posts plumb in concrete footings as shown on drawings.

2. Fill posts with concrete and trowel top of post round for water drainage. Posts may be capped in lieu of filling posts with concrete.

D. Installer's Galvanizing Repair:

1. Repair damage to galvanizing in accordance with Section 09 96 20 – Coatings.

E. Holes in Metalwork:

1. Drill, or drill and tap as required, holes in metalwork required for installation.

F. Painting:

1. Paint surfaces of miscellaneous metalwork exposed after installation; except galvanized steel, and cast iron; in accordance with Section 09 96 20 - Coatings.

END OF SECTION

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SECTION 07 19 20

SILANE WATER REPELLENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Silane Water Repellent:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARD

A. ASTM International (ASTM)

1.	ASTM D 5095-91(2013)	Determination of the Nonvolatile Content in Silanes, Siloxanes, Silane-Siloxane Blends Used in Masonry Water Repellent Treatments

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 07 19 20-1, Approval Data:

1. Manufacturer’s product data.

C. RSN 07 19 20-2, Instructions:

1. Manufacturer’s storage, surface preparation, and application instructions.

D. RSN 07 19 20-3, Documentation:

1. Evidence of applicator’s qualifications.
2. Include signed statement from water repellent manufacturer attesting to manufacturer’s approval of applicator.

1.04 QUALIFICATIONS

A. Applicator Qualifications: Experienced applicator approved by water repellent manufacturer.

1.05 FIELD SAMPLE

A. Field Sample: Apply water repellent to 2- by 2-foot area of building wall designated by COR.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to jobsite in manufacturer's original unopened packaging with labels and seals intact.

B. Store materials in protected area in accordance with manufacturer's instructions.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Do not apply when air or substrate temperature is below 45 degrees Fahrenheit.

B. Comply with manufacturer's environmental restrictions.

PART 2 PRODUCTS

2.01 SILANE WATER REPELLENT

A. Clear water-based silane water repellent.

B. Nonvolatile Content: 98.7 percent, minimum, when tested in accordance with ASTM D 5095.

C. Deep penetrating, non-film forming solution.

D. Does not contain silicone or urethane.

PART 3 EXECUTION

3.01 PREPARATION

A. Allow masonry to cure for 30 days after manufacturing, minimum, before application of water repellent.

B. Prepare clean, dry substrate surface in accordance with manufacturer's instructions. Remove dirt, efflorescence, and foreign materials.

3.02 APPLICATION

A. Apply to exterior concrete masonry surfaces.

B. Mix and apply in accordance with manufacturer’s instructions.

C. Apply at coverage rate recommended by manufacturer for new masonry.

3.03 CONTRACTOR FIELD QUALITY TESTING

A. Arrange for manufacturer’s representative to perform following field services at jobsite:

1. Verify proper equipment will be used in work before work begins.
2. Verify proper surface preparation and application methods will be used in work before work begins.
3. Supervise specified field sample preparation and application.
4. Verify proper application on treated surfaces.

3.04 CLEANING

A. Remove drips, runs, and overspray residue by methods recommended by manufacturer.

END OF SECTION

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SECTION 07 21 13

SOUND CONTROL BATT INSULATION

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Sound Control Batt Insulation:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM C665 - 12	Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
2.	ASTM E90-09	Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
3.	ASTM E413-10	Classification for Rating Sound Insulation

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 07 21 13-1, Approval Data:

1. Manufacturer’s product data for approval.

C. RSN 07 21 13-2, Instructions:

1. Manufacturer’s storage and installation instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Package and mark materials in accordance with ASTM C 665.

B. Deliver materials to jobsite in manufacturer’s original unopened packaging with labels intact.

C. Store materials in protected area in accordance with manufacturer’s recommendations.

PART 2 PRODUCTS

2.01 SOUND CONTROL BATTS

A. ASTM C 665, Type I, fiberglass batt.

B. Formaldehyde free.

C. Recovered Material Content: Minimum 20 percent glass.

D. Thickness: 6-1/2 inches.

E. Width: Match frame spacing.

F. Sound Transmission Class: Minimum 50 in accordance with ASTM E90 and ASTM E413.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install at locations shown on the drawings.

B. Place to completely fill space to be insulated.

C. Butt insulation tightly together and to intersecting surfaces.

D. Friction fit insulation between framing without edge or end gaps.

END OF SECTION

SECTION 07 21 50

SPRAY-APPLIED POLYURETHANE FOAM INSULATION

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in applicable prices offered in the schedule for blowoff, Precast Concrete Structures and Cast-in-Place concrete vaults.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1. ASTM C 1029-13 Spray-Applied Rigid Cellular Polyurethane Thermal Insulation

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 07 21 50-1, Approval Data:

1. Manufacturer’s product data.

C. RSN 07 21 50-2, Instructions:

1. Manufacturer’s product storage, surface preparation, environmental, and application instructions.

a. Include manufacturer’s recommendations for cleaning and preparing each substrate material to be covered by insulation.

D. RSN 07 21 50-3, Documentation:

1. Written evidence that applicator is approved by insulation manufacturer to apply product.

1.04 QUALIFICATIONS

A. Applicator Qualifications: Experienced applicator approved by insulation manufacturer to apply product.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to jobsite in manufacturer’s original unopened packaging with labels and seals intact.

B. Store materials in protected area in accordance with manufacturer's instructions.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Comply with manufacturer's environmental restrictions.

PART 2 PRODUCTS

2.01 SPRAY-APPLIED POLYURETHANE FOAM INSULATION

A. ASTM C 1029, Type II.

PART 3 EXECUTION

3.01 PREPARATION

A. Prepare clean, dry substrate surfaces in accordance with manufacturer's instructions.

1. Remove dirt, petroleum products, corrosion, loose materials, and other substances which could affect proper adhesion of insulation.

B. Mask and protect adjacent surfaces and equipment not to receive insulation from overspray.

C. Obtain approval of surface preparation, masking, and protection from COR before proceeding with application of insulation.

3.02 APPLICATION

A. Spray apply insulation in accordance with manufacturer's instructions.

B. Apply to uniform monolithic density without voids.

C. Apply to achieve thermal resistance value of R-20.

END OF SECTION

SECTION 07 21 60

INSULATION JACKET

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in applicable price offered in the schedule for the blowoff.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 07 21 60-1, Approval Data:

1. Manufacturer's product data.

C. RSN 07 21 60-2, Instructions:

1. Manufacturer's product storage, surface preparation, environmental, and application instructions.

a. Include manufacturer's recommendations for cleaning and preparing each substrate material to be covered by insulation.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to jobsite in manufacturer's original unopened packaging with labels and seals intact.

B. Store materials in protected area in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 INSULATION JACKET

A. Removable Box Jacket, manufactured by ThermaXX Jackets, LLC, 16 Hamilton Street, West Haven, CT 06516, Website: www.thermaxxjackets.com or equal with the following essential characteristics:

1. Equivalent R value of 20.

2. Accommodate operation of valve.

3. Removable and replacable.

PART 3 EXECUTION

3.01 PREPARATION

A. Prepare clean, dry substrate surfaces in accordance with manufacturer's instructions.

1. Remove dirt, petroleum products, corrosion, loose materials, and other substances which could affect proper adhesion of insulation.

B. Obtain approval of surface preparation from COR before proceeding with application of insulation.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 07 41 13

PREINSULATED METAL ROOF PANELS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Preinsulated Metal Roof Panels:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American Architectural Manufacturers Association (AAMA)

1.	AAMA 501.2	Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems.

B. ASTM International (ASTM)

1.	ASTM C518 - 10	Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
2.	ASTM C591 - 12b	Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
3.	ASTM E72 - 10	Conducting Strength Tests of Panels for Building Construction
4.	ASTM E90 - 09	Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
5.	ASTM E413 – 10	Classification for Rating Sound Insulation
6.	ASTM E283-04(2012)	Determining Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen
7.	ASTM E331-00(2009)	Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
8.	ASTM E1592 - 05(2012)	Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference

1.03 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E72:

1. Wind loads: As shown on drawings.
2. Other design loads: As shown on drawings.
3. Deflection limits: For wind loads, no greater than L/180 of the span.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 07 41 13 – 1, Sample and Color Sample Kit:

1. Two feet by 2 feet sample.

C. RSN 07 41 13 - 2, Product Data and Shop Drawings:

1. Metal panels, edges, joints, profiles, corners, anchorages, attachments, trim, flashings, closures and accessories approval data:
   a. Certification of specified recovered material content.
2. Shop drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
3. Product test reports.

D. RSN 07 41 13 – 3, Closeout Maintenance Data.

1.05 QUALIFICATIONS

A. Installer Qualifications: Worked on 3 projects of similar scope.

PART 2 PRODUCTS

2.01 GENERAL

A. Minimum R-value of 32 in accordance with ASTM C518.

B. Water Penetration: No uncontrolled water penetration through the panel joints at a pressure differential of 20 psf in accordance with ASTM E331.

C. Air Infiltration: Not to exceed 0.001 cfm/sf at 20 psf air pressure differential in accordance with ASTM E283.

D. Sound Transmission Coefficient (STC): Minimum of 22 in accordance with ASTM E90 and ASTM E413.

E. Insulating Core: Polyisocyanurate (ISO) core, ASTM C591 Type IV, CFC and HCFC free.

1. Minimum recovered materials content: 9 percent.

F. Steel Materials Content:

1. If manufactured in a Basic Oxygen Furnace:

a. Minimum post consumer content: 16 percent.

b. Minimum total recovered materials: 25 to 30 percent.

2. If manufactured in an Electric Arc Furnace:

a. Minimum post consumer content: 67 percent.

b. Minimum total recovered materials: 100 percent.

G. Coatings: In accordance with manufacturer's recommendation.

2.02 ROOF PANELS

A. 900 High Rib Panel, manufactured by Kingspan Insulated Panels, 2000 Morgan Road, Modesto, CA 95358, Website: www.kingspanpanel.com or equal with the following essential characteristics:

1. Factory-formed insulated metal panels.

2. Designed and manufactured to prevent through metal-to-metal contact between exterior and interior faces of installed system.

3. Total panel thickness: 4 inches.

4. ASTM A 755.

5. Coatings: Refer to 09 96 20 – Coatings.

6. Exterior face:

a. Gauge: 24.

b. Overlapping rib 1-1/2-inch to 2-inch high at panel joint.

c. Color: To be determined by Government from submitted color samples.

d. Finish and texture: Standard Manufacturer's.

7. Interior Face:

a. Gauge: 26.

b. Finish and Texture: Standard Manufacturer's.

c. Color: Imperial White.

B. Fasteners:

1. Structural fasteners shall be hex-head type, cadmium plated steel with neoprene washer, or as recommended by manufacturer.

2. Saddle clip for panel attachment shall be 16 gauge with integral self-sealing gasket supplied by the manufacturer.

3. Stitch fasteners for roof panel sidelaps and endlaps shall be vibration resistant type (anti-backout thread), self-drilling low profile screws with sealing washers, designed to resist back out by increasing thread friction as screw loosens.

4. Size and spacing: As recommended by manufacturer.

C. Perimeter Trim and Penetration Treatments:

1. Fabricated perimeter trim, penetration treatments and fascia, and metal flashing: Same gauge, material and coating color as exterior face of insulated metal roof panel.

D. Sealants: Butyl, non-skinning/curing type as recommended by manufacturer.

1. Butyl Tape: As recommended by manufacturer.

2.03 ACCESSORIES

A. EPDE Flexible Boot Flashings: D100 EPDM Flexible Flashing for Sloped Metal Roofs manufactured by Thaler Metal USA, Incorporated; 1902 Common Street, Suite 500, New Braunfels, TX 78130; or equal, having the following essential characteristics:

1. Flexible flashing consisting of black EPDM upper flashing boot with triple pressure grommet seal, EPDM base seal, cast zinc hold-down ring, and silicone dipped aluminum lock rivets with synthetic rubber washer under rivet head.

2. Fabricated for standing seam profile of metal roofing panels.

3. Weep hole for first two fins of base seal on down slope side of seal.

4. Size recommended by flashing manufacturer to match diameter of protruding pipe.

B. Gutters and Downspouts:

1. Material: ASTM A653, Coating Designation G90, or ASTM A792, Coating Designation AZ55, coated steel sheet.

2. Thickness: 24 gauge, minimum, core steel.

3. Gutter finish: Pre-finished, color to match building roof panels.

4. Downspout finish: Pre-finished, color to match building wall panels.

C. Splash Blocks: As shown on the drawings.

D. Gutter Supports:

1. Material: Zinc-coated steel.

2. Concealed support of type and size recommended by building manufacturer.

E. Downspout Anchors:

1. Same material, thickness, finish, and color as downspouts.

2. Type, size, and quantity recommended by building manufacturer.

PART 3 EXECUTION

A. Examination:

1. Provide field measurements to panel manufacturer.

B. Panel Installation:

1. In accordance with manufacturer's installation guidelines and recommendations.
2. Install panels plumb, level, and true-to-line to dimensions and layout indicated on shop drawings.
3. Cut panels prior to installing, where indicated on shop drawings, using a power circular saw with fine tooth carbide tip blade per manufacturer's instructions.
4. Butyl weather barrier sealant:
   a. Apply non-skinning butyl sealant as shown on shop drawings and manufacturer's installation instructions as necessary to establish the vapor barrier for the panels.
   b. Use non-skinning butyl tube sealant only for tight metal-to-metal contact.
   c. Do not use non-skinning butyl tube sealant to bridge gaps.
5. Place panel fasteners through pre-punched holes in attachment clips, concealed within the joint of the panel. Secure units to the structural supports. Space clips as recommended by manufacturer or otherwise indicated on the shop drawings.

C. Trim Installation:

1. Place fascia, trim and trim fasteners as indicated on the shop drawings.
2. Field drill weep holes where appropriate in horizontal trim; minimum 1/4-inch diameter at 24 inches on center.
3. Place a continuous strip of butyl tube sealant between the inside back face of closure trims and interior panel faces for proper weather seal.

D. Sealant Installation For Exposed Joints:

1. Clean and prime surfaces to receive exterior exposed sealants in accordance with sealant manufacturer's recommendations.
2. Follow sealant manufacturer's recommendations for joint width-to-depth ratio, application temperature range, size and type of backer rod, and compatibility of materials for adhesion.
3. Direct contact between butyl and silicone sealants shall not be permitted.

3.02 CONTRACTOR QUALITY CONTROL

A. Field Water Test: After completing portion of metal roof panel assembly including accessories and trim, test a 2-bay area for each structure selected by the COR for water penetration in accordance with AAMA 501.2.

B. Cleaning And Protection:

1. Remove protective film immediately after installation.
2. Touch-up, repair or replace metal panels and trim that have been damaged as approved by COR.
3. After metal roof panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

END OF SECTION

SECTION 07 41 15

REMOVABLE ROOF COVERS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Removable Roof Covers:

1. Payment: Lump sum price offered in the schedule.

   a. Includes roof and wall panels shown on drawings 1695-D-112 and 1695-D-118.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM C 518 - 10	Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
2.	ASTM C 591 - 12b	Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
3.	ASTM E 72 - 10	Conducting Strength Tests of Panels for Building Construction
4.	ASTM E 90 - 09	Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
5.	ASTM E 413 – 10	Classification for Rating Sound Insulation
6.	ASTM E 283-04(2012)	Determining Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen
7.	ASTM E 331-00(2009)	Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
8.	ASTM E 1592 - 05(2012)	Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference

1.03 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 72:

1. Wind Loads: As shown on drawings.

2. Other Design Loads: As shown on drawings.

3. Deflection Limits: For wind loads, no greater than L/180 of the span.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 07 41 13 – 1, Sample and Color Sample Kit:

1. Two feet by 2 feet sample.

C. RSN 07 41 13 - 2, Product Data and Shop Drawings:

1. Metal panels, edges, joints, profiles, corners, anchorages, attachments, trim, flashings, closures and accessories approval data:

   a. Certification of specified recovered material content.

2. Shop drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

3. Product test reports.

4. Closeout maintenance data.

1.05 QUALIFICATIONS

A. Installer Qualifications: Worked on 3 projects of similar scope.

PART 2 PRODUCTS

2.01 ROOF PANELS

A. General:

1. Minimum R-value of 31 in accordance with ASTM C 1363.

2. Water penetration: No uncontrolled water penetration through the panel joints at a pressure differential of 20 psf in accordance with ASTM E 331.

3. Air infiltration: Not to exceed 0.001 cfm/sf at 20 psf air pressure differential in accordance with ASTM E 283.

4. Sound Transmission Coefficient (STC): Minimum of 22 when ASTM E 90 and ASTM E 413.

5. Insulating core: Polyisocyanurate (ISO) core, ASTM C 591 Type IV, CFC and HCFC free.

   a. Minimum recovered materials content: 9 percent.

6. Steel materials content:

   a. If manufactured in a Basic Oxygen Furnace:

1) Minimum post consumer content: 16 percent.

2) Minimum total recovered materials: 25 to 30 percent.

b. If manufactured in an Electric Arc Furnace:

1) Minimum post consumer content: 67 percent.

2) Minimum total recovered materials: 100 percent.

7. 100 Series, manufactured by Kingspan Insulated Panels, 2000 Morgan Road, Modesto, CA 95358, Website: www.kingspanpanel.com with the following essential characteristics:

a. Factory-formed insulated metal panels.

b. Designed and manufactured to prevent through metal-to-metal contact between exterior and interior faces of installed system.

c. Total panel thickness: 4 inches.

d. ASTM A 755.

e. Coatings: Refer to 09 96 20 – Coatings.

f. Interlocking tongue and groove.

g. Exterior face:

1) Gauge: 26.

2) Interlock.

3) Color: To be determined by Government from submitted color sample.

4) Finish and Texture: Standard Manufacturer's.

h. Interior face:

1) Gauge: 26.

2) Finish and texture: Standard Manufacturer's.

3) Color: Imperial White.

8. Fasteners:

a. As recommended by the manufacturer.

b. Size and spacing: As recommended by manufacturer.

9. Perimeter trim and penetration treatments:

a. Fabricated perimeter trim, penetration treatments and metal flashing: Same gauge, material and coating color as exterior face of insulated metal roof panel.

10. Sealants: Butyl, non-skinning/curing type as recommended by manufacturer.

a. Butyl Tape: As recommended by manufacturer.

2.02 WALL PANELS

A. Refer to Section 07 42 13 – Formed Metal Wall Panels.

1. Exterior Metal Wall Panels – Type "A"

B. Panel Thickness: 4 inches.

PART 3 EXECUTION

A. Examination:

1. Provide field measurements to panel manufacturer.

B. Connect to steel frame as shown on the drawings.

C. Panel Installation:

1. In accordance with manufacturer's installation guidelines and recommendations.
2. Install panels plumb, level, and true-to-line to dimensions and layout indicated on shop drawings.
3. Cut panels prior to installing, where indicated on shop drawings, using a power circular saw with fine tooth carbide tip blade per manufacturer's instructions.
4. Butyl weather barrier sealant:
    a. Apply non-skinning butyl sealant as shown on shop drawings and manufacturer's installation instructions as necessary to establish the vapor barrier for the panels.
    b. Use non-skinning butyl tube sealant only for tight metal-to-metal contact.
    c. Do not use non-skinning butyl tube sealant to bridge gaps.

D. Trim Installation:

1. Place trim and trim fasteners as indicated on the shop drawings.
2. Field drill weep holes where appropriate in horizontal trim; minimum 1/4-inch diameter at 24 inches on center.
3. Place a continuous strip of butyl tube sealant between the inside back face of closure trims and interior panel faces for proper weather seal.

E. Sealant Installation For Exposed Joints:

1. Clean and prime surfaces to receive exterior exposed sealants in accordance with sealant manufacturer's recommendations.
2. Follow sealant manufacturer's recommendations for joint width-to-depth ratio, application temperature range, size and type of backer rod, and compatibility of materials for adhesion.

3. Direct contact between butyl and silicone sealants shall not be permitted.

F. Contractor Quality Control:

1. Spray panels with water. Repair leakage as approved by COR.

2. Inspect panels for light infiltration. Repair as approved by COR.

G. Cleaning And Protection:

1. Remove protective film immediately after installation.

2. Touch-up, repair or replace metal panels and trim that have been damaged as approved by COR.

END OF SECTION

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SECTION 07 42 13

PREINSULATED METAL WALL PANELS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Preinsulated Metal Wall Panels:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American Architectural Manufacturers Association (AAMA)

1.	AAMA 501.2	Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems.

B. ASTM International (ASTM)

1.	ASTM C518 - 10	Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
2.	ASTM C591 - 12b	Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
3.	ASTM E72 - 10	Conducting Strength Tests of Panels for Building Construction
4.	ASTM E90 - 09	Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
5.	ASTM E413 – 10	Classification for Rating Sound Insulation
6.	ASTM E283-04(2012)	Determining Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen
7.	ASTM E331-00(2009)	Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
8.	ASTM E1592 - 05(2012)	Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference

1.03 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E72:

1. Wind loads: As shown on drawings.
2. Other design loads: As shown on drawings.
3. Deflection limits: For wind loads, no greater than L/180 of the span.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 07 42 13 – 1, Sample and Color Sample Kit:

1. Two feet by 2 feet sample.

C. RSN 07 42 13 - 2, Product Data and Shop Drawings:

1. Metal panels, edges, joints, profiles, corners, anchorages, attachments, trim, flashings, closures and accessories approval data:
   a. Certification of specified recovered material content.
2. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
3. Product test reports.

D. RSN 17 42 13 – 3, Closeout Maintenance Data.

1.05 QUALIFICATIONS

A. Installer Qualifications: Worked on 3 projects of similar scope.

PART 2 PRODUCTS

2.01 GENERAL

A. Minimum R-value of 7.5 per inch in accordance with ASTM C518.

B. Water Penetration: No uncontrolled water penetration through the panel joints at a pressure differential of 20 psf in accordance with ASTM E331.

C. Air Infiltration: Not to exceed 0.001 cfm/sf at 20 psf air pressure differential in accordance with ASTM E283.

D. Sound Transmission Coefficient (STC): Minimum of 22 in accordance with ASTM E90 and ASTM E413.

E. Insulating Core: Polyisocyanurate (ISO) core, ASTM C591 Type IV, CFC and HCFC free.

1. Minimum recovered materials content: 9 percent.

F. Coatings:

1. In accordance with the manufacturer's recommendations.

2. Factory applied.

2.02 EXTERIOR METAL WALL PANELS – TYPE "A"

A. 300 A Azteco Panel, Manufactured by Kingspan Insulated Panels, 2000 Morgan Road, Modesto, CA 95358, Website: (www.kingspanpanel.com) with the following essential characteristics:

1. Factory-formed insulated metal panels.

2. Total panel thickness: 2 inches.

3. Exterior face:

a. ASTM A 755.

b. Gauge: 24.

c. Profile: 300A series, Flat.

d. Texture: Non-directional stucco embossed.

e. Color: Selected by Government from manufacturers standard chart in accordance with the Samples and Colors Section 01 33 00 – Submittals.

4. Interior face:

a. ASTM A 755.

b. Gauge: 24.

c. Profile: Minor Rib.

d. Texture: None.

e. Color: Imperial White.

2.03 INTERIOR WALL PANELS – TYPE "B"

A. 300 Minor Rib Panel, manufactured by Kingspan Insulated Panels, 2000 Morgan Road, Modesto, CA 95358, Website: (www.kingspanpanel.com) with the following essential characteristics:

1. Factory-formed insulated metal panels.

2. Total panel thickness: 2 inches.

3. Exterior and interior faces:

a. ASTM A 755.

b. Exterior and interior Gauge: 24.

c. Profile: Minor Rib.

d. Texture None.

e. Color: Imperial White (both faces).

4. Interior face coating: Arbosol, as manufactured by P and R Industries, Inc., www.arbonite.com or equal with the following essential conditions:

a. Factory applied.

b. Corrosion resistant.

c. Suitable for environments with chlorine gas.

2.04 ACCESSORIES

A. Fasteners:

1. Self drilling fasteners shall be cadmium plated steel with neoprene washer, as recommended by manufacturer.

2. Material: Hex-head type with steel and neoprene washer and 12 gauge stainless steel clip supplied by the manufacturer.

3. Size: As recommended by manufacturer.

B. Perimeter Trim:

1. Fabricated perimeter trim and metal flashing: Shall be same gauge, material and coating color as exterior face of insulated metal wall panel.

2. Extruded perimeter trim: Shall be extruded aluminum 6063-T5 alloy with spray applied PVF coating in same color as exterior face of insulated metal wall panel.

C. Sealants: Butyl, non-skinning/curing type as recommended by manufacturer.

D. Butyl Tape: As recommended by manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Provide field measurements to panel manufacturer.

B. Supporting steel (Girts): In accordance to 05 40 00 – Cold-Formed Metal Framing.

1. Verify that bearing support has been provided behind horizontal joints of vertical panel systems and behind vertical joints of horizontal panel systems.

2. Width of support as recommended by manufacturer.

C. Examine individual panels upon removing from the bundle; notify manufacturer of panel defects.

3.02 INSTALLATION

A. Panel Installation:

1. In accordance with manufacturer's installation guidelines and recommendations.
2. Install panels plumb, level, and true-to-line to dimensions and layout indicated on shop drawings.
3. Cut panels prior to installing, where indicated on shop drawings, using a power circular saw with fine tooth carbide tip blade per manufacturer's instructions.
4. Butyl weather barrier sealant:
    a. Apply non-skinning butyl sealant as shown on shop drawings and manufacturer's installation instructions as necessary to establish the vapor barrier for the panels.
    b. Use non-skinning butyl tube sealant only for tight metal-to-metal contact.
    c. Do not use non-skinning butyl tube sealant to bridge gaps.
5. Place panel fasteners through pre-punched holes in attachment clips, concealed within the joint of the panel. Secure units to the structural supports. Space clips as recommended by manufacturer or otherwise indicated on the shop drawings.

B. Trim Installation :

1. Place trim and trim fasteners as indicated on the shop drawings.
2. Field drill weep holes where appropriate in horizontal trim; minimum 1/4-inch diameter at 24 inches on center.
3. Place a continuous strip of butyl tube sealant between the inside back face of closure trims and interior panel faces for proper weather seal.

C. Sealant Installation For Exposed Joints:

1. Clean and prime surfaces to receive exterior exposed sealants in accordance with sealant manufacturer's recommendations.
2. Follow sealant manufacturer's recommendations for joint width-to-depth ratio, application temperature range, size and type of backer rod, and compatibility of materials for adhesion.
3. Direct contact between butyl and silicone sealants shall not be permitted.

3.03 CONTRACTOR QUALITY CONTROL

A. Field Water Test: After completing portion of metal wall panel assembly including accessories and trim, test a 2-bay area selected by the COR for each structure for water penetration in accordance with AAMA 501.2.

B. Cleaning and Protection:

1. Remove protective film immediately after installation.
2. Touch-up, repair or replace metal panels and trim that have been damaged as approved by COR.

3. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

END OF SECTION

SECTION 07 72 30
ROOF HATCHES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Roof Hatches:

1. Payment: Lump sum price offered in the schedule.

a. Includes:

1) Single leaf roof hatches:

a) Chlorine Injection Vault No. 1.

b) Chlorine Injection Vault No. 2.

c) Valve Vault No. 1.

d) Flowmeter Vault No. 1.

e) Flowmeter Vault No. 2.

2) Double leaf roof hatches:

a) Valve Vault No. 1.

b) Flowmeter Vault No. 1.

c) Flowmeter Vault No. 2.

1.02 REFERENCE STANDARDS

A. Aluminum Association (AA)

1.	AA ADM-2010	Aluminum Design Manual

B. ASTM International (ASTM)

1.	ASTM D1056-07	Flexible Cellular Materials - Sponge or Expanded Rubber

C. American Welding Society, Inc. (AWS)

1.	AWS D1.2/D1.2M-08	Structural Welding Code - Aluminum

1.03 DELIVERY, STORAGE, AND PROTECTION

A. Protect from corrosion, deformation, and other types of damage.

B. Store items in an enclosed area free from contact with soil and weather.

C. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.01 SINGLE LEAF ROOF HATCHES

A. Roof Hatches:

1. Aluminum access hatches of sizes shown on drawings.
2. Roof hatches: Type "S" as manufactured by the Bilco Company, P.O. Box 1203, New Haven, CT 06505; B-RH Series as manufactured by Babcock-Davis Hatchways, Incorporated, 50 Lowell Street, Arlington, MA 02174; or equal, having the following essential characteristics:
    a. Single leaf.
    b. Twelve-inch high curb with 3-1/2-inch wide flange with holes for securing to the roof (hatch), 11 gauge aluminum with welded watertight corners.
    c. Curb insulation: 1-inch rigid fiberboard. Enclose curb insulation with metal of same material and gauge as curb.
    d. Covers: 11 gauge aluminum.
    e. Cover insulation: 1-inch thick glass fiber. Fully enclose with metal cover of 18-gauge aluminum.
    f. Heavy duty hinges.
    g. Spring operators to ease operation when opening hatch.
    h. Automatic hold-open device.
    i. Turn handles and padlock hasps on inside and outside.
    j. Weathertight and watertight.

2.02 DOUBLE LEAF ROOF HATCHES

A. Roof Hatches:

1. Aluminum access hatches of sizes shown on drawings.
2. Roof hatches: Type "D" as manufactured by the Bilco Company, P.O. Box 1203, New Haven, CT 06505; B-RH Series as manufactured by Babcock-Davis Hatchways, Incorporated, 50 Lowell Street, Arlington MA 02174; or equal, having the following essential characteristics:
    a. Double leaf.
    b. Twelve-inch high curb with 3-1/2-inch wide flange with holes for securing to the roof (hatch), 3/16-inch aluminum with welded watertight corners.

c. Curb insulation: 1-inch rigid fiberboard. Enclose curb insulation with metal of same material and gauge as curb.

d. Covers: 3/16-inch aluminum.

e. Cover insulation: 1-inch thick glass fiber. Fully enclose with metal cover of 11-gauge aluminum.

f. Heavy duty hinges

g. Spring operators to ease operation when opening hatch.

h. Automatic hold-open device.

i. Turn handles and padlock hasps on inside and outside.

j. Weathertight and watertight.

2.03 MATERIALS

A. Gaskets:

1. Dense sheet neoprene gaskets: ASTM D1056, Grade 2A1.
2. Bond gasket to metal with manufacturer's standard adhesive.

B. Expansion Anchors: In accordance with Section 05 50 00 – Metal Fabrications.

2.04 FABRICATION

A. Fabricate metalwork in accordance with AA ADM, and these specifications.

1. Perform welding and related work in accordance with AWS D1.2.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install roof hatches as shown on drawings.

B. Install roof hatches in accordance with manufacturer’s instruction to be weathertight and watertight.

C. Expansion Anchors: Install in accordance with Section 05 50 00 – Metal Fabrications.

D. Painting:

1. Paint surfaces of hatches exposed after installation, except aluminum and galvanized steel, in accordance with Section 09 96 20 - Coatings.
2. Paint aluminum in contact with steel or concrete with one coat of industrial bituminous paint.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Spray hatches with water. Repair leakage as approved by COR.

B. Inspect hatches for light infiltration. Repair as approved by COR.

END OF SECTION

SECTION 07 92 00

PUMPING PLANT EXPANSION JOINT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for applicable items of work.

1.02 REFERENCES

A. ASTM International (ASTM)

1. ASTM C 920-08 Elastomeric Joint Sealants

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 07 92 00-1, Approval Data:

1. Manufacturer's product data.
2. Standard color chart.

C. RSN 07 92 00-2, Instructions:

1. Manufacturer's environmental, storage, surface preparation, installation, and cleanup instructions for each sealant and primer material.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to jobsite in manufacturer's original unopened packaging with labels and seals intact.

B. Store materials in accordance with manufacturer's instructions.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Do not install sealant when ambient air temperature is below 40 degrees Fahrenheit or above 90 degrees Fahrenheit.

B. Comply with sealant manufacturer's environmental restrictions.

PART 2 PRODUCTS

2.01 BACKERSEAL

A. Backerseal (Greyflex), as manufactured by Emseal Joint Systems, LTD, Website: www.emseal.com, or equal with the following essential characteristics:

1. Preformed foam sealant for use behind backer-rod and sealant.

2.02 BACKER ROD

A. Compatible with Sealant and Backerseal.

2.03 SEALANT

A. Non-sag Polyurethane Sealant:

1. ASTM C 920, Type S, Grade NS, Class 25, Use M.
2. Single-component, non-sag polyurethane sealant.

2.04 ACCESSORIES

A. Primers: As recommended by sealant manufacturer for joint surface materials.

B. Joint Cleaners: Noncorrosive and non-staining products recommended by sealant manufacturer for application.

PART 3 EXECUTION

3.01 PREPARATION

A. Preparation of Joint Surfaces:

1. Clean and prepare joint in accordance with sealant manufacturer's instructions.
2. Remove mortar, laitance, dust, coatings, curing compounds, petroleum products, corrosion, and other foreign material.
3. Allow joint to dry.
4. Prime joint surfaces as recommended by manufacturer of joint materials.

B. Obtain approval of joint preparation from COR before installation of sealant in joint.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Place and tool to smooth joints free of air pockets, embedded foreign material, ridges, and sags.

3.03 REPAIR

A. Remove defective or contaminated sealant. Reclean joint and replace sealant.

3.04 CLEANING

A. Remove excess sealant and soiling from adjacent surfaces.

3.05 SEALANT SCHEDULE

Table 07 92 00A - Sealant Schedule

Joint Location and Description	Sealant	Color
Pumping Plant – Between Masonry Wall and Insulated Wall Panels	Non-sag polyurethane sealant	As approved by Government

END OF SECTION

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SECTION 08 11 10

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Steel Doors and Frames:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1.	ANSI A250.8-2003	Standard Steel Doors and Frames

B. ASTM International (ASTM)

1.	ASTM A153 / A153M – 09	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
2.	ASTM A1008 / A1008M - 12a	Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
3.	ASTM C1048 - 12	Heat-Strengthened and Fully Tempered Flat Glass
4.	ASTM C1172 - 09	Laminated Architectural Flat Glass

C. Code of Federal Regulations (CFR)

1.	16 CFR 1201	Safety Standard for Architectural Glazing Materials

D. Commercial Item Description (CID)

1.	CID A-A-1923A	Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors), 21 August 2001

E. National Fire Protection Association (NFPA)

1.	NFPA 252-2012	Fire Tests of Door Assemblies

F. Steel Door Institute (SDI)

1.	SDI-111-C-09	Recommended Louver Details for Standard Steel Doors

G. Underwriters Laboratories Inc. (UL)

1. UL 10C Positive Pressure Fire Tests of Door Assemblies, 1998

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01330 – Submittals.

B. RSN 08 11 10-1, Approval Drawings and Data:

1. Manufacturer's shop drawings:

a. Show dimensions, material gauges, framing members, reinforcements, hardware preparation and locations, louver details, glazing details, anchorage details, and other fabrication and installation details.

b. Identify doors and frames by Government designations on drawings.

2. Manufacturer's product data for doors, frames, louvers, glass, and accessory materials.

a. Include complete descriptions and specifications for materials, construction, louvers, glass, glazing gasket, and finish.

b. Identify doors and frames by Government designations on drawings.

3. Manufacturer's product data for grout to be used to fill frames.

C. RSN 08 11 10-2, Instructions:

1. Manufacturer's storage, handling, and installation instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store and handle materials at jobsite in accordance with manufacturer's instructions and ANSI A250.8.

PART 2 PRODUCTS

2.01 HOLLOW STEEL DOORS

A. Exterior Doors:

1. ANSI A250.8, Level 3 and Physical Performance Level A, Model 2, hot-dipped zinc coated steel, 16 gauge.

2. Core construction: Polyurethane or polystyrene.

3. End closure: Flush end closure at top.

B. Interior Doors: ANSI A250.8, Level 2 and Physical Performance Level B, Model 2, 18 gauge.

2.02 HOLLOW STEEL FRAMES

A. Exterior Door Frames: ANSI A250.8, hot-dipped zinc coated steel, face welded type.

B. Interior Door Frames:

1. Frames installed in concrete walls: ANSI A250.8, face welded type.
2. Frames installed in gypsum board walls: ANSI A250.8, drywall slip-on type.

2.03 GLASS AND GLAZING MATERIALS

A. Glass - Type HG Doors:

1. ASTM C 1172, Kind LHS, laminated safety glass.
2. Glass Lites: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3.
3. Interlayer: 0.030-inch-thick polyvinyl butyral (PVB) resin.
4. Thickness: 1/4-inch.

2.04 DOOR ACCESSORIES

A. Steel Astragals:

1. Continuous steel astragal.
2. Thickness: 1/8-inch.
3. Width: 1-1/2 inches.

B. Louvers - Interior Doors:

1. SDI-111-C, sightproof, stationary, inserted louver.
2. Blade Design: Inverted “V” blade or “Z” blade.
3. Net Free Area: As indicated on drawings.
4. Mounting: Nonremovable mounting from secure side of door.

C. Glazing Stops and Beads: ANSI A250.8.

2.05 FRAME ACCESSORIES

A. Frame Anchors - Concrete Openings: Expansion anchor, spacer, and flush-mounted capscrew system with zinc-coated finish.

B. Frame Anchors - Other Openings: ANSI A250.8.

C. Mortar Guard Boxes: 22 gauge, minimum, sheet steel.

D. Floor Anchors: ANSI A250.8.

E. Expansion Anchors for Floor Anchors: CID A-A-1923A, Type 4.

2.06 FABRICATION

A. Fabricate in accordance with approved shop drawings and ANSI A250.8.

B. Reinforce frames 4 feet or greater in width with 12-gauge formed steel channel stiffener welded into head. Install stiffener flush with top of frame.

C. Weld astragal to door leaf before finishing.

D. Reinforce and prepare for hardware in accordance with ANSI A250.8. Use hardware manufacturer's templates for hardware preparation.

E. Weld mortar guards into frames to be grouted at hardware mortises.

F. Provide single grouting access opening in frames to be set in concrete openings.

1. Center opening in inside face of head.
2. Provide flush-mounted plate cover attached with countersunk flathead screws to cover opening.

G. Silencer Holes:

1. Refer to Section 08 71 00 – Door Hardware for schedule.
2. Provide three silencer holes in strike jamb of frames for single doors except as specified. Space holes equally along jamb.
3. Provide two silencer holes in head of frames for double doors except as specified.
4. Omit silencer holes in frames for exterior doors where self-adhesive weatherstripping is to be applied.

H. Repair damage to zinc-coated materials with commercial zinc-rich priming paint.

2.07 FINISH

A. Prime finish in accordance with ANSI A250.8.

B. Use lead- and chromate-free priming paint compatible with finish paint to be field applied.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with approved shop drawings, manufacturer's instructions, and ANSI A250.8.

B. Install plumb, level, and in alignment with adjacent work.

C. Fill frames installed in concrete openings with approved cementitious grout.

D. Test and adjust door operation for proper operation.

3.02 GLAZING

A. Side Lites:

1. Paint frame before glazing.
2. Clean and dry frame and glass immediately before glazing.
3. Dry glaze with continuous glazing gasket around glass perimeter.

3.03 CONTRACTOR FIELD QUALITY TESTING

A. Spray doors with water. Repair leakage as approved by COR.

B. Inspect doors for light infiltration. Repair as approved by COR.

3.04 PAINTING

A. Paint installed doors and frames in accordance with Section 09 96 20 – Coatings.

END OF SECTION

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SECTION 08 33 19
INDUSTRIAL DOORS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Sliding Door:

1. Payment: Lump sum price offered in the schedule.

B. Monorail Door:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. Underwriters Laboratories (UL)

1. UL 752 (2005) Standard for Bullet-Resisting Equipment

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 08 33 19-1, Approval Drawings, Data, and Color Charts:

1. Manufacturer's shop drawings:

   a. Show dimensions, materials, relationship to structure, mounting and anchorage details, and other fabrication and installation details.

   b. Identify doors by Government designation on drawings.

2. Manufacturer's product data for each door model.

   a. Include complete descriptions and specifications for materials, construction, features, and finishes.

C. RSN 08 33 19-2, Certification:

1. Manufacturer's certification that each door meets specified performance requirements.

D. RSN 08 33 19-3, Instructions:

1. Manufacturer's storage, handling, installation, and maintenance instructions.

E. RSN 08 33 19-4, Check Prints.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store and handle at jobsite in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 PUMPING PLANT SLIDING DOOR

A. Model SLD 2016, manufactured by PS Doors, 1150 S. 48th Street, Grand Forks, ND 58201, Telephone: 701-746-4519, Website: www.psdoors.com or equal, having following essential characteristics:

1. Electrically operated single slide industrial sliding door with weatherhood.
    a. Slide right.
    b. Operator as recommended by manufacturer.
2. c. Exterior face mounted, see architectural and structural drawings.
3. Level 3 bullet resistance steel in accordance with UL 752.
4. Structural track and frame assembly as recommend by manufacture.
5. Designed for wind loads shown on design data sheet.
6. Dead bolt locking device.
7. Weatherseals: Per manufacturer's recommendations.
8. Insulated.
9. Bottom guide roller with tracks.
10. Shop applied primer and first coat finish as recommended by manufacturer.
    a. Color to be selected by Government.

2.02 CHLORINE FEED BUILDING MONORAIL DOOR

A. Model SLD 1516, manufactured by, PS Doors, 1150 S. 48th Street, Grand Forks, ND 58201, Telephone 701-746-4519, Website: www.psdoors.com or equal, having following essential characteristics:

1. Paired swing door with monorail notch, see structural for monorail size.
2. Frame assembly, latches and hinges as recommended by manufacturer.
3. Weatherseals: Per manufacturer's recommendation.
4. Insulated.
5. Door Closer (both leafs): Provided by door manufacturer sized for the size and weight of door.
6. Lockset:
    a. Function: F13- dormitory of exit lock.

b. Lever on outside

7. Exit Device (both leafs with leaver): Provided by door manufacturer sized for the size and weight of door.

8. Concealed Vertical Rod Panic Device (inactive leaf): Provided by door manufacturer sized for the size and weight of door.

9. Door Shoe with rain drip: Provided by door manufacturer sized for the size and weight of door.

10. Door Bottom Sweep: similar or equal to Pemko 368_N.

11. Shop applied primer and first coat finish as recommended by manufacturer.

a. Color to be selected by Government.

PART 3 EXECUTION

3.01 INSTALLATION

A. Field verify monorail opening size prior to ordering door.

B. Install in accordance with approved shop drawings and manufacturer's instructions.

C. Install plumb and in alignment with adjacent work.

D. Securely anchor to building frame.

E. Test and adjust door operation for proper operation.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Spray doors with water. Repair leakage as approved by COR.

B. Inspect doors for light infiltration. Repair as approved by COR.

3.03 MAINTENANCE

A. Maintain doors in accordance with manufacturer's instructions until acceptance of work by Government.

END OF SECTION

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SECTION 08 51 23
STEEL WINDOWS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Steel Windows:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM C1048 - 12	Heat-Strengthened and Fully Tempered Flat Glass
2.	ASTM C1172 - 09	Laminated Architectural Flat Glass
3.	ASTM E2190 - 10	Insulating Glass Unit Performance and Evaluation

B. Steel Door Institute (SDI)

1.	SDI A250.8-2003(2008)	Standard Steel Doors and Frames

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 08 51 23-1, Approval Drawings and Data:

1. Manufacturer's shop drawings:
   a. Show dimensions, material gauges, glazing details, anchorage details, and other fabrication and installation details.
   b. Identify windows by Government designations on drawings.
2. Manufacturer's product data:
   a. Include complete descriptions and specifications for frame materials, construction, glass materials, glazing gasket, and finish.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Permanently mark tempered glass in accordance with ASTM C 1048.

B. Permanently mark insulating glass units on spacer or one insulating unit component with appropriate certification label of inspection and testing agency.

C. Store window frames off ground, under cover, and protected from contact with moisture.

PART 2 PRODUCTS

2.01 HOLLOW STEEL FRAMES

A. SDI A250.8, face welded type.

B. Thickness: 18 gauge, minimum.

2.02 INSULATING GLASS UNITS

A. Unit Thickness: 1-inch.

B. Construction:

1. Two lites of specified glass hermetically sealed to a desiccant-filled aluminum spacer.
2. Dual seal consisting of polyisobutylene primary seal and organic or silicone secondary seal.
3. Breather tube as required for changes in atmospheric pressure between point of manufacture and jobsite.

C. Outboard Glass Lite:

1. ASTM C 1048, Kind FT, Condition C, Type I, Class 1, Quality Q3.
2. Thickness: 1/4-inch.

D. Inboard Glass Lite:

1. ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3.
2. Thickness: 1/4-inch.
3. Coat No. 3 surface with low-emissivity (Low-E) coating.

E. Certification: Tested in accordance with ASTM E 2190 and certified by Insulating Glass Certification Council.

2.03 LAMINATED SAFETY GLASS

A. ASTM C 1172, Kind LHS.

B. Glass Lites: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3.

C. Interlayer: 0.030-inch-thick polyvinyl butyral (PVB) resin.

D. Thickness: 1/4-inch.

2.04 GLAZING MATERIALS

A. Glazing Gasket: Resilient, non-hardening, elastomeric glazing gasket.

2.05 ACCESSORIES

A. Frame Anchors: ANSI A250.8.

B. Glazing Stops:

1. Same material as frame.
2. Removable.
3. Attached with flush-mounted screws.

2.06 FABRICATION

A. Fabricate in accordance with approved shop drawings and ANSI A250.8.

2.07 FINISH

A. Prime finish in accordance with ANSI A250.8.

B. Use lead- and chromate-free priming paint compatible with finish paint to be field applied.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with approved shop drawings.

B. Install plumb, level, and in alignment with adjacent work.

C. Securely anchor frame to support system of wall.

3.02 GLAZING

A. Paint frames before glazing.

B. Clean and dry frame and glass immediately before glazing.

C. Dry glaze with continuous glazing gasket around glass perimeter.

D. Glazing Schedule:

1. Exterior windows: Insulating glass unit.
2. Interior windows: Laminated safety glass.

3.03 CLEANING

A. Clean frame and glass surfaces after installation and glazing.

B. Remove temporary labels from glass.

3.04 PAINTING

A. Paint installed window frames and glazing stops in accordance with Section 09 96 20 - Coatings.

END OF SECTION

SECTION 08 62 00
UNIT SKYLIGHTS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Unit Skylights:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM E283-04(2012)	Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
2.	ASTM E 331	Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

1.03 PERFORMANCE REQUIREMENTS

A. Performance-Test-Response Characteristics:

1. Air leakage: Maximum of 0.2 l/s/m^2 (0.04 CFM/ft^2) of total unit area, measured at a differential pressure of 75 Pa (1.57 psf).
2. Water infiltration: No water penetration with a test pressure differential of 720 Pa (15.0 psf).
3. Thermal Performance: U-factor = 0.51 Btu/hr*ft^2*F˚ or less, SHGC = 0.26 or less and Vt = 0.39 (white). Tested and certified in accordance with NFRC 100 and 200 procedures. 2010 ENERGY STAR qualified.

1.04 SUBMITTALS

A. Submit the following accordance with Section 01 33 00 – Submittals.

B. RSN 08 62 00-1, Approval Drawings and Data:

1. Manufacturer’s shop drawings:
   a. Show layout, dimensions, relationship to roof system, fastening, and installation details.
2. Manufacturer’s product data:

a. Include complete descriptions and specifications for materials and construction.

C. RSN 08 62 00-2, Instructions:

1. Manufacturer's storage, handling, and installation instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store and handle at jobsite in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 UNIT SKYLIGHTS

A. FCM Fixed Curb Mounted Skylight manufactured by VELUX America Incorporated, 450 Old Brickyard Road, Greenwood, SC 29648-5001; or equal, having following essential characteristics:

1. Unit skylight mounted on Prefabricated or site-built curbs.
2. Tempered LoE^3 pane over a laminated heat strengthened interior pane with 0.030" white interlayer.
3. Fabricated one piece aluminum counter flashing system with corner keys.
4. Provide internal drainage of glazing spaces with exterior through gaskets to remove condensation.
5. Factory glazed with structural silicone-based primary seal.
6. Maintenance-free roll-formed aluminum frame with neutral gray Kynar 500 polyvinylidene fluoride resin finish.
7. Roll-formed aluminum, neutral gray, baked on polyester polyamide primer and finish coats.

2.02 ACCESSORIES

A. Engineered, prefabricated gutter system designed for use with high profile roofing materials, and for slopes 14 to 60 degrees.

B. Custom flashing provided by others where applications of prefabricated flashing are not suitable.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with approved shop drawings and manufacturer's instructions.

B. Incorporate into building roof system, counterflash, and seal installation in accordance drawing and 07 41 13 – Preinsulated Metal Roof Panels.

C. Prevent galvanic action between aluminum and dissimilar metals by methods recommended by skylight manufacturer.

D. Make installation waterproof and weathertight.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Spray skylight with water. Repair leakage as approved by COR.

3.03 CLEANING

A. Clean exposed surfaces using methods recommended by manufacturer.

END OF SECTION

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SECTION 08 71 00
DOOR HARDWARE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in price offered in the schedule for steel doors and frames.

1.02 REFERENCE STANDARDS

A. Builders Hardware Manufacturers Association (BHMA)

1.	BHMA A156.1-2013	Butts and Hinges
2.	BHMA A156.4-2008	Door Controls - Closers
3.	BHMA A156.6-2010	Architectural Door Trim
4.	BHMA A156.13-2012	Mortise Locks and Latches
5.	BHMA A156.16-2008	Auxiliary Hardware
6.	BHMA A156.21-2009	Thresholds
7.	BHMA A156.22-2012	Door Gasketing and Edge Seal Systems

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 08 71 00-1, Approval Data:

1. Contractor’s hardware schedule.
    a. Include complete hardware group, door, handing, hardware, accessories, and finish identification.
    b. Use Government designations to identify doors and hardware groups.
2. Manufacturer’s product data.

C. RSN 08 71 00-2, Instructions:

1. Manufacturer’s installation instructions.

1.04 SEQUENCING

A. Do not install surface-mounted hardware, gasketing systems, or weatherstripping on steel doors and frames until doors and frames have been painted.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Label each hardware container with item number in approved hardware schedule.

PART 2 PRODUCTS

2.01 BASIC HARDWARE REQUIREMENTS

A. Single Source Requirement: Provide matching products from single manufacturer for each type of hardware.

B. Templates: Provide manufacturers' templates for door and frame preparation.

2.02 BUTT HINGES

A. Standard-Weight Steel Butt Hinges: BHMA A156.1, A8112, full-mortise template hinge with five knuckles, two ball bearings, non-rising pin, and flat button tips.

2.03 LOCKSETS AND LATCHES

A. Type, Series, and Grade: BHMA A 156.13, Series 1000, Grade 1, mortise locksets and latches.

B. Front: Armored.

C. Case: Wrought steel with zinc dichromate corrosion protection.

D. Latch Bolt: 3/4-inch-throw, anti-friction, deadlocking stainless steel bolt.

E. Deadbolt: 1-inch-throw, solid stainless steel bolt with two enclosed hardened steel roller pins.

F. Trim Installation: Self-aligning installation secured with thru-bolts from inside trim.

G. Trim:

1. Round rose and lever handle on inside and outside.
2. Round lever handle with end return.
3. Base Material:
    a. BHMA 630 finish: Stainless steel.

2.04 DOOR CLOSERS

A. BHMA A156.4, Grade 1, Surface Closer - Modern Type with Cover, Option PT 4A, Option PT 4D, adjustable latching speed, multisize spring power adjustable from size 2 through 6, non-handed arm, and corrosion inhibiting prime coat or pretreatment.

2.05 FLUSH BOLTS

A. Lever Extension Flush Bolts:

1. Non-fire-rated Doors: BHMA A156.16, with flat front and 12-inch length rod.

2.06 DOOR PLATES

A. Kick Plates: BHMA A156.6, J102, stainless steel plate, 0.050-inch thick, with three beveled edges.

B. Mop Plates: BHMA A156.6, J103, stainless steel plate, 0.050-inch thick, with three beveled edges.

2.07 STOPS

A. Wall Stop: BHMA A156.16, Convex Type, concealed mounting, convex bumper, and backplate.

2.08 AUXILIARY HARDWARE

A. Kick Down Holder: BHMA A156.16, solid cast brass with duraflex bumper, 4-5/8-inch projection.

B. Silencers: BHMA A156.16, inserted-type rubber silencer.

2.09 GASKETING SYSTEMS

A. Door Shoe with Drip Cap:

1. BHMA A156.22.
2. One-piece, channel-type, extruded aluminum housing with integral rain drip.
3. One-piece, removable, fingered vinyl insert seal.
4. One-half-inch seal height.

B. Door Shoe without Drip Cap:

1. BHMA A156.22, R3D434.
2. One-piece, channel-type, extruded aluminum housing.
3. One-piece, removable, fingered vinyl insert seal.
4. One-half-inch seal height.

2.10 WEATHERSTRIPPING

A. Neoprene Gasket Weatherstripping: Closed-cell expanded neoprene gasket, 1/8-inch thick and 1/2-inch wide, with self-adhesive backing.

2.11 THRESHOLDS

A. Saddle Threshold: BHMA A156.21, extruded aluminum with 1/4-inch height and 5-inch width or as required.

2.12 DOOR SWEEPS

A. Door Bottom Sweep: 3/8-inch wide, 1-11/16-inch total height with insert, neoprene insert, clear anodized aluminum.

2.13 ACCESSORIES

A. Strikes and Accessories: Provide matching strikes and accessories required for installation or operation of hardware.

B. Fasteners: Matching fasteners suitable for application furnished by product manufacturer.

2.14 LOCK CYLINDERS AND KEYING

A. Furnish locks with seven-pin, interchangeable-core, lock cylinders.

1. Furnish lock cylinders with temporary construction core system which can be voided after contract completion.
2. Key locks alike.

B. Furnish permanent core system after contract completion. Provide two keys per lock.

C. Stamp construction keys with "U.S. Property - Do Not Duplicate" and appropriate key numbers.

D. Furnish six construction keys to COR for Government’s use during construction.

E. Deliver all construction keys to COR at jobsite after completion of work when directed by COR.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. Mount hardware in accordance with approved shop drawings for doors and frames.

C. Use manufacturer’s templates for field mounting of hardware.

D. Adjust operation of door operators and closers as recommended by manufacturer for door size, weight, movement, and jobsite conditions.

E. Mount activation device for door operator with centerline of device at 36 inches above finished floor.

F. Thresholds:

1. Fit threshold to doorframe.
2. Attach to concrete with machine screws in expansion anchors.

G. Gasketing and Weatherstripping:

1. Install or apply in continuous lengths without joints.
2. Butt corners tight.
3. Provide effective door seal.

H. Test door operation and correct defects in operation.

3.02 HARDWARE SCHEDULE

Table 08 71 00A - Door Hardware Schedule

Hardware Group No.	Door Numbers	Required Hardware for Each Door
1	Pumping Plant 100, 101, 106 Chlorine Feed Building 101, 102	Standard-weight steel butt hinges - 4-1/2 by 4-1/2 inch size - 1-1/2 pair - BHMA 630 finish.. F13 dormitory lockset - BHMA 630 finish. Closer with non-hold-open parallel arm , cush-n-stop type feature. BHMA 630 finish. Door shoe: Pemko 209 V. Threshold: Saddle Type Weatherstripping: Self-adhesive neoprene, Pemko S88.
2	Pumping Plant 102	Standard-weight steel butt hinges - 4-1/2 by 4-1/2 inch size - 1-1/2 pair - BHMA 626 finish. F05 classroom lockset - BHMA 630 finish. Closer with non-hold-open standard arm - BHMA 630 finish. Doorstop or bumper: Rockwood #402 Silencers. Door shoe: Pemko 209 V Door Bottom Sweep: Pemko 368_N Threshold: Saddle Type

Table 08 71 00A - Door Hardware Schedule

Hardware Group No.	Door Numbers	Required Hardware for Each Door
3	Pumping Plant 103	Standard-weight steel butt hinges - 4-1/2 by 4-1/2 inch size - 1-1/2 pair - BHMA 630 finish. F02 privacy or bath lock - BHMA 630 finish. Closer with non-hold-open standard arm - BHMA 630 finish. Mop plate - 6-inch height - both sides of door - BHMA 630 finish. Door holder – Rockwell #461 Doorstop – Rockwood #402 Door shoe: Pemko 209V. Threshold: Saddle Type Silencer Louver Vent: 24 inch by 24 inch, 50 percent free air minimum.
4	Pumping Plant 104	Standard-weight steel butt hinges - 4-1/2 by 4-1/2 inch size - 1-1/2 pair - BHMA 630 finish. F01 passage latch - BHMA 630 finish. Exit Device: Falcon 1790 series touch bar, active leaf only, BHMA 630 finish. Kick plate - each leaf - both sides of door - 12-inch height Closer with non-hold-open parallel arm, BHMA 630 finish. Automatic flush bolts: Rockwood 2842, stainless steel Door holder: Rockwell #461 Door shoe: Pemko 222 V Threshold: Saddle type Astragal: Pemko 303 S Silencer
5	Pumping Plant 105	Standard-weight steel butt hinges - 4-1/2 by 4-1/2 inch size - 1-1/2 pair, BHMA 630finish. F13 Dormitory or exit lock. Exit Device – Falcon 1790 series touch bar active leaf only, Kick Plate – both leafs, push side only Closer with non-hold-open parallel arm, cush-n-stop feature, BHMA 630finish. Automatic flush bolts: Rockwood 2842, stainless steel Dust proof strikes Door holder: Rockwell #461 Door shoe with drip cap: Pemko 2221V. Threshold: Saddle type Weatherstriping: Self-adhesive neoprene, Pemko S88 Astragal: Standard welded steel.

END OF SECTION

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SECTION 09 29 00
GYPSUM BOARD

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Gypsum Board:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM C 473 - 12	Physical Testing of Gypsum Panel Products
2.	ASTM C 475 / C 475M - 12	Joint Compound and Joint Tape for Finishing Gypsum Board
3.	ASTM C 840 - 11	Application and Finishing of Gypsum Board
4.	ASTM C 954 - 11	Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
5.	ASTM C 1002 - 07	Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
6.	ASTM C 1047-10a	Accessories for Gypsum Wallboard and Gypsum Veneer Base
7.	ASTM C 1396/C 1396M-11	Gypsum Board
8.	ASTM C 1629/C 1629M-06	Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels
9.	ASTM D 3273-00(2005)	Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

B. Gypsum Association (GA)

1.	GA-214-10	Recommended Levels of Gypsum Board Finish

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 09 29 00-1, Approval Data:

1. Manufacturer's product data for gypsum board and accessories.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials in accordance with ASTM C 840 and manufacturer's recommendations.

1.05 SEQUENCING

A. Do not install board materials until work to be concealed by board has been completed and COR has inspected and accepted work.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Maintain environmental conditions in accordance with ASTM C 840.

PART 2 PRODUCTS

2.01 GYPSUM BOARD

A. Hi-Impact XP Gypsum Board manufactured by National Gypsum Company, 2001 Rexford Road, Charlotte, NC 28211; Mold Tough AR Firecode Core manufactured by United States Gypsum Company, 550 West Adams Street, Chicago, IL 60661; or equal, having following essential characteristics:

1. Meets requirements of ASTM C 1396, Type X.
2. Overall thickness: 5/8-inch.
3. Moisture resistance: ASTM C 473, average water absorption not greater than 5 percent by weight after two-hour immersion.
4. Mold/mildew resistance: ASTM D 3273, 10, minimum.
5. Surface abrasion: ASTM C 1629, Level 2, minimum.
6. Surface indentation: ASTM C 1629, Level 1, minimum.
7. Tapered long edges.
8. Plain face and plain back.

2.02 ACCESSORIES

A. Drywall Screws:

1. Type S: ASTM C 1002, Type S, 3/8 inch, minimum, longer than total thickness of board to be penetrated.
2. Type S-12: ASTM C 954, 1/2 inch, minimum, longer than total thickness of board to be penetrated.

B. Joint Compounds and Tapes:

1. ASTM C 475.
2. Materials recommended by gypsum board manufacturer for application and jobsite conditions.
3. Use water-resistant materials for finishing gypsum board to be covered with ceramic tile.

C. Cornerbead:

1. ASTM C 1047, zinc-coated steel, with perforated flanges.
2. Size recommended by gypsum board manufacturer for board thickness and application.

D. Edge Trim:

1. ASTM C 1047, U-Bead, zinc-coated steel.
2. Size to match board thickness.

E. Caulk: Paintable acrylic-latex sealant.

PART 3 EXECUTION

3.01 INSTALLATION

A. Gypsum Board:

1. Apply and finish in accordance with ASTM C 840.
2. Mechanically fasten to support systems with drywall screws in accordance with ASTM C 840, System VIII.
3. Use type S-12 screws for fastening to 20-gauge or heavier metal.
4. Use type S screws for fastening to lighter gauge metal.
5. Finish surfaces to be covered by ceramic tile with GA-214 Level 2 finish.
6. Finish surfaces to be painted with GA-214 Level 4 finish.

B. Joints: Construct and space in accordance with ASTM C840.

C. Accessories:

1. Place cornerbead at external corners.
2. Place edge trim where gypsum board abuts dissimilar materials.
3. Install in accordance with manufacturer’s recommendations.

D. Caulking:

1. Install in accordance with manufacturer’s recommendations.

2. Use backer rod and accessory materials recommended by manufacturer.

3. Place and tool to smooth surface free of air pockets, embedded foreign material, ridges, and sags.

3.02 PAINTING

A. Paint exposed surfaces in accordance with Section 09 91 10 – Coatings for Concrete, Masonry, and Gypsum Board.

END OF SECTION

SECTION 09 30 00

FIBER REINFORCED WALL PANEL

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Fiber Reinforced Wall Panel:

1. Payment: Lump sum price offered in the schedule.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 09 30 00-1, Approval Data and Color Sample Kits:

1. Manufacturer's product data for base and adhesive.
2. Manufacturer's color sample kit for color selection.

C. RSN 09 30 00-2, Instructions:

1. Manufacturer's surface preparation and installation instructions for base and adhesive.

1.03 REFERNCE STANDARDS

A. ASTM International (ASTM):

1. ASTM D5319-12 Glass-Fiber Reinforced Polyester Wall and Ceiling Panels

PART 2 PRODUCTS

2.01 WALL PANELS

A. Standard FRP Wall Panels, manufactured by Marlite, Website: www.marlite.com, or equal with the following essential characteristics:

1. ASTM D5319.
2. Panel thickness: 3/32-inch.
3. Stain and chemical resistant.
4. Water resistant.

2.02 ACCESSORIES

A. Corners: Matching factory-made molded corners.

B. Joints: Matching factory-made seam joints.

C. Adhesive: As recommended by base manufacturer for substrate surface.

PART 3 EXECUTION

3.01 PREPARATION

A. Install gypsum board in accordance with 09 29 00 – Gypsum Board.

B. Remove, clean and dry wall surface treatments in accordance with manufacturer's instructions.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in maximum possible lengths to minimize joints.

C. Butt joints in accordance with manufacturer's instructions

D. Accurately scribe to doorframes and intersecting surfaces.

E. Finish wall corners with molded corners.

END OF SECTION

SECTION 09 65 10

RUBBER WALL BASE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Rubber Wall Base:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1. ASTM F 1861-08(2012) Resilient Wall Base

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 09 65 10-1, Approval Data and Color Sample Kit:

1. Manufacturer's product data for base and adhesive.
2. Manufacturer's color sample kit for color selection.

C. RSN 09 65 10-2, Instructions:

1. Manufacturer's surface preparation and installation instructions for base and adhesive.

1.04 SEQUENCING

A. Install base before wall surface is painted.

PART 2 PRODUCTS

2.01 RUBBER WALL BASE

A. ASTM F 1861, Type TV, Group 1, Style B - cove.

B. Thickness: 1/8-inch.

C. Height: 6 inches.

2.02 ACCESSORIES

A. Corners: Matching factory-made molded corners.

B. Adhesive: As recommended by base manufacturer for substrate surface.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean and dry wall surface in accordance with manufacturer's instructions.

B. Prime substrate as recommended by adhesive manufacturer.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in maximum possible lengths to minimize joints.

C. Butt joints tight without gaps or offset.

D. Accurately scribe to doorframes and intersecting surfaces.

E. Finish internal and external wall corners with molded corners.

END OF SECTION

SECTION 09 91 10

COATINGS FOR MASONRY AND GYPSUM BOARD

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule items of work requiring coatings for masonry and gypsum board.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM C 920-11	Elastomeric Joint Sealants
2.	ASTM D 4138-07a	Measurement of Dru Film Thickness of Protective Coatings by Destructive, Cross Section Means
3.	ASTM D 4259-88(2006)	Abrading Concrete
4.	ASTM D 4263-83(2012)	Indicating Moisture in Concrete by the Plastic Sheet Method
5.	ASTM D 4285-83(2012)	Indicating Oil and Moisture in Compressed Air
6.	ASTM D 4414-95(2009)	Measurement of Wet Film Thickness by Notch Gages
7.	ASTM D 4787-08	Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
8.	ASTM D 6132-08	Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Over Concrete Using an Ultrasonic Gage
9.	ASTM F 1869-11	Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

B. Federal Standards (Fed Std)

1.	Fed Std 595C(1)-08	Colors Used in Government Procurement

C. Master Painters Institute (MPI)

1.	Approved Product List (APL)	www.paintinfo.com or www.mpi.net

D. The Society for Protective Coatings (SSPC)/NACE International (NACE)

1.	SSPC-AB1-2007	Mineral and Slag Abrasives
2.	SSPC-AB2-2004	Cleanliness of Recycled Ferrous Metallic Abrasives
3.	SSPC-AB3-2004	Newly Manufactured or Re-Manufactured Steel Abrasives
4.	SSPC-PA2-12	Measurement of Dry Paint Thickness with Magnetic Gages
5.	SSPC-SP13/NACE No. 6-03	Surface Preparation of Concrete

E. United States Bureau of Reclamation (USBR)

1.	USBR M 47-96	Standard Specifications for Repair of Concrete

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01330 – Submittals.

1. Include following information with each set of data or certification:
   a. Applicable tabulation number from Coating Tabulations.
   b. Identification of AItems to be coated@ including sub-letter and sub-number listed in Coating Tabulations.

B. RSN 09 91 10-1, Approval Data:

1. For each coating material:
   a. Manufacturer's product data, application, and MSDS sheets.
   b. Include the following information:
      1) Supplier's name, address, and phone number.
      2) Manufacturer's designated product name.
      3) Applicable tabulation number from Coating Tabulations.
      4) Identification of "Items to be coated" including sub-letter and sub-number listed in Coating Tabulations.
2. "Equal" Products:
   a. For coating materials proposed as "equal" products to specified brand name products in Coating Categories, submit following with specified approval data:
   b. List of projects (not less than three) where material has been successfully used in applications similar to this project. Include:
      1) Project name and location.
      2) Type of structure.
      3) Owner's name, address, and telephone number.

4) Application dates.

c. Manufacturer's certification substitute coating material meets specified requirements. Include:

1) Manufacturer's name, address, and phone number.

2) Batch number(s) for each material, except thinners.

3) Signature of manufacturer's technical representative and date of signature.

d. Certified test reports that demonstrates substitute material meets or exceeds specified coating category requirements for physical and performance characteristics from each of following:

1) Coating manufacturer.

2) Independent laboratory.

3. Paint Chip Samples:

a. Color chip samples approximately 4- by 6-inch.

b. Label each sample. Include manufacturer's designated product name; color; and gloss.

C. RSN 09 91 10-2, Final Approval Data:

1. For each coating material:

a. Purchase orders. Include:

1) Supplier's name, address, and phone number.

2) Purchase order number and date.

3) Manufacturer's designated product name.

4) Batch number(s) for each material, except thinners.

5) Quantities ordered for each material, except thinners.

D. RSN 09 91 10-3, Documentation:

1. Written evidence showing each applicator's qualifications by training or experience for each coating.

a. When documenting qualifications` by experience,

1) Include list of 3 recent jobs using comparable materials under similar conditions.

2) Include the owners contact information of 3 recent jobs.

1.04 QUALIFICATIONS

A. Coating Applicators Qualifications:

1. Qualified to apply specified coating materials by one of following:
    a. Successfully completed training in application of coating materials similar to materials and conditions specified.
    b. Skilled and experienced in application of coating materials similar to materials and conditions specified.

B. Compliance Criteria for Coating Materials:

1. Material is of same composition and formulation to meet physical and performance test results for one of following:
    a. Submitted batch or previously tested batch materials complies with these specifications.
    b. Submitted batch materials are unchanged from previously tested batch materials that comply with manufacturer's quality control (QC) and quality assurance (QA) programs.
    c. Submitted batch materials complies with manufacturer's quality control (QC) and quality assurance (QA) programs as listed on product data and application sheets.

1.05 DELIVERY, STORAGE, HANDLING

A. Deliver materials to jobsite in original, undamaged, unopened containers labeled with manufacturer's name, designated product name, batch number, date of manufacture, and any special instructions.

B. Deliver materials in containers not larger than 5 gallons as packaged by manufacturer unless suitable equipment is provided at jobsite to handle and thoroughly mix materials in larger containers.

C. Store materials in well ventilated area.

D. Do not expose to direct sunlight during storage.

E. Comply with manufacturer's storage instructions.

F. Do not use coating material which has exceeded manufacturer's specified storage stability period (shelf life).

1.06 ENVIRONMENTAL REQUIREMENTS

A. Comply with coating manufacturer's environmental restrictions. Comply with most restrictive requirements of coating manufacturer's restrictions and these specifications when coating manufacturer's restrictions conflict with these specifications.

B. Do not apply coatings under following environmental conditions:

1. Substrate surface temperature less than 5 degrees Fahrenheit above dewpoint.
2. Air and substrate surface temperature less than 50 degrees Fahrenheit and not to exceed manufacturer's recommended maximum temperature limit.
3. Humidity outside of manufacturer's recommended range.

C. Do not perform surface preparation or apply coatings when environmental conditions are not expected to meet specified requirements during surface preparation, coating application, and curing period.

D. Maintain environmental conditions to meet specified requirements during coating application and curing period. Provide heat and dehumidification required to maintain temperature and humidity conditions.

PART 2 PRODUCTS

2.01 MATERIALS

A. General:

1. Compliance criteria for coating materials:
    a. Material is of same composition and formulation to meet physical and performance test results for one of following:
        1) Submitted batch or previously tested batch materials complies with these specifications.
        2) Submitted batch materials are unchanged from previously tested batch materials that comply with manufacturer's quality control (QC) and quality assurance (QA) programs.
        3) Submitted batch materials complies with manufacturer's quality control (QC) and quality assurance (QA) programs as listed on product data and application sheets.
2. Materials required by these specifications and not listed in Coating Categories are subject to certification and testing in accordance with this section.
3. Provide compatible products of same manufacturer for coating system components.

B. Abrasives:

1. Mineral and slag abrasives: Meets SSPC-AB1, type I (natural minerals) and type II (slags), class A, except flint minerals are not permitted.
2. Ferrous metallic abrasives: Meets following requirements:
    a. SSPC-AB2 for recycled cleanliness.

1) Screen and air wash abrasive recycled at the job site to remove dirt and fines. Add new abrasive so that the combined new and recycled abrasive mixture meets specified abrasive requirements for moisture, friability, silica, anchor pattern, and oil content. Do not recycle abrasive which has picked up toxic or hazardous material. Do not recycle nickel slag.

b. SSPC-AB3, class I (steel) or II (iron) for angular shaped grit.

3. The contractor is to make every effort commercially available to render the hazardous waste stream non-hazardous.

4. Do not exceed toxicity threshold limit for hazardous materials.

C. Coatings:

1. Specified in Coating Categories.

2. Apply only one coating category per option in Coating Tabulations.

3. Volatile Organic Compounds (VOC):

a. Do not to exceed maximum permitted by Federal, State, and local air pollution control regulations.

b. Do not exceed maximum content as supplied in container or by addition of thinner material.

4. Factory color or tint. Do not color or tint at jobsite.

5. Use thinners recommended by manufacturer for each coating material.

6. Use of accelerator products is not permitted unless approved by CO.

D. Fillers and Caulks:

1. Flexible gaps or crevices:

a. Coating manufacturer's standard flexible filler or caulk material.

b. Caulk material: Meet or exceed ASTM C 920-08 type S or M, grade NS, class 25, suitable for water immersion service.

2. Nonflexible gaps or crevices:

a. Coating manufacturer's standard filler or caulk material.

PART 3 EXECUTION

3.01 PROTECTION OF ADJACENT SURFACES, EQUIPMENT AND NEWLY COATED SURFACES

A. Protect items or surfaces not to be coated and adjacent to surfaces to be cleaned and coated from contamination and damage during cleaning and coating operations.

1. Includes surfaces and equipment in physical contact with areas being cleaned or coated. Examples include: mechanical and electrical equipment (open or enclosed); instruction and similar plates; and wet and newly coated surfaces.
2. Protect from abrasive blast particles and airborne coating particles.
3. Prevent damage from bumping or striking with foreign objects.

B. Protect newly coated surfaces until coating is thoroughly dry or as determined by coating manufacturer's instructions.

3.02 REPAIR OF CONTRACTOR-DAMAGED SURFACES

A. Repair surfaces which are damaged or contaminated as determined by CO.

1. Repair damaged surfaces to original condition and appearance.
2. Before coating any damaged coated surfaces, re-clean exposed surface and apply coating materials in accordance with these specifications.

3.03 SURFACE PREPARATION

A. Before surface preparation and coating application, cure cementitious materials for 28 days, minimum.

B. Before coating application, repair cementitious defects greater than 3/4-inch in depth by one of following:

1. In accordance with USBR M47.
2. In accordance with manufacturer's product instructions.

C. Remove fungus, mold, and mildew on concrete or masonry surfaces before coating by one of following:

1. Wash brush affected area with solution of 5 ounces of trisodium phosphate, 3 ounces of household detergent, 1.25 percent sodium hypochlorite, and 3 quarts of warm potable water. After 24 hours, thoroughly flush with potable water. Repeat process if growth returns.
2. Use commercial products formulated and suitable for removal. Follow manufacturer's instructions.

D. Specific Surface Preparation:

1. See Coating Tabulations:
2. Method T (concrete and masonry): SSPC-SP13/NACE 6, except as specified:
    a. Section 4.3.3: Fractures and microcracks caused by impact tools are to be repaired in accordance with ASTM D 4259.
    b. Following methods are not permitted:

1) Section 4.3.3: Scabbling impact tool.

2) Section 4.4: Chemical surface preparation.

3) Section 4.5: Flame (Thermal) cleaning and blasting.

3. Method U (gypsum board):

a. Repair cracks and other surface imperfections with joint finishing compound in accordance manufacturer's instructions.

b. Remove all dirt, dust, and foreign matter with clean, lint-free, wiping material before coating application.

4. Manufacturer's instructions.

E. Surface Profile for Concrete:

1. Prepare in accordance with manufacturer's instructions for cementitious materials and service environment.

2. Where manufacturer's instructions do not specify a surface profile, prepare surfaces to appearance of medium (80 to 100) abrasive paper, minimum or:

a. Atmospheric Service Environments: 1-mil or greater angular profile and less than specified millage of first applied coat.

F. Surface irregularities for concrete: After surface preparation, repair following surface irregularities:

1. Air pockets (bugholes): Repair bugholes greater than 1/8-inch in diameter by adhesive epoxy or manufacturer's repair compound filler.

2. Protrusions, fins, or bulges: Grind down by SSPC-SP13/NACE 6 surface preparation methods to 1/16-inch or less of surrounding surface.

3. Cracks: Repair cracks with material compatible with manufacturer's coating material listed in Coating Tabulations.

G. Surface Cleanliness: Free of dirt, dust, grease, oil, laitance, efflorescence, form oil, and curing compounds.

H. Moisture Content for Concrete:

1. Test substrate surface for moisture content before applying coating.

2. Perform one test per 500 square feet, minimum.

3. Perform tests in accordance with moisture content inspection procedures specified and coating manufacturer allowable moisture content.

I. Reclean or perform additional surface preparation of completed surfaces that become contaminated before coating application.

J. Prepare surface free of moisture, frost, and ice before coating application.

3.04 APPLICATION EQUIPMENT

A. Air compressor and spray application equipment:

1. Provide appropriate type equipment, adequately sized, and in proper operating order.
2. Equip with pressure gauges and pressure regulators.
3. Equip with air supply lines free from oil and moisture. Keep lines free of oil and moisture during work.
4. Perform tests in accordance with oil and moisture inspection procedures specified.

B. Inspect air supply lines on air compressors for oil and moisture in accordance with ASTM D 4285. Remove oil or water before proceeding with work.

3.05 COATING APPLICATION

A. Apply in accordance with manufacturer's instructions.

B. Apply coatings so that surfaces exposed to public view display a uniform texture and color matched appearance.

C. Apply an even film of uniform thickness which tightly bonds to substrate or previous coat.

1. Fill crevices and cover irregularities.
2. Apply free of runs, pinholes, sags, laps, brush marks, voids, and other defects.

D. Primer Coats:

1. Cover peaks of surface profile by specified dry film thickness.
2. Apply stripe coats to edges, corners, and similar surfaces.

E. Intermediate and Topcoats:

1. Apply number of coats and coating thickness specified in Coating Tabulations.
2. Apply within re-coat window recommended by manufacturer.
3. Tint intermediate coats with manufacturer's standard color to differentiate between coats.

3.06 CONTRACTOR FIELD QUALITY TESTING

A. Measure moisture content of cementitious material on substrate surface by one of following methods:

1. Method 1:
    a. ASTM D 4263.

b. Acceptance Criteria: No visible moisture.

2. Method 2:

a. ASTM F 1869.

b. Acceptance Criteria: Not to exceed 3 pounds of water per 1,000 square feet per 24 hours.

3. Method 3:

a. Moisture meter calibrated to manufacturer's recommendation.

b. Acceptance Criteria: Not to exceed coating manufacturer's maximum recommendation for moisture content.

B. Wet Film Thickness (WFT) Testing:

1. Inspect wet film thickness immediately after application in accordance with ASTM D 4414.

2. Compensate for reduced thickness to achieve specified thickness in Coating Tabulations.

C. Dry Film Thickness (DFT) Testing and Acceptance:

1. Inspect hardened coating system before re-coating interval has been exceeded for DFT compliance by one of following:

a. ASTM D 4138.

b. ASTM D 6132.

2. Number of tests and numerical averaging to meet corresponding ASTM inspection method used above:

a. ASTM D 4138: Average of 3 tests per 1,000 square feet.

b. ASTM D 6132: In accordance with SSPC-PA2.

3. Acceptance Criteria:

a. 80 percent of minimum specified thickness.

b. 150 percent of maximum specified thickness.

4. Repair areas tested by destructive method.

D. Discontinuity (Holiday) Testing:

1. Burial and immersion exposure:

a. Inspect nonconductive coating applied to concrete substrate in accordance with ASTM D 4787.

1) Use maximum test voltage for any DFT as recommended by coating manufacturer to prevent coating damage.

2) Use of detergent wetting solution is not permitted.

3) Inspection of coating systems with aluminum, graphite, or other conductive pigments is not required.

3.07 REPAIR OF DEFECTIVE COATED SURFACES

A. Repair within minimum and maximum re-coat window time in accordance with coating manufacturer's recommendations and applicable Coating Tabulation.

B. Repair pinholes, holidays, laps, voids, and other defects.

C. Inspect repaired areas for compliance with specifications.

3.08 COATING TABULATIONS

Tabulation No. 01

Items to be coated:

a. Gypsum board.

Coating materials Latex	Number and thickness of coats	Surface preparation method
Primer/sealer for gypsum board substrate, use: No. 50, Interior Latex Primer/Sealer	Follow manufacturer's instructions for number of coats and thickness per coat.	U
Finish coats: Interior High Performance Latex for specified gloss, use: No. 151, eggshell No. 153, semigloss No. 154, high gloss Color and gloss: Fed Std. 595B #27880, Semi-gloss	2 or more compatible manufacturer's finish coats. Follow manufacturer's instructions for thickness per coat. Total system, excluding block fillers: 3-mil DFT, minimum	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

Approved Materials: Approved Products List (APL) materials from MPI (Master Painters Institute)

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Tabulation No. 02		
Items to be coated: a. Surfaces of pumping plant building interior and exterior split face masonry units. b. Surfaces of chlorine disinfection building exterior split face masonry units.		
Coating materials - Water Repellants	Number and thickness of coats	Surface preparation method
For concrete and masonry surfaces: No. 117. Water repellant Color and gloss: Clear only	Follow manufacturer's instructions for number of coats (2 coats minimum) and thickness per coat.	T Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Approved Materials: Approved Products List (APL) materials from MPI (Master Painters Institute)		

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END OF SECTION

SECTION 09 96 20
COATINGS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Include cost in other items of price offered in the schedule for items of work requiring coating.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A 380-06	Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
2.	ASTM A 780/780M-09	Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings
3.	ASTM C 920-11	Elastomeric Joint Sealants
4.	ASTM D 522-93a(2008)	Mandrel Bend Test of Attached Organic Coatings
5.	ASTM D 570-98(2010)	Water absorption of Plastics
6.	ASTM D 870-09	Testing Water Resistance of Coatings Using Water Immersion
7.	ASTM D 903-98(2012)	Peel or Strip Strength of Adhesive Bonds
8.	ASTM D 2244-11	Calculation of Color Differences From Instrumentally Measured Color Coordinates
9.	ASTM D 2794-93(2010)	Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
10.	ASTM D 3359-09	Measuring Adhesion by Tape Test
11.	ASTM D 3363-05(2011)	Film Hardness by Pencil Test
12.	ASTM D 4060-10	Abrasion Resistance of Organic Coatings by the Taber Abraser
13.	ASTM D 4285-83(2012)	Indicating Oil or Water in Compressed Air
14.	ASTM D 4541-09	Pull-Off Strength of Coatings Using Portable Adhesion Testers
15.	ASTM D 4587-11	Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water-Exposure Apparatus

16.	ASTM D 5894-10	Cyclic Salt Fog/UV Exposure of painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
17.	ASTM G 8-96(2010)	Cathodic Disbonding of Pipeline Coatings
18.	ASTM G 154-12	Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

B. American Water Works Associations (AWWA)

1.	AWWA C 104-10	Cement Mortar Protective Lining for Ductile Iron Pipe, and Fittings for Water
2.	AWWA C 205-08	Cement Mortar Protective Lining and Coating for Steel Water Pipe – 4 in. and Larger – Shop Applied
3.	AWWA C 210-08	Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
4.	AWWA C216-07	Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
5.	AWWA C 222-08	Polyurethane Coating for the Interior and Exterior of Steel Water Pipe and Fittings
6.	AWWA C 602-06	Cement Mortar Lining of Water Pipelines in Place – 4 in. and Lager

C. Federal Standards (Fed Std)

1.	Fed Std 595C(1)-08	Colors Used in Government Procurement

D. International Organization For Standardization (ISO)

1.	ISO 8502-3-1992	Assessment of dust on Steel Surface Prepared for Painting (Pressure- Sensitive Tape Method)

E. Military Specifications (MIL) and Quality Products List (QPL)

1.	MIL-DTL-24441/19B	Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III Qualified products listed by Qualified Data Set (QDS) in the Qualified Products Database (QDS) available online at assist.daps.dla.mil/online

F. National Association of Pipe Fabricators (NAPF)

1.	NAPF 500-03-04-06	Abrasive Blast Cleaning of Ductile Iron Pipe
2.	NAPF 500-03-05-06	Abrasive Blast Cleaning of Cast Ductile Iron Fittings

G. NSF International (NSF)

1.	NSF 61-2010a	Drinking Water System Components

H. The Society for Protective Coatings (SSPC)/NACE International (NACE)

1.	SSPC-AB1-07	Mineral and Slag Abrasives
2.	SSPC-AB2-2004	Cleanliness of Recycled Ferrous Metallic Abrasives
3.	SSPC-AB3-2004	Newly Manufactured or Re-Manufactured Steel Abrasives
4.	SSPC-PA2-2012	Procedures for Determining Conformance to Dry Coating Thickness Requirements
5.	SSPC-QP1-2012	Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)
6.	SSPC-QP3-2010	Certification Standard for Shop Application of Complex Protective Coating Systems
7.	SSPC-SP1-2004	Solvent Cleaning
8.	SSPC-SP2-2004	Hand Tool Cleaning
9.	SSPC-SP3-2004	Power Tool Cleaning
10.	SSPC-SP6/NACE No. 3-07	Commercial Blast Cleaning
11.	SSPC-SP7/NACE No. 4-07	Brush-Off Blast Cleaning
12.	SSPC-SP10/NACE No. 2-07	Near-White Blast Cleaning
13.	SSPC-SP11-2004	Power Tool Cleaning to Bare Metal
14.	SSPC-VIS1-2012	Guide and Reference Photographs for Steel Surfaces Prepared by Abrasive Blast Cleaning
15.	SSPC-VIS3-2004	Visual Standard for Power- and Hand-Tool Cleaned Steel
16.	NACE RP 0274-2004	High Voltage Electrical Inspection of Pipeline Coatings
17.	NACE RP 0287-2002	Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape
18.	NACE SP 0188-06	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

1. Include the following information with each set of data or certification:

a. Applicable tabulation number from Coating Tabulations.

b. Identification of "Items to be coated" including sub-letter and sub-number listed in Coating Tabulations.

B. RSN 09 96 20-1, Approval Data:

1. For each coating material:

a. Manufacturer's product data, application, and MSDS sheets.

b. Include the following information:

1) Supplier's name, address, and phone number.

2) Manufacturer's designated product name.

3) Applicable tabulation number from Coating Tabulations.

4) Identification of "Items to be coated" including sub-letter and sub-number listed in Coating Tabulations.

2. "Equal" Products:

a. For coating materials proposed as "equal" products to specified brand name products in Coating Categories, submit following with specified approval data:

b. List of projects (not less than three) where material has been successfully used in applications similar to this project. Include:

1) Project name and location.

2) Type of structure.

3) Owner's name, address, and telephone number.

4) Application dates.

c. Manufacturer's certification substitute coating material meets specified requirements. Include:

1) Manufacturer's name, address, and phone number.

2) Batch number(s) for each material, except thinners.

3) Signature of manufacturer's technical representative and date of signature.

d. Certified test reports that demonstrates substitute material meets or exceeds specified coating category requirements for physical and performance characteristics from each of following:

1) Coating manufacturer.

2) Independent laboratory.

3. Paint Chip Samples:

a. Color chip samples approximately 4- by 6-inch.

b. Label each sample to include manufacturer's designated product name, color, and gloss.

C. RSN 09 96 20-2, Final Approval Data:

1. For each coating material:

a. Purchase orders. Include:

1) Supplier's name, address, and phone number.

2) Purchase order number and date.

3) Manufacturer's designated product name.

4) Batch number(s) for each material, except thinners.

5) Quantities ordered for each material, except thinners.

D. RSN 09 96 20-3, Certifications:

1. Current SSPC-QP1 certification for field application to complex industrial structures.

2. Current SSPC-QP3 certification shop application.

3. National Sanitation Foundation (NSF) 61 certification that materials meet specified requirements for coating systems in-contact with potable water.

E. RSN 09 96 20-4, Documentation:

1. Written evidence showing each applicator's qualifications by training or experience for each coating.

a. When documenting qualifications by experience,

1) Include list of 3 recent jobs using comparable materials under similar conditions.

2) Include the owners contact information of 3 recent jobs.

b. When documenting applicator qualifications' for application of plural component coatings,

1) Include coating manufactures training certificate that the applicator(s) can apply the plural component materials successfully

2) Completed SSPC Plural Component Basics Training

F. RSN 09 96 20-5, Contractor Quality Testing Data:

1. For "Shop or Field Applied" Coatings (not required for a manufacturer's standard coating systems):

2. Date of work.

3. Description of areas and work performed.
4. Surface preparation.
5. Surface cleanliness/ profile.
6. Ambient conditions.
7. Dry film thickness.

1.04 QUALIFICATIONS

A. Current SSPC-QP1 certification for field application to complex industrial structures.

B. Coating Applicators Qualifications:

1. Qualified to apply specified coating materials by one of following:
   a. Successfully completed training in application of coating materials similar to materials and conditions specified.
   b. Skilled and experienced in application of coating materials similar to materials and conditions specified.

1.05 DELIVERY, STORAGE, HANDLING

A. Deliver materials to jobsite in original, undamaged, unopened containers labeled with manufacturer's name, designated product name, batch number, date of manufacture, and any special instructions.

B. Deliver materials in containers not larger than 5 gallons as packaged by manufacturer unless suitable equipment is provided at jobsite to handle and thoroughly mix materials in larger containers.

C. Store materials in well ventilated area.

D. Do not expose to direct sunlight during storage.

E. Comply with manufacturer's storage instructions.

F. Do not use coating material which has exceeded manufacturer's specified storage stability period (shelf life).

1.06 AMBIENT CONDITIONS

A. Comply with coating manufacturer's environmental restrictions. Comply with most restrictive requirements of coating manufacturer's restrictions and these specifications when coating manufacturer's restrictions conflict with these specifications.

B. Do not apply coatings under following environmental conditions.

1. Substrate surface temperature less than 5 degrees Fahrenheit above dewpoint.

2. Air and substrate surface temperature less than 50 degrees Fahrenheit or not to exceed manufacturer's recommended minimum and maximum temperature limit.

3. Humidity outside of manufacturer's recommended range.

C. Do not perform surface preparation or apply coatings when environmental conditions are not expected to meet specified requirements during surface preparation, coating application, and curing period.

D. Maintain environmental conditions to meet specified requirements during coating application and curing period. Provide heating or cooling, and dehumidification required to maintain temperature and humidity.

E. Application of the first coat will follow immediately after surface preparation, cleaning, and strip coats, before rust bloom (flash rust) occurs or the same day, whichever is less. Any cleaned surface areas not receiving first coat within this period shall be re-cleaned prior to application of the first coat.

1.07 PROJECT CONDITIONS

A. There may be mil scale present on the existing steel.

PART 2 PRODUCTS

2.01 MATERIALS

A. General:

1. Compliance criteria for coating materials:

a. Material is of same composition and formulation to meet physical and performance test results for one of following:

1) Submitted batch or previously tested batch materials complies with these specifications.

2) Submitted batch materials are unchanged from previously tested batch materials that comply with manufacturer's quality control (QC) and quality assurance (QA) programs.

3) Submitted batch materials complies with manufacturer's quality control (QC) and quality assurance (QA) programs as listed on product data and application sheets.

2. Materials required by these specifications and not listed in Coating Categories are subject to certification and testing in accordance with this Section.

3. Provide compatible products of same manufacturer for coating system components.

B. Abrasives:

1. Mineral and slag abrasives: Meets SSPC-AB1, type I (natural minerals) and type II (slags), class A, except flint minerals are not permitted.
2. SSPC-AB2 for recycled cleanliness.
3. SSPC-AB3 class I (steel) or II (iron) for angular shaped grit.
4. The contractor is to make every effort commercially available to render the hazardous waste stream non-hazardous.
5. Do not exceed toxicity threshold limit for hazardous materials.

C. Coatings:

1. Specified in Coating Categories.
2. Apply only one coating category per option in Coating Tabulations.
3. Volatile Organic Compounds (VOC):
   a. Do not exceed maximum permitted by Federal, State, and local air pollution control regulations.
   b. Do not exceed maximum content as supplied in container or by addition of thinner material.
4. Factory color or tint. Do not color or tint at jobsite.
5. Use thinners recommended by manufacturer for each coating material.
6. Use of accelerator products is not permitted unless approved by COR.

D. Fillers and Caulks:

1. Flexible gaps or crevices:
   a. Coating manufacturer's standard flexible filler or caulk material.
   b. Caulk material: Meet or exceed ASTM C 920-08 type S or M, grade NS, class 25, suitable for water immersion service.
2. Nonflexible gaps or crevices:
   a. Coating manufacturer's standard filler or caulk material.

PART 3 EXECUTION

3.01 PROTECTION OF ADJACENT SURFACES, EQUIPMENT AND NEWLY COATED SURFACES

A. Protect items or surfaces not to be coated and adjacent to surfaces to be cleaned and coated from contamination and damage during cleaning and coating operations.

1. Includes surfaces and equipment in physical contact with areas being cleaned or coated. Examples include: mechanical and electrical equipment (open or enclosed); instruction and similar plates; and wet and newly coated surfaces.

2. Protect from abrasive blast particles and airborne coating particles.

B. Do not move newly coated items until coating is thoroughly dry as determined by one of following:

1. Coating manufacturer's instructions for handling.

2. Coating film cannot be distorted or removed by exerting substantial, but less than maximum, pressure with thumb and turning thumb through 90 degrees in plane of film.

3.02 REPAIR OF CONTRACTOR-DAMAGED SURFACES

A. Repair items, equipment, or surfaces which are damaged or contaminated as determined by COR.

1. Repair damaged items or restore manufacturer-coated equipment to original condition and appearance.

2. Before coating any damaged coated surfaces, re-clean exposed surface and apply coating materials in accordance with these specifications.

3.03 COATING OF METALWORK EMBEDDED IN CONCRETE

A. Extend primer coat 6 inches, minimum, into concrete embedment measured from face of concrete and along surface of embedded. Examples include: concrete vaults, floors, and walls.

B. Extend primer coat continuously through solid concrete structure with burial or immersion service exposure on either side of concrete faces. Examples include: thrust or anchor blocks.

C. Caulk the concrete/steel interface to seal gaps.

3.04 SURFACE PREPARATION

A. Remove or repair weld spatter, slag burrs, porosity, sharp edges, pits, laminations, crevices, or other objectionable surface irregularities before specific surface preparation.

B. Specific Surface Preparation:

1. See Coating Tabulations.

a. SSPC-SP1 - Solvent Cleaning.

b. SSPC-SP6/NACE 3 – Commercial Blast Cleaning.

c. SSPC-SP10/NACE 2 – Near-White Blast Cleaning.

d. SSPC-SP11 – Power Tool Cleaning to Bare Metal.

1) Repair of defective or damaged coated areas where abrasive blasting is impractical:

a) To metal substrate:

i. Feather abrupt edges and around repair by hand or power tool with non-woven pads.

ii. Roughen or abrade adjacent intact coating surfaces in accordance with the coating manufacturer's recommendations.

iii. Overlap the prepared adjacent coating sufficiently (1-inch minimum) to form a seamless repair.

b) To prime or intermediate coat:

i. SSPC-SP1.

ii. Feather abrupt edges and around repair area by hand or power tool with non-woven pad.

iii. Roughen or abrade surface in accordance with manufacturer's recommendations.

iv. Achieve matted or lusterless finish.

e. Aluminum, brass, bronze, or copper:

1) SSPC SP-1 followed by light etch blast using soft abrasives or by hand or power tool.

2) Repeat SSPC-SP1 and treat with metal conditioner specific for substrate type in accordance with manufacturer's instructions.

3) Rinse surface with potable water.

f. NAPF 500-03-05, Blast Clean No. 4. - Cast iron.

g. NAPF 500-03-04 - Ductile iron.

C. Surface Profile:

1. Prepare in accordance with manufacturer's instructions for metallic or existing coating surfaces and service environment, unless specified in Coating Tabulations.

2. Where manufacturer's instruction do not specify a surface profile, prepare blasted surfaces to following profile:

a. Atmospheric Service Environments: 1-mil or greater angular profile and less than specified millage of first applied coat.

b. Burial and Immersion Service Environments: Angular profile between 2 to 3 mils minimum and less than specified millage of first applied coat.

3. Perform tests in accordance with surface profile inspection procedures specified.

D. All welds must be smooth and continuous, no skip welds. All weld splatter, buckshot, laminations, and slivers must be removed and ground smooth; undercuts and pinholes

must be ground smooth and filled with weld metal. All projections, sharp edges, high points and fillets must be ground smooth to a radius of at least 1/8-inch and all corners must be likewise rounded.

E. All pitting, gouges, scratches, and other defects must be repaired either by welding or filling with repair materials that are compatible with the coating system and suitable for the intended service conditions.

F. Re-clean or perform additional surface preparation of completed metallic or coated surfaces that become contaminated before coating application.

G. Prepare surface free of moisture, frost, and ice. Heat substrate surface which is not thoroughly dry to remove moisture before coating application.

H. Heat cast iron components to between 140 and 180 degrees Fahrenheit to evaporate moisture in crystalline matrix for 2 hours minimum.

3.05 APPLICATION EQUIPMENT

A. Air Compressor and Spray Application Equipment:

1. Provide appropriate type equipment, adequately sized, and in proper operating order.
2. Equip with pressure gauges and pressure regulators.
3. Equip with air supply lines free from oil and moisture. Keep lines free of oil and moisture during work.
4. Perform tests in accordance with oil and moisture inspection procedures specified.

B. Inspect air supply lines on air compressors for oil and moisture in accordance with ASTM D 4285. Remove oil or water before proceeding with work.

3.06 COATING APPLICATION

A. Apply in accordance with manufacturer’s instructions.

B. Apply coatings so that surfaces exposed to public view display a uniform texture and color matched appearance.

C. Apply an even film of uniform thickness which tightly bonds to substrate or previous coat.

1. Fill crevices and cover irregularities.
2. Apply free of runs, pinholes, sags, laps, brush marks, voids, and other defects.

D. Each application of coating will be applied evenly, free of brush marks, sages, runs, and with no evidence of defects or blemishes. Coatings shall be sharply cut to lines.

E. Care will be taken so as to eliminate over spray or dry spray. Where such conditions are encountered, the surface will be cleaned of all the over spray or dry spray prior to the application of succeeding coats.

F. Primer Coats:

1. Cover peaks of surface profile by specified dry film thickness.
2. Apply stripe coats to edges, bolt heads, welds seams, corners, and similar surfaces prior to application of first prime coat.

G. Intermediate and Topcoats:

1. Apply number of coats and coating thickness specified in Coating Tabulations.
2. Apply within re-coat window at referenced humidity and temperature recommended by manufacturer.
3. Tint intermediate coats with manufacturer's standard color to differentiate between coats.

3.07 FILLERS AND CAULK APPLICATION

A. Apply fillers and/or caulks in a uniform texture, neatness, and color matched appearance.

B. Apply fillers and/or caulks in accordance with manufacture's instructions which tightly bonds to substrate or previous coats.

1. Fill crevices and other gaps where coatings can not bridge.
2. Apply caulk after the coating has been applied.
3. Areas may include crevices, steel plates butted together, bolts, rivets, seams, skip welds, and conduit through metal.

3.08 CONTRACTOR FIELD QUALITY TESTING

A. Surface Profile: Inspect surface profile in accordance with NACE RP 0287 for compliance with specified requirements.

1. Use replica tape suitable for surface profile depth range.

B. Visual Comparison of Prepared Surfaces:

1. Compare prepared steel surfaces to following visual reference photographs for allowable visible contaminants and stains:
   a. SSPC-VIS1 for abrasive blast cleaning.
   b. SSPC-VIS3 for power and hand tool cleaning.
2. Remove all dust, grit, or other foreign matter from the surface to be coated by blowing off with clean, dry, oil free compressed air. Vacuum cleaning or other

methods are acceptable. The surface shall be clean and dust free before application of coating or lining.

3. Assessment of dust on newly prepared metal surfaces:

   a. Visually inspect and conduct pressure sensitive clear tape test method in accordance with ISO 8502-3 to verify surface cleanliness at a minimum of three random tests per each blasted section per shift.

   b. Clear tape test shall meet cleanliness with a No. 3 grade maximum contamination is allowed.

C. Completed Coating System:

1. Dry Film Thickness (DFT):

   a. Inspect hardened coating system before re-recoating interval has been exceeded for DFT compliance in accordance with SSPC-PA2 with following modifications:

      1) Section 5.2.1: Minimum thickness of 80 percent of specified minimum thickness.

      2) Section 5.2.2: Maximum thickness of 120 percent of specified maximum thickness.

   b. Acceptance Criteria: No single spot measurement in any 100 square foot area less than 80 percent of minimum specified thickness or greater than 120 percent of maximum specified thickness.

2. Discontinuity (Holiday) Testing:

   a. Burial and Immersion Exposure:

      1) Inspect nonconductive coating applied to conductive base metals in accordance with NACE RP 0188.

         a) Use maximum test voltage for any DFT as recommended by coating manufacturer to prevent coating damage.

         b) Use of detergent wetting solution is not permitted.

         c) Subtract thickness of zinc-rich primer from applied coating systems to determine test voltage.

      2) Inspect nonconductive coating applied to conductive base metals in accordance with NACE RP 0274.

         a) Use maximum test voltage for any DFT as recommended by coating manufacturer to prevent coating damage.

      3) Perform test in presence of COR.

3.09 REPAIR OF DEFECTIVE COATED SURFACES

A. Repair within minimum and maximum recoat window time in accordance with coating manufacturer's recommendations and applicable Coating Tabulation under which coating was applied.

B. Repair pinholes, holidays, laps, voids, and other defects.

C. Inspect repaired areas for compliance with specifications.

3.10 COATING TABULATIONS

Tabulation No. 01		
Items to be coated: a. Pumping plant structural steel and secondary framing. Match to the interior and exterior Kingspan building panel color and gloss once they have been selected. b. Pumping plant structural steel and secondary framing associated fasteners to include nuts bolts and washers, to be coated after installation.		
Factory or field coatings: 1. Manufacturer's standard surface preparation and shop applied permanent coating system that meets the following: a. Complete shop applied permanent 3-coat system that consists of 1-prime coat and 2-finish coats. b. Baked-on, coil, extrusion, or fusion bonded that consists of 1 or more coats of UV stable system. 2. Shop applied primer and field finish coating system that consists of: 2-mil DFT primer, minimum, and 2-field finish coats compatible with shop applied primer as specified below in coating material options. 3. The permanent coating system must have a minimum of 6-year corrosion-free protection without significant defects stored in atmospheric exposure. 4. Repair all damaged areas with same shop applied primer and finish coat materials or compatible materials with color and gloss to match undamaged areas. 5. Remove stabilizing or storage treatments on galvanizing by one of following (a) SSPC-SP1 and sweep blasting or (b) manufacturer's compatible wash treatment.		
Coating materials - Option 1 Alkyd/Silicon Alkyd	Number and thickness of coats	Surface preparation method

Tabulation No. 01		
Prime coat: Carboline: Carbocoat 115 VOC International Paint: Devguard 4160 Sherwin Williams: Kem Kromik Universal Primer Tnemec: Chem-Prime HS Series 37H	1 or more prime coats for uncoated or repair of damaged surfaces. Apply at 2 to 3 mils DFT, per coat, plus stripe coats.	Undamaged coated surfaces to receive additional coats: SSPC-SP1 followed by Uncoated surfaces: SSPC-SP6 Damaged coated surfaces: SSPC-SP6 and/or SSPC-SP11 where abrasive blasting is impractical
Topcoat: Carboline: Carbocoat 30R International Paint: Devshield 877 Sherwin Williams: Steel Master 9500 Tnemec: Versatone Series 82HS	2 or more compatible manufacturer's finish coats. Apply at 2 to 3 mils DFT, per coat. Total system, excluding stripe coats: 6-mil DFT, minimum 9-mil DFT, maximum	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Coating materials - Option 2 Water-borne acrylic	Number and thickness of coats	Surface preparation method
Prime coat: Carboline: Carbocrylic 3358 International Paint: Devflex 4020PF DTM Sherwin Williams: DTM Waterborne Acrylic Primer series B66W1	1 or more prime coats for uncoated or repair of damaged surfaces. Apply at 2 to 3 mils DFT, per coat, plus stripe coats.	Undamaged coated surfaces to receive additional coats: SSPC-SP1 followed by Uncoated surfaces: SSPC-SP6 Damaged coated surfaces: SSPC-SP6 and/or SSPC-SP11 where abrasive blasting is impractical Galvanizing: SSPC-SP7, SSPC-SP3, or manufacturer's chemical treatment

Tabulation No. 01

Topcoat: Carboline: Carbocrylic 3359 International Paint: Devflex 4216HP Sherwin Williams: DTM Finish B66-100 or B66-200	2 or more compatible manufacturer's finish coats. Apply at 2 to 3 mils DFT, per coat. Total system, excluding stripe coats: 6-mil DFT, minimum 9-mil DFT, maximum	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

PERFORMANCE REQUIREMENTS:

Testing Protocol	Acceptance Criteria
Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	250 milligram loss or less
Direct impact, ASTM D 2794	40 inch-pounds for alkyd/silicone alkyd 140 inch-pounds for waterborne acrylics
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	250 psi or greater for alkyd/silicone alkyd 500 psi or greater for waterborne acrylics
Cyclic testing salt fog/UV, ASTM D 5894:	1/4 inch or less undercutting at 3000 hrs
QUV accelerated weathering test, ASTM D 4587, ASTM G 154:	Passes 3,000 hour test with no blisters evident on either scribed or unscribed sides, or color difference ASTM D 2244.

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Tabulation No. 02

Items to be coated:

a. Engine generator set and weather-protective housing, vaporizer and weather-protective housing, and propane tank.
b. Flow-meter system.
c. Air compressor.
d. Hoist equipment, electrical motors, speed reducers, and actuators.
e. Overhead traveling crane and mono rail crane equipment including bridge girder, end trucks, enclosures and housings for hoist and trolley, runway beam, and accessories..
f. Electrical transformers.
g. Motor control cabinets.
h. Station service cabinets.
i. Motor operators for valves.
j. Pumping unit and motors.
k. Feeder pumps.
l. Flow meter.
m. Fire panel.
n. Fire pumps/Jockey pump.
o. Clean agent fire extinguishing system (tanks, piping, and valves).
p. HVAC system components.
q. Power Factor Capacitors.
r. Cabinets for SCADA and communications equipment.
s. Equipment controls, electrical boxes, and other miscellaneous electrical equipment.
t. Air valve assemblies.
u. Chlorine containment tanks.
v. Chlorine gas container loading system.
w. One-Ton ChlorTainer system and components.
x. Chlorine feed system, controls, and devices.

Notes:
1. Do not paint aluminum-brass, bronze, and stainless steel metalwork.
2. Do not coat seals and machined surfaces where paint could interfere with proper operation or fit.
3. Do not coat steel surfaces in contact with concrete or grout.
4. Do not coat crane hooks, chains, wheel treads, surfaces of members that contact wheel treads, galvanized surfaces, stainless steel, bronze, brass, gear teeth, bolt threads, seal and bearing contact surfaces, mating machined surfaces, or seals.

Coating materials	Number and thickness of coats	Surface preparation method

Tabulation No. 02
Factory's coating system: a. Factory's standard surface preparation and permanent coating system. b. Items subject to sunlight are to be topcoated with ultraviolet (UV) stable materials. c. Color and gloss: Factory's standard color unless a specific color is otherwise specified in the color schedule. d. The permanent coating system must have a minimum of 6-year corrosion-free protection without significant defects stored in atmospheric exposure. e. Unless otherwise specified, unexposed surfaces that require coatings, such as interior of cabinets, enclosures, and equipment, are to be given the factory's standard permanent coated finish.
Field Repair: Repair damaged areas of coated surfaces with compatible materials to equal thickness and color match of undamaged areas, unless otherwise tabulated herein.

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Tabulation No. 03

Items to be coated:

a. Registers and grills. Match to the exterior Kingspan building panel color and gloss once they have been selected.
b. Louvers. Match to the exterior Kingspan building panel color and gloss once they have been selected.
c. Exterior Pumping Plant doors and frames. Match to the exterior Kingspan building panel color and gloss once they have been selected.
d. Interior Pumping Plant doors and frames. Match to the interior Kingspan building panel color and gloss once they have been selected.
e. Exterior of Chlorine building doors and frames. Match to the exterior Kingspan building panel color and gloss once they have been selected.
f. Overhead traveling crane rails and mono rails.
g. Overhead traveling crane rails, runway beams and monorail crane beam.
h. Bollards (barrier posts).
i. Cattle guard.
j. Propane fuel tank.
k. Sump-pump piping.
l. Compressed air auxiliary piping.

Notes:

1. Shop applied coatings: Standard surface preparation and shop applied permanent coating system that meets the following:
   a. 5-year corrosion-free protection without significant defects stored in atmospheric exposure.
   b. Color and gloss to be manufacturer's standard unless specified below or in color schedule.
   c. Unexposed interior surfaces of cabinets, enclosures, and equipment to be given the manufacturer's standard permanent coated finish.
2. Shop coating to meet one or more of following application alternatives:
   a. Alternative 1 – Complete shop applied permanent 3-coat system that consists of 1-prime coat and 2-finish coats.
   b. Alternative 2 – Baked-on, coil, extrusion, or fusion bonded that consists of 1 or more coats of UV stable system.
   c. Alternative 3 – Shop applied primer and field finish coating system that consists of: 2-mil DFT primer, minimum, and 2-field finish coats compatible with shop applied primer as specified below in coating material options.
3. Repair all damaged areas with same shop applied primer and finish coat materials or compatible materials.
4. Do not coat surfaces of crane rails or monorail crane beam that contacts trolley or end truck wheel treads

Tabulation No. 03
5. Remove stabilizing or storage treatments on galvanizing by one of following (a) SSPC-SP1 and sweep blasting or (b) manufacturer's compatible wash treatment.

Tabulation No. 03		
Coating materials - Option 2 Water-borne acrylic	Number and thickness of coats	Surface preparation method
Prime or spot repair: Carboline: Carbocrylic 3358 International Paint: Devflex 4020PF DTM Sherwin Williams: DTM Waterborne Acrylic Primer series B66W1	1 or more prime coats for uncoated or repair of damaged surfaces. Apply at 2 to 3 mils DFT, per coat, plus stripe coats.	Undamaged coated surfaces to receive additional coats: SSPC-SP1 followed by Uncoated surfaces: SSPC-SP6 Damaged coated surfaces: SSPC-SP6 and/or SSPC-SP11 where abrasive blasting is impractical Aluminum, brass, bronze, and copper surfaces: lightly abrade by SSPC-SP2 or SSPC-SP3 Galvanizing: SSPC-SP7, SSPC-SP3, or manufacturer's chemical treatment
Topcoat: Carboline: Carbocrylic 3359 International Paint: Devflex 4216HP Sherwin Williams: DTM Finish B66-100 or B66-200 Color and gloss: see color schedule	2 or more compatible manufacturer's finish coats. Apply at 2 to 3 mils DFT, per coat. Total system, excluding stripe coats: 6-mil DFT, minimum 9-mil DFT, maximum	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

Tabulation No. 03

PERFORMANCE REQUIREMENTS: Testing Protocol	Acceptance Criteria
Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	250 milligram loss or less
Direct impact, ASTM D 2794	40 inch-pounds for alkyd/silicone alkyd 140 inch-pounds for waterborne acrylics
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	250 psi or greater for alkyd/silicone alkyd 500 psi or greater for waterborne acrylics
Cyclic testing salt fog/UV, ASTM D 5894:	1/4 inch or less undercutting at 3000 hrs
QUV accelerated weathering test, ASTM D 4587, ASTM G 154:	Passes 3,000 hour test with no blisters evident on either scribed or unscribed sides, or color difference ASTM D 2244.

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Tabulation No. 04

Items to coated:

a. Exterior surfaces of exposed valves, fittings, and appurtenances located above ground.
b. Exterior surfaces of exposed valves, fittings, and appurtenances located in concrete vaults.
c. Exterior surfaces of exposed valves, fittings, and appurtenances feeding and draining the water storage tank.
d. Exterior surfaces of air chamber tanks and fittings.
e. Exterior surfaces of booster pump station tank and piping.
f. Exterior surfaces of pumping plant pumps and fittings.
g. Exterior surfaces of exposed pipe, pipe fittings, and appurtenances located above ground.
h. Exterior surfaces of exposed pipe, fittings, and appurtenances located in concrete vaults.
i. Exterior surfaces of exposed pump manifolds and mounts.
j. Exterior of exposed pipe couplings.
k. Exterior of exposed air compressor piping.
l. Exterior of exposed above ground propane fuel piping and fittings.
m. Exterior of exposed blow off piping, fittings, and valves.
n. Chlorine building tank holding cylinder racks.
o. Pipe support systems and pipe flange supports to be field painted.
p. Associated fasteners to include nuts, bolts and washers.

Notes:
1. Do not paint aluminum-brass, bronze, and stainless steel metalwork.
2. Do not coat seals and machined surfaces where paint could interfere with proper operation or fit.
3. Seal all steel/concrete interface areas to prevent corrosion.

Coating materials – Option 1 Epoxy/ polyurethane	Number and thickness of coats	Surface preparation method

Tabulation No. 04		
Prime coat for ferrous surfaces: Carboline: Carboguard 691 International Paint: Bar Rust 235 or Bar Rust 235V PPG: Amerlock 400 or Amerlock 2 Sherwin Williams: Duraplate 235 or Macropoxy 646 Tnemec: Epoxoline Series N69 or Epoxoline Series V69	2 or more prime coats. Apply at 6 to 8 mils DFT, per coat, plus stripe coats.	SSPC-SP1 followed by - For ductile-iron: NAPF 500-03-04 For cast-iron: NAPF 500-03-05 For steel: SSPC-SP5/NACE 1 or SP10/NACE 2 For damaged coated surfaces: SSPC SP-1 followed by SP-10 and/or SSPC SP-11 where abrasive blasting is impractical Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Finish coats: Carboline: Carbothane 134 HB, HG, or VOC International Paint: Devthane 379 or 379H PPG: Amercoat 450H or Amershield VOC Sherwin Williams: Hi solids polyurethane or Hi solids polyurethane 250 Tnemec: Endura-shield 175 Color and gloss: see color schedule	1 or more compatible manufacturer's finish coats, apply at 3 to 4 mils DFT, per coat. Total system, excluding stripe coats: 15-mil DFT, minimum 20-mil DFT, maximum	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

Tabulation No. 04		
Coating materials – Option 2 Moisture-cured urethane	Number and thickness of coats	Surface preparation method
Prime coat for ferrous surfaces: Sherwin Williams: Corothane I Mio-zinc Wasser: MC-Miozinc 2.8 or 100	1 or more prime coats. Apply at 3 to 5 mils DFT, per coat, plus stripe coats.	SSPC-SP1 followed by - For ductile-iron: NAPF 500-03-04 For cast-iron: NAPF 500-03-05 For steel: SSPC-SP5/NACE 1 or SP10/NACE 2 For damaged coated surfaces: SSPC SP-1 followed by SP-10 and/or SSPC SP-11 where abrasive blasting is impractical
Intermediate coat: Sherwin Williams: Corothane I Ironox B Wasser: MC Ferrox B 2.8 or 100	1 or more compatible manufacturer's finish coats, apply at 3 to 5 mils DFT, per coat.	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Finish coats: Semi-gloss Sherwin Williams: Corothane II Satin Polyurethane Wasser: MC Luster 2.8 or 100 Color and gloss: see color schedule	1 or more compatible manufacturer's finish coats, apply at 2 to 4 mils DFT, per coat. Total system, excluding stripe coats: 8-mil DFT, minimum 14-mil DFT, maximum	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

Tabulation No. 04		
Finish coats: Gloss Sherwin Williams: Corothane I Aliphatic Finish Coat Wasser: MC Shieldcoat 2.8 or 100 Color and gloss: see color schedule	2 or more compatible manufacturer's finish coats, apply at 1 to 3 mils DFT, per coat. Total system, excluding stripe coats: 7-mil DFT, minimum 13-mil DFT, maximum	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

PERFORMANCE REQUIREMENTS:

Testing Protocol	Acceptance Criteria
Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	Epoxy/polyurethane: 100 milligram loss or less MC urethanes: 100 milligram loss or less
Direct impact, ASTM D 2794	Epoxy/polyurethane: 30 inch-pounds MC Urethanes: 100 inch-pounds
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	Epoxy polyurethane, and MC urethane: 800 psi or greater
Cyclic testing salt fog/UV, ASTM D 5894:	1/4 inch or less undercutting at 3000 hrs
QUV accelerated weathering test, ASTM D 4587:	Passes 3,000 hour test with no blisters evident on either scribed or unscribed sides, or color difference ASTM D 2244.

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Tabulation No. 05

Items to be coated:

For potable water service, NSF 61 approved coating:

a. Interior surfaces of pump bowls except do not coat the split line.
b. Interior surfaces of valves.
c. Interior surfaces of 24-inch dia. piping and fittings.
d. Interior surfaces of 30-inch dia. and 36-ich dia. manifold piping, fittings, and valves.
e. Interior surfaces of 42-inch dia. piping, fittings, and valves.
f. Interior surfaces of pipe couplings.
g. Interior surfaces of blow off piping, fittings, and valves.
h. Interior of air chamber tanks and fittings.
i. Interior and exterior of metal fittings for turnout PVC piping (as an option fittings may also be fusion bonded epoxied at no additional cost to the project).
j. Coat all fasteners to include nuts, bolts, washers, and exposed anchors.

Notes:
1. Materials listed require certified NSF 61 approval for contact with potable water.
2. Do not coat stainless steel, aluminum-brass, bronze, or other non-metallic surfaces.
3. Do not coat mating surfaces, machine surfaces, seals, and surfaces where the coating could interfere with proper operation or fit.
4. Coat exposed machined surfaces after assembly.

Coating materials – Option 1 Epoxy	Number and thickness of coats	Surface preparation method

Tabulation No. 05		
For ferrous surfaces: Base Coats: Carboline: Carboguard 691(pw) International Paint (Devoe): Bar-Rust 233H(pw) PPG (Ameron): Amerlock 2(pw) Sherwin Williams: Duraplate 235 NSF(pw) Tnemec: Pota-Pox Series 20(pw) Color and gloss: manufacturer's standard color and gloss	3 or more base coats, apply at 8 to 10 mils DFT, per coat, plus stripe coats. Total base coat system, excluding stripe coats: 24-mil DFT, minimum 30-mil DFT, maximum	SSPC-SP1 followed by - For ductile-iron: NAPF 500-03-04 For cast-iron: NAPF 500-03-05 For steel: SSPC-SP5/NACE 1 or SP10/NACE 2 For damaged coated surfaces: SSPC SP-1 followed by SP-10 and/or SSPC SP-11 where abrasive blasting is impractical 2-4 mil surface profile Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Coating materials – Option 2 100% Solids Epoxy	Number and thickness of coats	Surface preparation method

Tabulation No. 05		
For ferrous surfaces: Base coats: International (Enviroline) Enviroline 230(pw) Raven Lining Systems AquataPoxy A-6(pw) Color: manufacturer's standard color and gloss	1 or more base coats, apply at 30 to 50 mils DFT, per coat, plus stripe coats. Total coat system, excluding stripe coats: 30-mil DFT, minimum 50-mil DFT, maximum	SSPC-SP1 followed by - For ductile-iron: NAPF 500-03-04 For cast-iron: NAPF 500-03-05 For steel: SSPC-SP5/NACE 1 or SP10/NACE 2 For damaged coated surfaces: SSPC SP-1 followed by SP-10 and/or SSPC SP-11 where abrasive blasting is impractical 2-4 mil surface profile Material amine blushes, multiple coat systems need to be prepared in accordance with manufacturer's instructions to apply subsequent coats. Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Coating materials – Option 3 100% Solids Epoxy	Number and thickness of coats	Surface preparation method

Tabulation No. 05		
For ferrous surfaces: Base Coats: Carboline Plasite 4500 S(pw) NSP Products: NSP 120(pw) Sherwin Williams Dura-Plate UHS(pw) Color and gloss: manufacturer's standard color and gloss	2 or more base coats, apply at 10 to 16 mils DFT, per coat. Total coating system, excluding stripe coats: 20-mil DFT, minimum 32-mil DFT, maximum	SSPC-SP1 followed by - For ductile-iron: NAPF 500-03-04 For cast-iron: NAPF 500-03-05 For steel: SSPC-SP5/NACE 1 or SP10/NACE 2 For damaged coated surfaces: SSPC SP-1 followed by SP-10 and/or SSPC SP-11 where abrasive blasting is impractical 2-4 mil surface profile Material amine blushes, multiple coat systems need to be prepared in accordance with manufacturer's instructions to apply subsequent coats. Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

PERFORMANCE REQUIREMENTS:

Testing Protocol	Acceptance Criteria
Fresh/deionized water immersion test, ASTM D 870:	passes, 2 years test with aerated water held at ambient temperature with no blisters evident on either scribed or unscribed sides.
Dilute Harrison immersion test, Modified ASTM D 870:	passes, 2 years test with aerated water held at ambient temperature with no blisters evident on either scribed or unscribed sides.

Tabulation No. 05	
Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	Epoxy: 100 milligram loss or less
Direct impact, ASTM D 2794	30 inch-pounds
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	1000 psi or greater
Cyclic testing salt fog/UV, ASTM D 5894:	1/4 inch or less undercutting at 3000 hrs.
Cathodic disbondment, ASTM G 8:	No disbondment at 120 day test

Tab IE-03.DOC

Tabulation No. 06

Items to be coated:

a. Buried exterior surfaces of steel manifold.
b. Buried exterior surfaces of field welded joints on steel manifold.
c. Buried exterior surfaces of steel line pipe and fittings not encased in concrete.
d. Buried exterior surfaces of steel or cast iron valves.
e. Buried propane fuel piping and fittings.
f. Buried exterior surfaces of Mega-Coupling restraint coupling.
g. Buried ferrous surfaces of DiscoPlex flange adapters.
h. Buried exterior surfaces of ductile iron pipe and fittings.
i. Buried exterior surfaces of ductile iron pipe and fittings for PVC pipe.
j. Buried exterior surfaces of ferrous piping and fittings not tabulated herein.

Notes:

1. For Bell and Spigot style pipe: Coat up to the stab line of the spigot and coat around bell up to the gasket.
2. Do not paint aluminum-brass, bronze, and stainless steel metalwork.
3. Do not coat seals, mating surfaces, and machined surfaces where paint could interfere with proper operation or fit. Coat exposed machined surfaces after installation.
4. Do not expose fusion bonded epoxy to direct sunlight. Exposed fusion bonded epoxy coating will need a compatible UV resistant protective topcoat.
5. Coated ferrous surfaces permanently exposed to direct sunlight will require a compatible UV resistant protective topcoat.
6. Pipe bedding and trench backfill will be installed so as to avoid abrasion or other damage to the coatings.

Coating materials – Option 1 Coal-Tar Epoxy	Number and thickness of coats	Surface preparation method

Tabulation No. 06		
For ferrous surfaces: Base coats: Category options: IE-2AA IE-2AB Color: Manufacturer's standard black	3 or more base coats. Apply at 8 to 10 mils DFT per coat, plus stripe coats. Total system, excluding stripe coats: 24-mil DFT, minimum 30-mil DFT, maximum	SSPC-SP1 followed by - For ductile-iron: NAPF 500-03-04 For cast-iron: NAPF 500-03-05 For steel: SP10/NACE 2 For damaged coated surfaces: SSPC SP-1 followed by SP-10 and/or SSPC SP-11 where abrasive blasting is impractical 2-4 mil surface profile Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Coating materials – Option 2 Polyurethane	Number and thickness of coats	Surface preparation method

Tabulation No. 06	
For ferrous surfaces: Material: Coating category BE-5A Standard: Meets or exceeds requirements of AWWA C 222 Thickness: 25-mil DFT, minimum Color: Manufacturer's standard black	SSPC-SP1 followed by - For ductile-iron: NAPF 500-03-04 For cast-iron: NAPF 500-03-05 For steel: SP10/NACE 2 2-4 mil surface profile Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
For repair of damaged and defective polyurethane areas: Material: Use coating manufactures recommended repair materials. Thickness: Achieve thickness equal to surrounding undamaged polyurethane.	For damaged coated surfaces: SSPC SP-1 followed by SP-10 and/or SSPC SP-11 where abrasive blasting is impractical Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
For girth weld area option 1: Category: BE-SLEEVE Application: Follow manufacturer's recommendations and instructions to apply heat shrink sleeve. Repair: Repair damage or defective sleeve areas per manufacturer's instructions. Replace sleeve for areas exceeding 6 square inches.	Follow manufacturer's surface preparation and application instructions to apply sleeve and any subsequent repairs.

Tabulation No. 06	
For girth weld area option 2: Category: Liquid applied girth weld coating, compatible and approved by the polyurethane pipe coating manufacture. Application: Follow manufacturer's recommendations and instructions to apply girth weld coating. Repair: Repair damage or defective areas per manufacturer's instructions.	Follow manufacturer's surface preparation and application instructions to apply girth weld coating and any subsequent repairs.

Tabulation No. 06

Coating materials – Option 3 Fusion-bonded epoxy	Number and thickness of coats	Surface preparation Method
For ferrous surfaces: Fluidize bed method or Electrostatic hot flock spray method using: Scotchkote 206N or Scotchkote 6233 or Scotchkote 134 or equal Color: 206N; manufacturer's standard blue-green 6233: manufacturer's standard green 134: manufacturer's standard blue-green	Apply 1 coat only, redipping is not permitted. System range: 15 to 30 mil DFT	SSPC-SP1 followed by - For ductile-iron: NAPF 500-03-04 For cast-iron: NAPF 500-03-05 For steel: SP10/NACE 2 Follow manufacturer's surface preparation and application instructions to apply subsequent coats. Round sharp corners and edges to 1/8-inch radius, minimum
Field repair and girth weld coating: Repair material: Scotchkote 323 or equal Ambient temperature cured, two component, 100 percent solids, liquid thermosetting epoxy.	1 or more coats as required for repair of small defects or damaged areas of coating. Repair of thin areas is not permitted. Match DFT of undamaged coating.	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

* as manufactured by: 3M Company, Corrosion Protection Division, Electrical Specialties Division, 6801 River Place Boulevard, Austin TX 78726, (512) 984-5670, www.3m.com

Tabulation No. 07	
Items to be coated: a. Interior surfaces of buried steel line pipe segments, specials, fittings and flanges. Do not coat mating surfaces of flanges. b. Interior surfaces of ductile iron pipe segments, specials, fittings and flanges. Do not coat mating surfaces of flanges. c. Interior of steel line pipe or ductile iron pipe segments, specials, fittings, and flanges encased in concrete. d. Interior surfaces of steel, ductile iron, or cast iron fittings for PVC pipe.	
Option 1: Cement-mortar lining	Surface preparation method
For ferrous surfaces: Apply in accordance with following standards: AWWA C 104 or C 205, shop applied.	In accordance with AWWA C 104 or C 205
For girth welds and damaged areas: Apply in accordance with AWWA C 602, in-place method.	In accordance with AWWA C 602
Option 2: 100% solids epoxy NSF 61 lining	Surface preparation method
For ferrous surfaces: Materials: IE-6AA Standard: Meets or exceeds requirements of AWWA C210, and NSF 61 Thickness: 25-mil DFT, minimum; unless manufacture requires greater thickness Color: Manufacturer's standard light color	SSPC-SP1 followed by - For ductile-iron: NAPF 500-03-04 For cast-iron: NAPF 500-03-05 For steel: SP10/NACE 2 Achieve 2 to 4-mil surface profile, minimum
For repair of damaged and defective epoxy areas: Repair material: Repair epoxy lining manufacturer's recommended repair materials. Thickness: Achieve thickness equal to surrounding undamaged epoxy in 1 or more coats.	Follow manufacturer's surface preparation and application instructions

Tabulation No. 07	
For girth weld area: Category: Liquid applied NSF 61 lining, compatible and approved by the epoxy pipe lining manufacture. Thickness: Achieve thickness equal to surrounding epoxy lining	Follow manufacturer's surface preparation and application instructions.
Option 3: 100% solids polyurethane NSF 61 lining	Surface preparation method
For ferrous surfaces: Materials: IE-5AA Standard: Meets or exceeds requirements of AWWA C222, and NSF 61 Thickness: 25-mil DFT, minimum; unless manufacture requires greater thickness Color: Manufacturer's standard light color	SSPC-SP1 followed by - For ductile-iron: NAPF 500-03-04 For cast-iron: NAPF 500-03-05 For steel: SP10/NACE 2 Achieve 3.5-mil surface profile, minimum
For repair of damaged and defective polyurethane areas: Repair material: Repair polyurethane coating manufacturer's recommended repair materials. Thickness: Achieve thickness equal to surrounding undamaged polyurethane in 1 or more coats.	Follow manufacturer's surface preparation and application instructions
For girth weld area: Category: Liquid applied NSF 61 lining, compatible and approved by the polyurethane pipe lining manufacture. Thickness: Achieve thickness equal to surrounding polyurethane lining	Follow manufacturer's surface preparation and application instructions.

Tabulation No. 08		
Items to be coated: a. Chlorine building doors and frames. b. Gratings. c. Ladders. d. Handrail and safety railings. e. Platforms. f. W-Beam Guardrails. g. Damaged galvanized surfaces not otherwise tabulated.		
Note: Repair damaged galvanized surface areas for above listed items.		
Coating materials – Option 1 Zinc-rich polyamide epoxy	Number and thickness of coats	Surface preparation method
For immersion exposures not subject to direct sunlight: Spot prime coat: Meets: MIL-DTL-24441/19B*, formula 159, type II and QPL-24441* approved.	1 or more coats as required for repair of damaged galvanized surfaces. DFT to equal existing undamaged galvanizing thickness.	SSPC-SP1 followed by: For spotty, damaged, rusted areas through galvanizing to ferrous surface use SSPC-SP6 and/or SSPC-SP11 where abrasive blasting is impractical Repair damaged galvanized surfaces in accordance with ASTM A 780, except zinc paints and spray containing cadmium and lead are not permitted.
Coating materials – Option 2 Moisture-cured urethane	Number and thickness of coats	Surface preparation method

Tabulation No. 08		
Prime coat for ferrous surfaces: For limited periods of immersion exposure subject to direct sunlight: Sherwin Williams: Corothane I Mio-zinc Wasser: MC-Miozinc 2.8 or 100	1 or more prime coats apply at 3 to 5 mils DFT, per coat, plus stripe coats.	SSPC-SP1 followed by: For spotty, damaged, rusted areas through galvanizing to ferrous surface use SSPC-SP6 and/or SSPC-SP11 where abrasive blasting is impractical Repair damaged galvanized surfaces in accordance with ASTM A 780, except repair materials containing cadmium and lead are not permitted.
Finish coats: Semi-gloss Sherwin Williams: Corothane II Satin Polyurethane Wasser: MC Luster 2.8 or 100 Color and gloss: Match to existing finish	1 or more compatible manufacturer's finish coats, apply at 2 to 4 mils DFT, per coat. Total system, excluding stripe coats: 5-mil DFT, minimum 9-mil DFT, maximum	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Finish coats: Gloss Sherwin Williams: Corothane I Aliphatic Finish Coat Wasser: MC Shieldcoat 2.8 or 100 Color and gloss: Match to existing finish	2 or more compatible manufacturer's finish coats, apply at 1 to 3 mils DFT, per coat. Total system, excluding stripe coats: 5-mil DFT, minimum 11-mil DFT, maximum	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

PERFORMANCE REQUIREMENTS:	
Testing Protocol	Acceptance Criteria
Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	Epoxy/polyurethane: 100 milligram loss or less MC urethanes: 100 milligram loss or less
Direct impact, ASTM D 2794	Epoxy/polyurethane: 30 inch-pounds MC Urethanes: 100 inch-pounds

Tabulation No. 08

Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	Epoxy polyurethane, and MC urethane: 800 psi or greater
Cyclic testing salt fog/UV, ASTM D 5894:	1/4 inch or less undercutting at 3000 hrs
QUV accelerated weathering test, ASTM D 4587:	Passes 3,000 hour test with no blisters evident on either scribed or unscribed sides, or color difference ASTM D 2244.

Coating materials – Option 3 Zinc-rich aerosol	Number and thickness of coats	Surface preparation method
For atmospheric and direct sunlight exposures: Base coat options: Aerosol Zinc-Clad Cold Galvanizing Compound** Aerosol Brite Zinc Galvanizing Compound***	1 or more coats as required for repair of damaged galvanized surfaces. DFT to equal existing undamaged galvanizing thickness.	SSPC-SP1 followed by: For spotty, damaged, rusted areas through galvanizing to ferrous surface use SSPC-SP6 and/or SSPC-SP11 where abrasive blasting is impractical Repair damaged galvanized surfaces in accordance with ASTM A 780, except repair materials containing cadmium and lead are not permitted.

Repair damaged galvanized surfaces in accordance with ASTM A 780, except repair materials containing cadmium and lead are not permitted.

* Military Specification MIL-DLT-24441C and QPL-24441: Prepared by Naval Sea Systems Command (Ship Systems), Commander, Naval Sea Systems Command – Command Standards Executive Program Office, 1333 Isaac Hull Avenue, South East, Washington Navy Yard DC 20376, (202) 781-4563

** as manufactured by: Sherwin-Williams Co., 101 Prospect Ave. NW, Cleveland OH 44115, (216) 566-2000, www.sherwin-williams.com

*** as manufactured by: Brite Products, 14650 Dequindre, Detroit MI 48212, (313) 883-4930, www.briteproducts.com

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Tabulation No. 09

Items not to be coated and to receive a uniform passivation layer:

a. Stainless steel clad surfaces not otherwise tabulated herein.

Note: Do not coat stainless steel items listed above. New stainless steel surfaces to receive uniform passivation at point of manufacture. Clean and restored uniform passivation layer of damaged, contaminated, or depassivated stainless steel surfaces by methods listed below.

Do not coat unless specifically listed elsewhere in these tabulations.

Repassivation Methods and Inspection Procedures of Contaminated Stainless Steel Surfaces

Degree of surface contamination	ASTM A 380* Surface preparation methods**	ASTM A 380* Surface inspection methods**
Locally heavy surface contaminated areas: Contaminated by free iron, oxide scale, or rust related contaminates caused by field welding or cutting.	Method 5. - "Descaling", General Method 5.3 - "Mechanical Descaling" by grinding and/or Method 6.3 - "Cleaning of Welds and Weld-Joint Areas"	Method 7.2 - "Gross Inspection" Methods 7.2.5 - "Tests for Free Iron: Gross Indications"
General surface contaminated areas: Contaminated by free iron, oxide scale, or rust related contaminates.	Method 5. - "Descaling," General Method 5.2 - "Chemical Descaling" Method 5.2.2.(1) - "Chemical Descaling" by swab or spray wetting the surfaces and/or Method 5.3 - "Mechanical Descaling" by grinding	Method 7.2 – "Gross Inspection" Method 7.2.5 – Tests for Free Iron: Gross Indication

Tabulation No. 09		
General surface contaminated areas: Contaminated by grease, oil, residual chemical films, or other non-free iron related contaminates.	Method 6.2.10 - "Water Jetting" and/or Method 6.4 - "Final Cleaning, or Passivation, or Both", wiping with a clean, solvent-moistened cloth	Method 7.2 - "Gross Inspection" Method 7.2.2 - "Wipe Tests" Where films are not detectable under white light conditions, use Method 7.3 - "Precision Inspection" Method 7.3.2 - "Black Light Inspection"
* Other ASTM A 380 methods may be used instead of above specified surface preparation methods and inspection procedures. ** Do not damage attached parts, adjacent parts, or materials by field cleaning and passivation methods of stainless steel.		

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Tabulation No. 010		
Items to be coated: a. Aluminum surfaces in contact with concrete, grout, or mortar. b. Aluminum surfaces in contact with steel or cast iron.		
Coating materials	Number and thickness of coats	Surface preparation method
Any industrial grade bituminous paint	1 or more coats, plus stripe coats. Total system, excluding stripe coats: 8-mil, minimum	Aluminum surfaces: SSPC-SP1 followed by lightly abrading using SSPC-SP2 or SSPC-SP3

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3.11 COATING CATEGORIES

A. Categories not otherwise listed previously:

Category BE-5A

EC-120 or Corropipe II TX-15; as manufactured by:

Madison Chemical Industries Inc., 490 McGeachie Drive, Milton, Ontario, Canada L9T 3Y5, 905-878-8863, www.madisonchemical.com

Durashield 210 or 310; as manufactured by:
Lifelast, 1301 NE 144th Street Suite 125, Vancouver WA 98685, 360-254-0563, www.lifelast.com

Protec II; as manufactured by:
ITW Futura Coatings, 1685 Galt Industrial BLVD, St. Louis, MO, 314-733-1110, www.futuracoatings.com

Polyclad 777; as manufactured by:
Carboline, 2150 Schuetz Rd. St. Louis, MO, 63146, 314-644-1000, www.carboline.com

Chemthane 2261 or 2265; as manufactured by:
Chemline, 5151 Natural Bridge Rd, St. Louis, MO, 63115, 314-332-2802, www.chemline.net

or equal, having following essential characteristics:

COMPOSITION:

Self-priming, two component, aromatic polyurethane

PHYSICAL CHARACTERISTICS:

Solids by volume:	98 percent, minimum
VOC, as supplied:	15 grams per liter, maximum
Mix ratio:	1:1, 1:2, 1:3, or 1:4 ratio by volume
Ambient application temperature:	40 degrees F, minimum
Surface application temperature above dew point:	5 degrees F, minimum
Initial set time:	Between 30 seconds and 15 minutes
Recoat time at 70 degrees F:	45 minutes, maximum
Cure time to handle at 70 degrees F:	30 min., maximum
Application method:	Heated plural-component airless spray
Color:	Limited colors

PERFORMANCE REQUIREMENTS:

Flexibility, ASTM D 522, 180 degree bend	passes, no cracking or delamination

Category BE-5A

over 3-inch mandrel:	
Impact resistance, ASTM G14	75 in lbs, minimum
Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	100 milligram loss or less
Water Absorption, ASTM D570	2.0 percent maximum
Hardness, ASTM D 2240 Shore D::	65 minimum
Pulloff adhesion, ASTM D 4541:	1,500 psi or greater
Cathodic disbondment, ASTM E 95:	½ inch maximum 28 day test

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Category BE-SLEEVE

Aqua-Shield AQW; as manufactured by:	
Canusa-CPS, 2408 Timberloch Place, Building C-8, The Woodlands TX 77380, 281-367-8866, www.canusacps.com	
or equal, having following essential characteristics:	
COMPOSITION:	
Heat activated elastomeric mastic adhesive with cross-linked polyolefin backing, heat shrinkable sleeve with full recovery thickness of 105 mils	
PHYSICAL CHARACTERISTICS OF ADHESIVE:	
Softening point, ASTM E 28:	77 degrees F
Thickness, as supplied:	45 mils
PHYSICAL CHARACTERISTICS OF POLYOLEFIN BACKING:	
Abrasion resistance, ASTM D 1044:	45 mg loss or less
Elongation, ASTM D 638:	600 percent or greater
Tensile strength, ASTM D 638:	2,900 psi, minimum
Hardness, Shore D, ASTM D 2240:	46
Thickness, as supplied:	36 mils
Color:	Blue
PERFORMANCE REQUIREMENTS:	
Fully recovered sleeve thickness:	105 mil
Peel strength, ASTM D 903:	25 pounds per linear inch, minimum
Impact resistance, ASTM G 14:	50 inch-pounds, minimum
Volume resistivity, ASTM D 257:	10^{17} ohm-centimeter
Water absorption, ASTM D 570 at 150 degrees F for 28 days:	0.01 percent or less
Dielectric strength ASTM D 149:	700 volts per mil

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Category IE-2AA

Amercoat 78HB; as manufactured by:

PPG Protective & Marine Coatings, One PPG Place, Pittsburgh, Pennsylvania 15272, 412-434-3131, www.ppgamercoatus.ppgmc.com

or equal, having following essential characteristics:

COMPOSITION:

Self-priming, two component, amine-cured, coal-tar epoxy

Lead and chromate free.

PHYSICAL CHARACTERISTICS:

Solids by volume:	75 percent, minimum
VOC, as supplied:	1.9 pounds per gallon (228 grams per liter), maximum
Mix ratio - resin:hardener:	19:1
Mixed usable pot life at 50 degrees F:	8 hours, minimum
Ambient application temperature:	50 degrees F, minimum
Surface application temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	16 mils
Recoat time at 50 degrees F:	72 hours, maximum
Full cure time before immersion at 50 degrees F and 50 percent humidity:	14 days, minimum
Application methods:	Brush, roller, or spray
Color/finish:	Black or dark red/flat

PERFORMANCE REQUIREMENTS:

Fresh/deionized water immersion test, ASTM D 870:	passes, 3,000 hour test with aerated water held at ambient temperature with no blisters evident on either scribed or unscribed sides.
Salt water immersion test, ASTM D 870; ASTM D 1141 formula A with no heavy metals:	passes, 3,000 hour test with aerated water held at ambient temperature with no blisters evident on either scribed or unscribed sides.
Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	120 milligram loss or less
Flexibility, ASTM D 522, 180 degree bend over 1-inch mandrel:	passes
Pencil hardness, ASTM D 3363:	2B, minimum

Category IE-2AA

Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	500 psi or greater
Pulloff tape, ASTM D 3359:	4A or better
Cathodic disbondment, ASTM G 8:	passes 90 day test

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Category IE-2AB

Use one of following:

Bitumastic 300M; as manufactured by: Carboline, 350 Hanley Industrial Court, St. Louis MO, 314-644-1000, www.carboline.com

Targuard; as manufactured by: Sherwin-Williams, 101 Prospect Avenue NW, Cleveland OH 44115, 216-566-2000, www.sherwin-williams.com

Hi-Build Tnemec-Tar, Series 46H-413; as manufactured by: Tnemec Company, 6800 Corporate Drive, Kansas City MO 64141, 800-863-6321, www.tnemec.com

or equal, having following essential characteristics:

COMPOSITION:

Self-priming, two component, polyamide, coal-tar epoxy

Lead and chromate free.

PHYSICAL CHARACTERISTICS:

Solids by volume:	72 percent, minimum
VOC, as supplied:	1.88 pounds per gallon (225 grams per liter), maximum
Mix ratio - resin:hardener:	Varies by manufacturer
Mixed usable pot life at 75 degrees F:	2 hours, minimum
Ambient application temperature:	50 degrees F, minimum
Substrate temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	16 to20 mils, varies by manufacturer
Recoat time:	Varies by manufacturer
Full cure time before immersion at 70 degrees F and 50 percent humidity:	14 days, minimum
Application methods:	Brush, roller, or spray
Color/finish:	Black or dark red/flat, gloss, or semigloss; varies by manufacturer

PERFORMANCE REQUIREMENTS:

Fresh/deionized water immersion test, ASTM D 870:	passes, 3,000 hour test with aerated water held at ambient temperature with no blisters evident on either scribed or unscribed sides.
Salt water immersion test, ASTM D 870; ASTM D 1141 formula A with no heavy metals:	passes, 3,000 hour test with aerated water held at ambient temperature with no blisters evident on either scribed or unscribed sides.
Abrasion resistance, ASTM D 4060, CS-	120 milligram loss or less

Category IE-2AB

17 wheel, 1,000 cycles, 1-kg load:	
Flexibility, ASTM D 522, 180 degree bend over 1-inch mandrel:	passes
Pencil hardness, ASTM D 3363:	2B, minimum
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	500 psi or greater
Pulloff tape, ASTM D 3359:	4A or better
Cathodic disbondment, ASTM G 8:	passes 90 day test

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Category IE-5AA

Durashield 210-61 or 310-61; as manufactured by:
Lifelast, 1301 NE 144th Street Suite 125, Vancouver WA 98685, 360-254-0563, www.lifelast.com

Protec II PW; as manufactured by:
ITW Futura Coatings, 1685 Galt Industrial BLVD, St. Louis, MO, 314-733-1110, www.futuracoatings.com

Endura-Flex 1988; as manufactured by:
Global Eco Technologies, Inc., PO Box 2205, Antioch, CA 94531; 925-473-9250; www.getcoatings.com

Polibrid 705; as manufactured by:
Carboline, 350 Hanley Industrial Court, St. Louis, MO 63144-1599, 314/644-1000, www.carboline.com

or equal, having following essential characteristics:

COMPOSITION:

Self-priming, two component, aromatic polyurethane

PHYSICAL CHARACTERISTICS:

Solids by volume:	98 percent, minimum
VOC, as supplied:	15 grams per liter, maximum
Mix ratio:	1:1, 1:2, 1:3, or 1:4 ratio by volume
Ambient application temperature:	40 degrees F, minimum
Surface application temperature above dew point:	5 degrees F, minimum
Initial set time:	Between 30 seconds and 30 minutes
Recoat time at 70 degrees F:	24 hours, maximum
Cure time to handle at 70 degrees F:	60 min., maximum
Application method:	Heated plural-component airless spray
Color:	Limited colors

PERFORMANCE REQUIREMENTS:

Fresh/deionized water immersion test, ASTM D 870:	passes, 2 years test with aerated water held at ambient temperature with no blisters evident on either scribed or unscribed sides.
Dilute Harrison immersion test, Modified ASTM D 870:	passes, 2 years test with aerated water held at ambient temperature with no blisters evident on either scribed or unscribed sides.

Category IE-5AA

Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	100 milligram loss or less
Direct impact, ASTM D 2794	80 inch-pounds
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	1500 psi or greater
Cyclic testing salt fog/UV, ASTM D 5894:	1/4 inch or less undercutting at 3000 hrs
Cathodic disbondment, ASTM G 8:	No disbondment 120 day test

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Category IE-6AA

Duraplate UHS or Sherplate PW; as manufactured by:
Sherwin Williams Company, 101 Prospect Avenue NW, Cleveland OH 44115, 216-566-2000, www.sherwin-williams.com

Bar Rust 234P or Enviroline 230; as manufactured by:
International Paint LLC, 6001 Antoine Drive, Houston, TX 77091, 800-589-1267, www.international-pc.com

Epoxoline Series FC22; as manufactured by:
Tnemec Company, 6800 Corporate Drive, Kansas City MO 64141
800-863-6321, www.tnemec.com

Amercoat 133; as manufactured by:
PPG Protective & Marine Coatings, One PPG Place, Pittsburgh, Pennsylvania 15272, 412-434-3131, www.ppgamercoatus.ppgmc.com

Plasite 4500; as manufactured by:
Carboline, 350 Hanley Industrial Court, St. Louis, MO 63144-1599, 314/644-1000, www.carboline.com

NSP 120 High Performance Epoxy; as manufactured by:
NSP Specialty Products, PO. Box 4690 Pinehurst, NC 28374: 800-248-8907; www.nsp-specialty.com

or equal, having following essential characteristics:

COMPOSITION:

Self-priming, two component, 100% solids epoxy

PHYSICAL CHARACTERISTICS:

Potable water certification:	National Sanitation Foundation 61
Solids by volume:	98 percent, minimum
VOC, as supplied:	100 grams per liter, maximum
Mix ratio:	1:1, 1:2, 1:3, or 1:4 ratio by volume
Ambient application temperature:	40 degrees F, minimum
Surface application temperature above dew point:	5 degrees F, minimum
Cure time to handle at 70 degrees F:	6 hours, maximum
Application method:	Heated plural-component airless spray
Color:	Limited colors

PERFORMANCE REQUIREMENTS:

Fresh/deionized water immersion test, ASTM D 870:	passes, 2 years test with aerated water held at ambient temperature with no blisters evident on either scribed or

Category IE-6AA

	unscribed sides.
Dilute Harrison immersion test, Modified ASTM D 870:	passes, 2 years test with aerated water held at ambient temperature with no blisters evident on either scribed or unscribed sides.
Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	100 milligram loss or less
Direct impact, ASTM D 2794	40 inch-pounds
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	1000 psi or greater
Cyclic testing salt fog/UV, ASTM D 5894:	1/4 inch or less undercutting at 3000 hrs
Cathodic disbondment, ASTM G 8:	No disbondment 120 day test

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3.12 COLOR SCHEDULE

A. Colors and glosses of finished coats:

1. Meet accurate match of color and gloss of specified coated surfaces.

B. Color and gloss to meet one or more of following:

1. Munsell Color.
2. Fed Std 595B.
3. Manufacturer's standard color.

C. Gloss abbreviations:

a. G - Full Gloss.
b. SG - Semigloss.
c. ES - Eggshell.
d. L - Lusterless.
e. F - Flat.

D. Color schedule table

1. Numbers listed in the "Tabulation No." column correspond to "Items to be coated" listed in Coating Tabulations.

Schedule 3.12 - Color Schedule.

Tabulation No.	Item Surface	Color	Color No.	Gloss
2	o. Clean agent fire extinguishing system (tanks, piping, and valves).	Safety Red	11120	G
2	e. Overhead traveling crane and mono rail crane equipment including bridge girder, end trucks, enclosures and housings for hoist and trolley, and runway beam.	Manufactures safety yellow		G

Schedule 3.12 - Color Schedule.

Tabulation No.	Item Surface	Color	Color No.	Gloss
3	f. Overhead traveling crane rails and mono rails. g. Overhead traveling crane rails, runway beams and monorail crane beam. h. Bollards (barrier posts). i. Cattle guard.	Manufactures safety yellow		G

Schedule 3.12 - Color Schedule.

Tabulation No.	Item Surface	Color	Color No.	Gloss
4	a. Exterior surfaces of exposed valves, fittings, and appurtenances located above ground. b. Exterior surfaces of exposed valves, fittings, and appurtenances located in concrete vaults. c. Exterior surfaces of exposed valves, fittings, and appurtenances feeding and draining the water storage tank. d. Exterior surfaces of air chamber tanks and fittings. e. Exterior surfaces of booster pump station tank and piping. f. Exterior surfaces of pumping plant pumps and fittings. g. Exterior surfaces of exposed pipe, pipe fittings, and appurtenances located above ground. h. Exterior surfaces of exposed pipe, fittings, and appurtenances located in concrete vaults. i. Exterior surfaces of exposed pump manifolds and mounts. j. Exterior of exposed pipe couplings. k. Exterior of exposed air compressor piping. l. Exterior of exposed above ground propane fuel piping and fittings. m. Exterior of exposed blow off piping, fittings, and valves. n. Chlorine building tank holding cylinder racks. o. Pipe support systems and pipe flange supports to be field painted.	Beige	Munsell 2.5Y8/4	SG
6	a. Safety ladders. b. Safety railing.	Manufacturer’s standard safety yellow No		SG

E. Final color and gloss of finished coats to be selected by COR.

END OF SECTION

SECTION 09 96 21

COATING CONCRETE OR STEEL TANK

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in price offered in the schedule for concrete or steel tank requiring coating.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A 380-06	Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
2.	ASTM A 780/780M-9	Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings
3.	ASTM C 920-11	Elastomeric Joint Sealants
4.	ASTM D 870-09	Testing Water Resistance of Coatings Using Water Immersion
5.	ASTM D 2244-09	Calculation of Color Differences From Instrumentally Measured Color Coordinates
6.	ASTM D 2794-93(2010)	Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
7.	ASTM D 4060-10	Abrasion Resistance of Organic Coatings by the Taber Abraser
8.	ASTM D 4138-07a	Measurement of Dru Film Thickness of Protective Coatings by Destructive, Cross Section Means
9.	ASTM D 4259-88(2006)	Abrading Concrete
10.	ASTM D 4263-83(2012)	Indicting Moisture in Concrete by the Plastic Sheet Method
11.	ASTM D 4285-83(2012)	Indicating Oil and Moisture in Compressed Air
12.	ASTM D 4414-95(2007)	Measurement of Wet Film Thickness by Notch Gages
13.	ASTM D 4541-09	Pull-Off Strength of Coating Using Portable Adhesion Testers

14.	ASTM D 4587 - 11	Fluorescent UV-Condensation Exposures of Paint and Related Coatings
15.	ASTM D 4787-08	Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
16.	ASTM D 5894-10	Cyclic Salt Fog/UV Exposure of painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
17.	ASTM D 6132-08	Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Over Concrete Using an Ultrasonic Gage
18.	ASTM F 1869-11	Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
19.	ASTM G 8-96(2010)	Cathodic Disbonding of Pipeline Coatings

B. Federal Standards (Fed Std)

1.	Fed Std 595C(1)-08	Colors Used in Government Procurement

C. International Organization For Standardization (ISO)

1. ISO 8502-3-1992 Assessment of dust on Steel Surface Prepared for Painting (Pressure- Sensitive Tape Method)

D. Master Painters Institute (MPI)

1.	Approved Product List (APL)	www.paintinfo.com or www.mpi.net

E. National Association of Pipe Fabricators (NAPF)

1.	NAPF 500-03-04-06	Abrasive Blast Cleaning of Ductile Iron Pipe
2.	NAPF 500-03-05-06	Abrasive Blast Cleaning of Cast Ductile Iron Fittings

F. NSF International (NSF)

1.	NSF 61-2010a	Drinking Water System Components

G. The Society for Protective Coatings (SSPC)/NACE International (NACE)

1.	SSPC-AB1-07	Mineral and Slag Abrasives
2.	SSPC-AB2-2004	Cleanliness of Recycled Ferrous Metallic Abrasives
3.	SSPC-AB3-2004	Newly Manufactured or Re-Manufactured Steel Abrasives
4.	SSPC-PA2-2012	Procedures for Determining Conformance to Dry Coating Thickness Requirements

5.	SSPC-QP1-2012	Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)
6.	SSPC-QP3-2010	Certification Standards for Shop Application of Complex Coating Systems
7.	SSPC-SP1-2004	Solvent Cleaning
8.	SSPC-SP10/NACE No.2-07	Near-White Blast Cleaning
9.	SSPC-SP11-2012	Power Tool Cleaning to Bare Metal
10.	SSPC SP13/NACE No.6-03	Surface Preparation of Concrete
11.	SSPC-VIS1-2012	Guide and Reference Photographs for Steel Surfaces Prepared by Abrasive Blast Cleaning
12.	SSPC-VIS3-2004	Visual Standard for Power- and Hand-Tool Cleaned Steel
13.	NACE RP 0274-2004	High Voltage Electrical Inspection of Pipeline Coatings
14.	NACE RP 0287-2002	Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape
15.	NACE SP 0188-06	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

H. United States Bureau of Reclamation (USBR)

1.	USBR M 47-96	Standard Specifications for Repair of Concrete

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

1. Include following information with each set of data or certification:
    a. Applicable tabulation number from Coating Tabulations.
    b. Identification of “Items to be coated” including sub-letter and sub-number listed in Coating Tabulations.

A. RSN 09 96 21-1, Approval Data:

1. For each coating material:
    a. Manufacturer’s product data, application, and MSDS sheets.
    b. Include the following information:
        1) Supplier’s name, address, and phone number.
        2) Manufacturer’s designated product name.
        3) Applicable tabulation number from Coating Tabulations.

4) Identification of "Items to be coated" including sub-letter and sub-number listed in Coating Tabulations.

2. "Equal" Products:

a. For coating materials proposed as "equal" products to specified brand name products in Coating Categories, submit following with specified approval data:

b. List of projects (not less than three) where material has been successfully used in applications similar to this project. Include:

1) Project name and location.

2) Type of structure.

3) Owner's name, address, and telephone number.

4) Application dates.

c. Manufacturer's certification substitute coating material meets specified requirements. Include:

1) Manufacturer's name, address, and phone number.

2) Batch number(s) for each material, except thinners.

3) Signature of manufacturer's technical representative and date of signature.

d. Certified test reports that demonstrates substitute material meets or exceeds specified coating category requirements for physical and performance characteristics from each of following:

1) Coating manufacturer.

2) Independent laboratory.

3. Paint Chip Samples:

a. Color chip samples approximately 4- by 6-inch.

b. Label each sample to include manufacturer's designated product name, color, and gloss.

B. RSN 09 96 21-2, Final Approval Data:

1. For each coating material:

a. Purchase orders. Include:

1) Supplier's name, address, and phone number.

2) Purchase order number and date.

3) Manufacturer's designated product name.

4) Batch number(s) for each material, except thinners.

5) Quantities ordered for each material, except thinners.

C. RSN 09 96 21-3, Certifications:

1. Current SSPC-QP1 certification for field application to complex industrial structures.

2. Current SSPC-QP3 certification shop application.

3. National Sanitation Foundation (NSF) 61 certification that materials meet specified requirements for coating systems in-contact with potable water.

D. RSN 09 96 21-4, Documentation:

1. Written evidence showing each applicator's qualifications by training or experience for each coating.

a. When documenting qualifications` by experience,

1) Include list of 3 recent jobs using comparable materials under similar conditions.

2) Include the owners contact information of 3 recent jobs.

b. When documenting applicator qualifications' for application of plural component coatings,

1) Include coating manufactures training certificate that the applicator(s) can apply the plural component materials successfully

2) Completed SSPC Plural Component Basics Training

E. RSN 09 96 21-5, Contractor Quality Testing Data:

1. For "Shop or Field Applied" Coatings (not required for a manufacturer's standard coating systems):

2. Date of work.

3. Description of areas and work performed.

4. Surface preparation.

5. Surface cleanliness/ profile.

6. Ambient conditions.

7. Dry film thickness.

1.04 QUALIFICATIONS

A. A. Current SSPC-QP1 certification for field application to complex industrial structures.

B. Coating Applicators Qualifications:

1. Qualified to apply specified coating materials by one of following:

a. Successfully completed training in application of coating materials similar to materials and conditions specified.

b. Skilled and experienced in application of coating materials similar to materials and conditions specified.

1.05 DELIVERY, STORAGE, HANDLING

A. Deliver materials to jobsite in original, undamaged, unopened containers labeled with manufacturer's name, designated product name, batch number, date of manufacture, and any special instructions.

B. Deliver materials in containers not larger than 5 gallons as packaged by manufacturer unless suitable equipment is provided at jobsite to handle and thoroughly mix materials in larger containers.

C. Store materials in well ventilated area.

D. Do not expose to direct sunlight during storage.

E. Comply with manufacturer's storage instructions.

F. Do not use coating material which has exceeded manufacturer's specified storage stability period (shelf life).

1.06 ENVIRONMENTAL REQUIREMENTS

A. Comply with coating manufacturer's environmental restrictions. Comply with most restrictive requirements of coating manufacturer's restrictions and these specifications when coating manufacturer's restrictions conflict with these specifications.

B. Do not apply coatings under following environmental conditions:

1. Substrate surface temperature less than 5 degrees Fahrenheit above dewpoint.
2. Air and substrate surface temperature less than 50 degrees Fahrenheit or not to exceed manufacturer's recommended minimum and maximum temperature limit.
3. Humidity outside of manufacturer's recommended range.

C. Do not perform surface preparation or apply coatings when environmental conditions are not expected to meet specified requirements during surface preparation, coating application, and curing period.

D. Maintain environmental conditions to meet specified requirements during coating application and curing period. Provide heat and dehumidification required to maintain temperature and humidity conditions.

1.07 PROJECT CONDITIONS

A. The existing coatings may contain hazardous materials.

B. There may be mil scale present on the existing steel.

PART 2 PRODUCTS

2.01 MATERIALS

A. General:

1. Compliance criteria for coating materials:

a. Material is of same composition and formulation to meet physical and performance test results for one of following:

1) Submitted batch or previously tested batch materials complies with these specifications.

2) Submitted batch materials are unchanged from previously tested batch materials that comply with manufacturer's quality control (QC) and quality assurance (QA) programs.

3) Submitted batch materials complies with manufacturer's quality control (QC) and quality assurance (QA) programs as listed on product data and application sheets.

2. Materials required by these specifications and not listed in Coating Categories are subject to certification and testing in accordance with this Section.

3. Provide compatible products of same manufacturer for coating system components.

B. Abrasives:

1. Mineral and slag abrasives: Meets SSPC-AB1, type I (natural minerals) and type II (slags), class A, except flint minerals are not permitted.

2. Ferrous metallic abrasives: Meets following requirements:

a. SSPC-AB2 for recycled cleanliness.

b. SSPC-AB3, class I (steel) or II (iron) for angular shaped grit.

3. Do not exceed toxicity threshold limit for hazardous materials.

C. Coatings:

1. Specified in Coating Tabulations.

2. Apply only one coating per option in Coating Tabulations.

3. Volatile Organic Compounds (VOC):

a. Do not exceed maximum permitted by Federal, State, and local air pollution control regulations.

b. Do not exceed maximum content as supplied in container or by addition of thinner material.

4. Factory color or tint. Do not color or tint at jobsite.

5. Use thinners recommended by manufacturer for each coating material.

6. Use of accelerator products is not permitted unless approved by COR.

D. Fillers and Caulks:

1. Flexible gaps or crevices:

a. Coating manufacturer's standard flexible filler or caulk material.

b. Caulk material: Meet or exceed ASTM C 920-08 type S or M, grade NS, class 25, suitable for water immersion service.

2. Nonflexible gaps or crevices:

a. Coating manufacturer's standard filler or caulk material.

PART 3 EXECUTION

3.01 PROTECTION OF ADJACENT SURFACES, EQUIPMENT AND NEWLY COATED SURFACES

A. Protect items or surfaces not to be coated and adjacent to surfaces to be cleaned and coated from contamination and damage during cleaning and coating operations.

1. Includes surfaces and equipment in physical contact with areas being cleaned or coated. Examples include: mechanical and electrical equipment (open or enclosed); instruction and similar plates; and wet and newly coated surfaces.

2. Protect from abrasive blast particles and airborne coating particles.

B. Do not move newly coated items until coating is thoroughly dry as determined by one of following:

1. Coating manufacturer's instructions for handling.

2. Coating film cannot be distorted or removed by exerting substantial, but less than maximum, pressure with thumb and turning thumb through 90 degrees in plane of film.

3.02 REPAIR OF CONTRACTOR-DAMAGED SURFACES

A. Repair items, equipment, or surfaces which are damaged or contaminated as determined by COR.

1. Repair damaged items or restore manufacturer-coated equipment to original condition and appearance.

2. Before coating any damaged coated surfaces, re-clean exposed surface and apply coating materials in accordance with these specifications.

3.03 COATING OF METALWORK EMBEDDED IN CONCRETE

A. Extend primer coat 6 inches, minimum, into concrete embedment measured from face of concrete and along surface of embedded. Examples include: concrete vaults, floors, and walls.

B. Extend primer coat continuously through solid concrete structure with burial or immersion service exposure on either side of concrete faces. Examples include: thrust or anchor blocks.

C. Caulk the concrete/steel interface to seal gaps.

3.04 SURFACE PREPARATION OF METALS

A. Remove or repair weld spatter, slag burrs, porosity, sharp edges, pits, laminations, crevices, or other objectionable surface irregularities before specific surface preparation.

B. For steel in immersion or atmospheric service: SSPC SP-1 followed by SSPC SP-10.

1. Repair to prime or intermediate coat:

a. SSPC SP-1 followed by SSPC SP-10 and/or SSPC SP-11where abrasive blasting is impractical.

b. Feather abrupt edges and around repair area by hand or power tool with non-woven pad.

c. Roughen or abraded adjacent intact coating surfaces in accordance with manufacturer's recommendations.

d. Achieve matted or lusterless finish to apply repair material.

e. Overlap the prepared adjacent coating sufficiently (1-inch minimum) to form a seamless repair.

C. For surface prep of ductile iron pipe and fittings use standard NAPF 500-03-04-06 and for surface prep of cast-iron pipe and fittings use standard NAPF 500-03-05-06.

D. Surface Profile:

1. Prepare in accordance with manufacturer's instructions for metallic or existing coating surfaces and service environment, unless specified in Coating Tabulations.

2. Where manufacturer's instruction or tabulations do not specify a surface profile, prepare blasted surfaces to following profile:

a. Atmospheric Service Environments: 1-mil or greater angular profile and less than specified millage of first applied coat.

b. Burial and Immersion Service Environments: Angular profile between 2 to 3 mils minimum and less than specified millage of first applied coat.

3. Perform tests in accordance with surface profile inspection procedures specified.

E. Re-clean or perform additional surface preparation of completed metallic or coated surfaces that become contaminated before coating application.

F. Prepare surface free of moisture, frost, and ice. Heat substrate surface which is not thoroughly dry to remove moisture before coating application.

3.05 SURFACE PREPARATION AND REPAIR OF CONCRETE

A. Before surface preparation and coating application, cure cementitious materials for 28 days, minimum.

B. Before coating application, repair cementitious defects greater than 3/4-inch in depth by one of following:

1. In accordance with USBR M47.

2. In accordance with manufacturer's product instructions.

C. Remove fungus, mold, and mildew on concrete or masonry surfaces before coating by one of following:

1. Wash brush affected area with solution of 5 ounces of trisodium phosphate, 3 ounces of household detergent, 1.25 percent sodium hypochlorite, and 3 quarts of warm potable water. After 24 hours, thoroughly flush with potable water. Repeat process if growth returns.

2. Use commercial products formulated and suitable for removal. Follow manufacturer's instructions.

D. Specific Surface Preparation:

1. See Coating Tabulations.

2. Method T (concrete and masonry): SSPC-SP13/NACE 6, except as specified:

a. Section 4.3.3: Fractures and microcracks caused by impact tools are to be repaired in accordance with ASTM D 4259.

b. Following methods are not permitted:

1) Section 4.3.3: Scabbling impact tool.

2) Section 4.4: Chemical surface preparation.

3) Section 4.5: Flame (Thermal) cleaning and blasting.

E. Surface Profile for Concrete:

1. Prepare in accordance with manufacturer's instructions for cementitious materials and service environment.

2. Where manufacturer's instructions do not specify a surface profile, prepare surfaces to appearance of medium (80 to 100) abrasive paper, minimum or:

a. Atmospheric Service Environments: 1 mil or greater angular profile and less than specified millage of first applied coat.

F. Surface irregularities for concrete: Repair following surface irregularities.

1. Air pockets (bugholes): Repair bugholes greater than 1/8-inch in diameter by adhesive epoxy or a manufacturer's repair compound filler.

2. Protrusions, fins, or bulges: Grind down by SSPC-SP13/NACE 6 surface preparation methods to 1/16-inch or less of surrounding surface.

3. Cracks: Repair cracks with material compatible with manufacturer's coating material listed in Coating Tabulations.

G. Surface Cleanliness: Free of dirt, dust, grease, oil, laitance, efflorescence, form oil, and curing compounds.

H. Moisture Content for Concrete:

1. Test substrate surface for moisture content before applying coating.

2. Perform one test per 500 square feet, minimum.

3. Perform tests in accordance with moisture content inspection procedures specified and coating manufacturer allowable moisture content.

I. Reclean or perform additional surface preparation of completed surfaces that become contaminated before coating application.

J. Prepare surface free of moisture, frost, and ice before coating application.

3.06 APPLICATION EQUIPMENT

A. Air Compressor and Spray Application Equipment:

1. Provide appropriate type equipment, adequately sized, and in proper operating order.

2. Equip with pressure gauges and pressure regulators.

3. Equip with air supply lines free from oil and moisture. Keep lines free of oil and moisture during work.

4. Perform tests in accordance with oil and moisture inspection procedures specified.

B. Inspect air supply lines on air compressors for oil and moisture in accordance with ASTM D 4285. Remove oil or water before proceeding with work.

3.07 COATING APPLICATION

A. Apply in accordance with manufacturer's instructions.

B. Apply coatings so that surfaces exposed to public view display a uniform texture and color matched appearance.

C. Apply an even film of uniform thickness which tightly bonds to substrate or previous coat.

1. Fill crevices and cover irregularities.
2. Apply free of runs, pinholes, sags, laps, brush marks, voids, and other defects.

D. Primer Coats:

1. Cover peaks of surface profile by specified dry film thickness.
2. Apply stripe coats to edges, bolt heads, welds seams, corners, and similar surfaces.

E. Intermediate and Topcoats:

1. Apply number of coats and coating thickness specified in Coating Tabulations.
2. Apply within re-coat window at referenced humidity and temperature recommended by manufacturer.
3. Tint intermediate coats with manufacturer's standard color to differentiate between coats.

3.08 FILLERS AND CAULK APPLICATION

A. Apply fillers and/or caulks in a uniform texture, neatness, and color matched appearance.

B. Apply fillers and/or caulks in accordance with manufacture's instructions which tightly bonds to substrate or previous coats.

1. Fill crevices and other gaps where coatings can not bridge.
2. Apply caulk after the coating has been applied.
3. Areas may include crevices, steel plates butted together, bolts, rivets, seams, skip welds, and conduit through metal.

3.09 CONTRACTOR FIELD QUALITY TESTING

A. Ferrous Surfaces:

1. Surface Profile: Inspect surface profile in accordance with NACE RP 0287 for compliance with specified requirements.
    a. Use replica tape suitable for surface profile depth range.
2. Visual Comparison of Prepared Surfaces:
    a. Compare prepared steel surfaces to following visual reference photographs for allowable visible contaminants and stains:
        1) SSPC-VIS1 for abrasive blast cleaning.
        2) SSPC-VIS3 for power and hand tool cleaning.
    b. Remove all dust, grit, or other foreign matter from the surface to be coated by blowing off with clean, dry, oil free compressed air. Vacuum cleaning or other methods are acceptable. The surface shall be clean and dust free before application of coating or lining.
    c. Assessment of dust on newly prepared metal surfaces:
        1) Visually inspect and conduct pressure sensitive clear tape test method in accordance with ISO 8502-3 to verify surface cleanliness at a minimum of three random tests per each blasted section per shift.
        2) Clear tape test shall meet cleanliness with a No. 3 grade maximum contamination is allowed.
3. Completed Coating System:
    a. Dry Film Thickness (DFT):
        1) Inspect hardened coating system before re-recoating interval has been exceeded for DFT compliance in accordance with SSPC-PA2 with following modifications:
            a) Section 5.2.1: Minimum thickness of 80 percent of specified minimum thickness.
            b) Section 5.2.2: Maximum thickness of 120 percent of specified maximum thickness.
        2) Acceptance Criteria: No single spot measurement in any 100 square foot area less than 80 percent of minimum specified thickness or greater than 120 percent of maximum specified thickness.
    b. Discontinuity (Holiday) Testing:
        1) Burial and Immersion Exposure:
            a) Inspect nonconductive coating applied to conductive base metals in accordance with NACE RP 0188.

i. Use maximum test voltage for any DFT as recommended by coating manufacturer to prevent coating damage.

ii. Use of detergent wetting solution is not permitted.

iii. Subtract thickness of zinc-rich primer from applied coating systems to determine test voltage.

b) Inspect nonconductive coating applied to conductive base metals in accordance with NACE RP 0274.

i. Use maximum test voltage for any DFT as recommended by coating manufacturer to prevent coating damage.

c) Perform test in presence of COR.

B. Concrete Surfaces:

1. Measure moisture content of cementitious material on substrate surface by one of following methods:

a. Method 1:

1) ASTM D 4263.

2) Acceptance Criteria: No visible moisture.

b. Method 2:

1) ASTM F 1869.

2) Acceptance Criteria: Not to exceed 3 pounds of water per 1,000 square feet per 24 hours.

c. Method 3:

1) Moisture meter calibrated to manufacturer's recommendation.

2) Acceptance Criteria: Not to exceed coating manufacturer's maximum recommendation for moisture content.

C. Wet Film Thickness (WFT) Testing:

1. Inspect wet film thickness immediately after application in accordance with ASTM D 4414.

2. Compensate for reduced thickness to achieve specified thickness in Coating Tabulations.

D. Dry Film Thickness (DFT) Testing and Acceptance:

1. Inspect hardened coating system before re-coating interval has been exceeded for DFT compliance by one of following:

a. ASTM D 4138.

b. ASTM D 6132.

2. Number of tests and numerical averaging to meet corresponding ASTM inspection method used above:

a. ASTM D 4138: Average of 3 tests per 1,000 square feet.

b. ASTM D 6132: In accordance with SSPC-PA2.

3. Acceptance Criteria:

a. 80 percent of minimum specified thickness.

b. 150 percent of maximum specified thickness.

4. Repair areas tested by destructive method.

E. Discontinuity (Holiday) Testing:

1. Burial and immersion exposure:

a. Inspect nonconductive coating applied to concrete substrate in accordance with ASTM D 4787.

1) Use maximum test voltage for any DFT as recommended by coating manufacturer to prevent coating damage.

2) Use of detergent wetting solution is not permitted.

3) Inspection of coating systems with aluminum, graphite, or other conductive pigments is not required.

3.10 REPAIR OF DEFECTIVE COATED SURFACES

A. Repair within minimum and maximum recoat window time in accordance with coating manufacturer's recommendations and applicable Coating Tabulation under which coating was applied.

B. Repair pinholes, holidays, laps, voids, and other defects.

C. Inspect repaired areas for compliance with specifications.

3.11 COATING TABULATIONS

A. Outdoor water storage tank options:

1. Steel water storage tank option – Coat on the exterior and lined on the interior.
2. Concrete water storage tank option Coat the exterior only and not the interior. .

Tabulation No. 01		
Items to coated: Ferrous Surfaces: a. Exterior surfaces of the outdoor steel water storage tank. b. Exterior surfaces of the outdoor steel water piping, fitting, and valves for both the concrete and steel tanks. c. Exterior surfaces of the steel overflow piping and flap valve for both the concrete and steel tanks. d. Exterior surfaces of the steel wall manhole and hatch covers for the concrete and steel tanks. e. Tank dome vent. f. Surfaces of accompanying metalwork to be coated and not left galvanized: Ladders, stairs, walkways, hatches, balconies, safety cages, handrail, safety railings, platforms, and catwalks. g. All fasteners to include bolts, nuts, washers, and anchors.		
Note: 1. Do not paint aluminum-brass, bronze, and stainless steel metalwork. 2. Do not coat seals and machined surfaces where paint could interfere with proper operation or fit.		
Coating materials – Option 1 Zinc rich epoxy/epoxy/ polyurethane	Number and thickness of coats	Surface preparation method

Tabulation No. 01		
Prime coat for ferrous surfaces: Carboline: Carbozinc 859 or Carbozinc 859 VOC International Paint: Catha-coat 303H PPG: Amercoat 68HS or Amercoat 68HS VOC Sherwin Williams: Zinc Clad III HS or Zinc Clad III HS 100 Tnemec: Tneme-zinc 90-97	1 or more prime coats. Apply at 3 to 5 mils DFT, per coat, plus stripe coats.	Uncoated surfaces: SSPC SP-1 followed by SSPC SP10 For damaged coated surfaces: SSPC SP-1 followed by SP-10 and/or SSPC SP-11 where abrasive blasting is impractical
Intermediate coat for ferrous surfaces: Carboline: Carboguard 691 International Paint: Bar Rust 235 or Bar Rust 235V PPG: Amerlock 400 or Amerlock 2 Sherwin Williams: Duraplate 235 or Macropoxy 646 Tnemec: Epoxoline Series N69 or Epoxoline Series V69	1 or more intermediate coats. Apply at 6 to 8 mils DFT, per coat, plus stripe coats.	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

Tabulation No. 01		
Finish coats: Carboline: Carbothane 134 HB, HG, or VOC International Paint: Devthane 379 or 379H PPG: Amercoat 450H or Amershield VOC Sherwin Williams: Hi solids polyurethane or Hi solids polyurethane 250 Tnemec: Endura-shield 175 Color and gloss: see color schedule	1 or more compatible manufacturer's finish coats, apply at 3 to 4 mils DFT, per coat. Total system, excluding stripe coats: 12-mil DFT, minimum 17-mil DFT, maximum	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Coating materials – Option 2 Moisture-cured urethane	Number and thickness of coats	Surface preparation method
Prime coat for ferrous surfaces: Sherwin Williams: Corothane I Mio-zinc Wasser: MC-Miozinc 2.8 or 100	1 or more prime coats. Apply at 3 to 5 mils DFT, per coat, plus stripe coats.	Uncoated surfaces: SSPC SP-1 followed by SSPC SP10 For damaged coated surfaces: SSPC SP-1 followed by SP-10 and/or SSPC SP-11 where abrasive blasting is impractical
Intermediate coat: Sherwin Williams: Corothane I Ironox B Wasser: MC Ferrox B 2.8 or 100	1 or more compatible manufacturer's finish coats, apply at 3 to 5 mils DFT, per coat.	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

Tabulation No. 01		
Finish coats: Gloss Sherwin Williams: Corothane I Aliphatic Finish Coat Wasser: MC Shieldcoat 2.8 or 100 Color and gloss: see color schedule	2 or more compatible manufacturer's finish coats, apply at 1 to 3 mils DFT, per coat. Total system, excluding stripe coats: 8-mil DFT, minimum 16-mil DFT, maximum	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

PERFORMANCE REQUIREMENTS:

Testing Protocol	Acceptance Criteria
Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	Epoxy/polyurethane: 100 milligram loss or less MC urethanes: 100 milligram loss or less
Direct impact, ASTM D 2794	Epoxy/polyurethane: 30 inch-pounds MC Urethanes: 100 inch-pounds
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	Epoxy polyurethane, and MC urethane: 800 psi or greater
Cyclic testing salt fog/UV, ASTM D 5894:	1/4 inch or less undercutting at 3000 hrs.
QUV accelerated weathering test, ASTM D 4587:	Passes 3,000 hour test with no blisters evident on either scribed or unscribed sides, or color difference ASTM D 2244.

Application methods: Brush, roll, or spray

Tab AE-08.DOC

Tabulation No. 02

Items to be coated:
Ferrous Surfaces:

a. Interior surfaces of the steel tank, piping, and valves in-contact with potable water.
b. Interior and exterior of buried steel piping and valves for both concrete and steel tanks.
c. Interior surfaces of the steel overflow piping and flap valve for both the concrete and steel tanks.
d. Interior surfaces of the steel wall manhole and hatch covers for the concrete and steel tanks.
e. Pipe supports.
f. All interior or buried fasteners to include bolts, nuts, washers, and anchors.

Note:
1. Materials listed below require certified **NSF 61** approval for contact with potable water.
2. Do not paint aluminum-brass, bronze, and stainless steel metalwork.
3. Do not coat seals and machined surfaces where paint could interfere with proper operation or fit.

Coating materials – Option 1 Epoxy	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Base coats: Carboline: Carboguard 691(pw) International (Devoe): Bar-Rust 233H(pw) PPG (Ameron): Amerlock 2(pw) Sherwin Williams: Duraplate 235 PW(pw) Tnemec: Pota-Pox Series 20(pw) Color: manufacturer's standard white and gloss	3 or more base coats. Apply at 8 to 10 mils DFT, per coat, plus stripe coats. Total system, excluding stripe coats: 24-mil DFT, minimum 30-mil DFT, maximum	Uncoated surfaces: SSPC SP-1 followed by SSPC SP10 For damaged coated surfaces: SSPC SP-1 followed by SP-10 and/or SSPC SP-11 where abrasive blasting is impractical Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

Tabulation No. 02		
Coating materials – Option 2 100% Solids Epoxy	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Base coats: Raven Lining Systems AquataPoxy A-6(pw) Color: manufacturer's standard white and gloss	1 or more base coats. Apply at 20 to 60 mils DFT, per coat, plus stripe coats. Total system, excluding stripe coats: 20-mil DFT, minimum 60-mil DFT, maximum	Uncoated surfaces: SSPC SP-1 followed by SSPC SP10, 2 to 3-mil profile For damaged coated surfaces: SSPC SP-1 followed by SP-10 and/or SSPC SP-11 where abrasive blasting is impractical Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Coating materials – Option 3 100% Solids Epoxy	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Base coats: Carboline: Plasite 4500 S(pw) Color: manufacturer's standard gray and gloss.	1or more base coats. Apply at 20 to 60 mils DFT, per coat, plus stripe coats. Total system, excluding stripe coats: 20-mil DFT, minimum 60-mil DFT, maximum	Uncoated surfaces: SSPC SP-1 followed by SSPC SP10, 3 to 4-mil profile For damaged coated surfaces: SSPC SP-1 followed by SP-10 and/or SSPC SP-11 where abrasive blasting is impractical Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Coating materials – Option 4 100% Solids Epoxy	Number and thickness of coats	Surface preparation method

Tabulation No. 02		
For ferrous surfaces: Base coats: NSP Specialty Products NSP 120(pw) Color: manufacturer's standard gray and gloss.	2 or more base coats. Apply at 10 to 15 mils DFT, per coat, plus stripe coats. Total system, excluding stripe coats: 20-mil DFT, minimum 30-mil DFT, maximum	Uncoated surfaces: SSPC SP-1 followed by SSPC SP10, 3 to 4-mil profile For damaged coated surfaces: SSPC SP-1 followed by SP-10 and/or SSPC SP-11 where abrasive blasting is impractical Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

PERFORMANCE REQUIREMENTS:	
Testing Protocol	Acceptance Criteria
Fresh/deionized water immersion test, ASTM D 870:	passes, 2 years aerated water at ambient temperature no blisters on scribed or unscribed sides.
Dilute Harrison immersion test, Modified ASTM D 870:	passes, 2 years aerated water at ambient temperature no blisters on either scribed or unscribed sides.
Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	100 milligram loss or less
Direct impact, ASTM D 2794	30 inch-pounds
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	1000 psi or greater
Cyclic testing salt fog/UV, ASTM D 5894:	1/4 inch or less undercutting at 3000 hrs.
Cathodic disbondment, ASTM G 8:	No disbondment 120 day test

Application methods: Brush, roll, spray, or plural component

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Tabulation No. 03		
Items to be coated: Concrete: a. Exterior surfaces of the concrete tank.		
Coating materials Waterproof coating	Number and thickness of coats	Surface preparation method
Cement based, heavy duty waterproof coating. Fills and seals concrete pores and voids while resisting hydrostatic pressure: Waterproof coating: BASF Thoroseal or equitant	Apply at manufacturer's recommended thickness per coat.	In accordance with SSPC-SP 13/NACE N0.6 and manufacturer's recommendations.
Finish coats: Water Borne Light Industrial Coatings for specified exterior service exposure and gloss, use: Exterior No. 161, eggshell-like Exterior No. 163, semigloss Exterior No. 164, gloss Color and gloss: see color schedule	2 or more compatible manufacturer's finish coats. Follow manufacturer's instructions for thickness per coat. Total system: 6 to 10-mil DFT	Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Approved Materials: Materials from MPI APL		

099CT_82.DOC

Tabulation No. 04

Galvanized items to be repaired:

a. Hatch covers.
b. Gratings.
c. Ladders.
d. Stairs.
e. Handrail and safety railings.
f. Platforms and catwalks.
g. Vents.
h. Damaged galvanized surfaces not otherwise tabulated.

Coating materials	Number and thickness of coats	Surface preparation method
Repair damaged galvanized surfaces in accordance with ASTM A 780, except zinc spray and paint containing cadmium and lead are not permitted.		

Tab AE-11.DOC

Tabulation No. 05

Items not to be coated and to receive a uniform passivation layer:

a. Concrete tank manhole doors.
b. Concrete tank inside ladder with T-S rail safety device.
c. Stainless steel clad surfaces not otherwise tabulated herein.

Note: Do not coat stainless steel items listed above. New stainless steel surfaces to receive uniform passivation at point of manufacture. Clean and restored uniform passivation layer of damaged, contaminated, or depassivated stainless steel surfaces by methods listed below.

Coating materials	Number and thickness of coats	Surface preparation method
Do not coat unless specifically listed elsewhere in these tabulations.		ASTM A380

Repassivation Methods and Inspection Procedures of Contaminated Stainless Steel Surfaces

Degree of surface contamination	ASTM A 380* Surface preparation methods**	ASTM A 380* Surface inspection methods**
Locally heavy surface contaminated areas: Contaminated by free iron, oxide scale, or rust related contaminates caused by field welding or cutting.	Method 5. - "Descaling", General Method 5.3 - "Mechanical Descaling" by grinding and/or Method 6.3 - "Cleaning of Welds and Weld-Joint Areas"	Method 7.2 - "Gross Inspection" Methods 7.2.5 - "Tests for Free Iron: Gross Indications"
General surface contaminated areas: Contaminated by free iron, oxide scale, or rust related contaminates.	Method 5. - "Descaling," General Method 5.2 - "Chemical Descaling" Method 5.2.2.(1) - "Chemical Descaling" by swab or spray wetting the surfaces and/or Method 5.3 - "Mechanical Descaling" by grinding	Method 7.2 – "Gross Inspection" Method 7.2.5 – Tests for Free Iron: Gross Indication

Tabulation No. 05		
General surface contaminated areas: Contaminated by grease, oil, residual chemical films, or other non-free iron related contaminates.	Method 6.2.10 - "Water Jetting" and/or Method 6.4 - "Final Cleaning, or Passivation, or Both", wiping with a clean, solvent-moistened cloth	Method 7.2 - "Gross Inspection" Method 7.2.2 - "Wipe Tests" Where films are not detectable under white light conditions, use Method 7.3 - "Precision Inspection" Method 7.3.2 - "Black Light Inspection"
* Other ASTM A 380 methods may be used instead of above specified surface preparation methods and inspection procedures. ** Do not damage attached parts, adjacent parts, or materials by field cleaning and passivation methods of stainless steel.		

Tab AE-14.DOC

3.12 COLOR SCHEDULE

A. Colors and glosses of finished coats:

1. Meet requirements of schedule 3.13 - Color Schedule.
2. Meet accurate match of color and gloss of specified coated surfaces.

B. Color and gloss to meet one or more of following:

1. Munsell Color.
2. Fed Std. 595B.
3. Manufacturer’s standard color.

C. Color schedule table

1. Numbers listed in the “Tabulation No.” column correspond to “Items to be coated” listed in Coating Tabulations.

D. Color and gloss of finished coats to be selected by COR.

Schedule 3.13 - Color Schedule.

Tabulation No.	Item Surface	Color	Color No.	Gloss
1 & 3	All exterior tank surfaces, piping, fittings, valves, and accompanying metal work.	Beige	Munsell 2.5Y8/4	G
1 & 3	For lettering or stenciling of the tanks.	Blue	Munsell 7.5B7/8	G

END OF SECTION

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SECTION 10 14 26
UTILITY MARKERS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 REFERENCE STANDARDS

A. New Mexico State Law

1. NMOC Color Codes New Mexico One Call (NMOC)

PART 2 PRODUCTS

2.01 UTILITY MARKERS

A. CRM3007, Utility Marker, manufactured by Carsonite, Website: www.carsonite.com, or equal with the following essential characteristics:

1. Durable.
2. UV resistant.
3. T-cross section with support rubs along each edge.
4. Resistant to impact, ozone and hydrocarbons.
5. Service temperature range: -40 degrees Fahrenheit to 140 degrees Fahrenheit.
6. Width 3.75 inches.
7. Length: 60 inches minimum.
8. Anchor Barb.
9. Color: Blue in conformance NMOC Color Codes.

PART 3 EXECUTION

3.01 INSTALLATION

A. Use manual driving tool drive per manufacturer's recommendations.

B. Install approximately 50 at locations directed by COR.

END OF SECTION

SECTION 10 28 13

TOILET ROOM ACCESSORIES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Toilet Accessories:

1. Payment: Lump sum price offered in the schedule.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 10 28 13-1, Approval Data:

1. Manufacturer's product data.

C. RSN 10 28 13-2, Instructions:

1. Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 SOAP DISPENSER

A. Model B-4063 ConturaSeries, Recessed Soap Dispenser, as manufactured by Bobrick Washroom Equipment, Website: www.washroominc.com; or equal, having following essential characteristics:

1. Stainless steel.
2. Recessed in the wall.
3. Manual operated.
4. Molded plastic soap dispenser.

2.02 RECESSED CONVERTIBLE PAPER TOWEL DISPENSER AND WASTE RECEPTACLE

A. B-3947 Recessed Convertible Automatic Universal Roll Paper Towel Dispenser and Waste Receptacle with 3944-130 TowelMate and 3961-50 Universal Touch-Free Roll Towel Dispenser Module manufactured by Bobrick Washroom Equipment Incorporated, 11611 Hart Street, North Hollywood, CA 91605-5882; or equal, having following essential characteristics:

1. Combination paper towel dispenser and waste receptacle.
2. Stainless steel cabinet with all-welded construction.

3. Beveled, one-piece, seamless, 22-gauge stainless steel flange.
4. 20-gauge stainless steel door with full-length stainless steel piano hinge and key tumbler lock.
5. 22-gauge stainless steel paper towel dispenser.
6. Dispenses 600 C-fold or 800 multifold paper towels.
7. Towel guide allows towels to dispense one at a time without bulging, sagging, or falling through towel tray opening.
8. Convertible to roll towels.
9. Removable 22-gauge stainless steel waste receptacle with 18-gallon capacity, hemmed edges, interior hooks for vinyl liner, and key tumbler lock.
10. Type 304 stainless steel materials.
11. Satin finish on exposed stainless steel surfaces.
12. Satin finish on stainless steel waste receptacle.
13. Recessed wall mounting at recommended height for accessible design.

2.03 RECESSED SEAT-COVER DISPENSER, SANITARY NAPKIN DISPOSAL AND TOILET TISSUE DISPOSAL

A. Model 819843, Recessed Seat-Cover Dispenser, Sanitary Napkin Disposal And Toilet Tissue Disposal, manufactured by Bobrick Washroom Equipment Incorporated, Website: www.washroominc.com; or equal, having following essential characteristics:

1. Type 304, stainless steel with all-welded construction.
2. Beveled opening.
3. Dispenses paper toilet seat covers from beveled opening.
4. Satin finish on exposed surfaces.
5. Concealed surface mounting.
6. Self-closing disposal panel with international graphic symbol identifying sanitary napkin disposal.
7. Key tumbler lock in door.

2.04 MIRROR

A. B-280 Series Mirror with Stainless Steel Channel Frame manufactured by Bobrick Washroom Equipment Incorporated, www.washroominc.com; or equal, having following essential characteristics:

1. One-piece, Type 430, stainless steel channel frame with 90-degree mitered corners and bright polish finish on exposed frame surfaces.
2. No. 1 quality, 1/4-inch-thick, select silvered mirror glass with 10-year guarantee against silver spoilage.

3. Friction-absorbing filler strip corner protectors.
4. Full-size, shock-absorbing, water-resistant, nonabrasive, 3/16-inch-thick polyethylene back padding.
5. Galvanized steel back.
6. 20-gauge galvanized steel wall hangers.
7. Concealed wall mounting.

2.05 GRAB BARS

A. B-6806.99 Series 1-1/2" (38mm) Diameter Stainless Steel Grab Bars with Snap Flange manufactured by Bobrick Washroom Equipment Incorporated, 11611 Hart Street, North Hollywood, CA 91605-5882; or equal, having following essential characteristics:

1. Type 304, 18-gauge, 1-1/2-inch diameter, stainless steel tubing.
2. Type 304, 1/8-inch-thick, stainless steel flanges.
3. Type 304, 22-gauge, stainless steel snap flange covers.
4. Capable of supporting 900 pounds.
5. Satin finish with peened gripping surface.
6. Concealed wall mounting.

2.06 KEYING

A. Key tumbler locks alike.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Securely mount at locations indicated on drawings. Use fasteners recommended by manufacturer for mounting to wall or toilet partition.

END OF SECTION

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SECTION 10 44 20
FIRE EXTINGUISHERS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Fire Extinguishers:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA)

1. NEMA Z535.2-2011 Environmental and Facility Safety Signs

B. National Fire Protection Association (NFPA)

1. NFPA 10-2013 Portable Fire Extinguishers

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 10 44 20-1, Approval Data:

1. Manufacturer's technical data, certification of UL rating, and installation instructions for all portable fire extinguishers.

PART 2 PRODUCTS

2.01 FIRE EXTINGUISHERS

A. Hand-Held Portable Dry Chemical Extinguishers:

1. Twenty-pound agent capacity.
2. Minimum UL rating 10A:120B:C, multi-purpose pressurized dry chemical, manufacturer's rated temperature range above -27 degrees Fahrenheit and below 120 degrees Fahrenheit.
3. Red glossy coated steel shell.
4. Minimum 12-year hydrostatic test requirement.
5. Waterproof pressure gauge, wall mounted, hand-operated, minimum 15-foot stream.

6. Provide all bolts, screws, expansion anchors, and mounting brackets required for installation of hand-held portable fire extinguishers. Mounting hardware and fasteners shall be corrosion resistant stainless steel.

B. Recessed Cabinet for Dry Chemical Extinguisher:

1. Embassy Fire-FX 5734 V17 by J.L. Johnson Industries, Incorporated, or equal, with the following characteristics:

a. Maximum depth 8 inches.

b. 2 hour fire-rated extinguisher cabinets.

c. Stainless steel tub and doors.

d. Safety glass vision panel.

e. Concealed hinges and handles with manufacturer's standard door roller catches.

f. Vertical fire extinguisher decal.

g. Coordinate size of recessed fire extinguisher cabinets required with extinguisher selected for complete system integration.

C. Outdoor Cabinet for Dry Chemical Extinguishers:

1. FB Series Fiberglass Fire Extinguisher Cabinet by J.L. Johnson Industries, Incorporated, or equal, with the following characteristics:

a. Fiberglass tub and door construction.

b. UV resistant.

c. Full length stainless steel hinge.

d. Rubber-gasketed door.

e. Red finish.

f. Safety glass or acrylic view window.

g. Coordinate size of outdoor fire extinguisher cabinets required with extinguisher selected for complete system integration.

D. Labeling:

1. Provide signs to indicate location of extinguishers.

2. NEMA Z535.2

2.02 COATINGS

A. Manufacturer’s standard finish for fire extinguishers in accordance with Section 09 96 20 – Coatings.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with NFPA 10, install hand-held portable extinguishers and recessed fire extinguisher cabinets as follows:

1. Pumping plant and air chamber:

a. Six hand-held portable dry chemical extinguishers on the interior walls:

1) Adjacent to each of the following egress doors: 100, 101, 106, and 107.

2) Near building lines 4 and f; inside Air Chamber Room 104, adjacent to door 105.

b. One hand-held portable dry chemical extinguisher in a recessed cabinet in the interior walls:

1) Near building line b, in the exterior wall of the Control Room, accessible from Plant Area, Room 100.

2. Chlorine building:

a. Two hand-held portable dry chemical extinguishers on the interior walls:

1) Adjacent to each of the following egress doors: 101 and 102.

2) Adjacent to the exit of the “clear opening”.

b. Two hand-held portable dry chemical extinguishers on the exterior walls:

1) Adjacent to building line 1 on building line b.

2) Midway between building lines 2 and 3 along building line a.

B. Install signs directly above surface mounted portable fire extinguishers, securely mounted, attached to substrate in accordance with manufacturer's instructions. Install level and plumb.

END OF SECTION

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SECTION 10 51 00
LOCKERS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Lockers:

1. Payment: Lump sum price offered in the schedule.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 10 51 00-1, Approval Data and Color Sample Kit:

1. Manufacturer's product data for lockers.

PART 2 PRODUCTS

2.01 LOCKERS

A. Plastic Box Locker, manufactured by Lenox, Website: www.schoollockers.com, or equal with the following essential characteristics:

1. Locker width: 18 inches.
2. Locker height: total unit height 72 inches.
3. Body thickness: 3/8-inch.
4. Dent, scratch, and corrosion resistant.
5. Construction material: HDPE.
6. Locker Depth: 18-inches.
7. Latch: Continuous slide type, lockable.
8. Continuous Hinge: Stainless Steel
9. Shelf and Hook
10. One (1) finished end panel.
11. Drain hole.
12. Sloped Tp.

2.02 ACCESSORIES

A. Wall anchor attachment points as recommended by manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Assemble in accordance with manufacturer's instructions.

B. Install where shown on the drawings.

END OF SECTION

SECTION 21 22 00
CLEAN AGENT FIRE EXTINGUISHING SYSTEM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Clean Agent Fire Extinguishing System:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American Society of Civil Engineers (ASCE)

1.	ASCE 7-2005	Minimum Design Loads for Buildings and Other Structures

B. American Society Of Mechanical Engineers (ASME)

1.	ASME BPVC IX-2013	Boiler and Pressure Vessel Code - Section IX - Welding and Brazing Qualifications
2.	ASME B31.1-2012	Power Piping

C. ASTM International (ASTM)

1.	ASTM A53/A53M-12	Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless
2.	ASTM A106/A106M-11	Seamless Carbon Steel Pipe for High-Temperature Service
3.	ASTM A197/A197M-00 (2011)	Cupola Malleable Iron
4.	ASTM E779-10	Determining Air Leakage Rate by Fan Pressurization

D. American Welding Society (AWS)

1.	AWS D1.1/D1.1M-10	Structural Welding Code – Steel

E. Federal Register — Volume 59, EPA SNAP Program

F. National Fire Protection Association (NFPA)

1.	NFPA 2001-2012	Clean Agent Fire Extinguishing Systems

1.03 SYSTEM DESCRIPTION

A. Design Requirements:

1. Design, furnish and install for the area described below, a fixed fire suppression extinguishing system of the total flooding type utilizing FK-5-1-12 - Dodecafluoro-2-methylpentan-3-one (NOVEC 1230) halocarbon clean agent to an operating pressure of 360 pounds per square inch (psi) at 85 degrees Fahrenheit, or approved equal.
2. Protect the Control Room as a zone. The zone shall have a main supply of clean agent only; a reserve supply is not required. Locate the clean agent cylinder(s) and appurtenances against the exterior wall of the Control Room where shown on drawing 1695-D-110.
3. The developed pressurization/depressurization in the zone due to the release of the clean agent shall not exceed 5 pounds per square foot. Provide venting to prevent excessive pressures. Designers shall consult with system manufacturer's recommended procedures relative to enclosure venting.
4. The system shall be released automatically by a Fire Alarm Suppression Panel (FASP) (see Section 28 31 00 - Fire Detection and Alarm).
5. Comply with requirements and recommendations of NFPA 2001 for design, fabrication, and installation of fire suppression extinguishing system and its components. Meet the approval of Factory Mutual Research Corporation (FM) and/or Underwriters Laboratories (UL) for design and installation of system.
6. Design the flame extinguishing concentration for a Class C hazard.
7. Size the system to provide the required room concentration levels of clean agent, but not to exceed the lowest observable adverse effect level as defined by NFPA 2001. Design the system to discharge its contents between a minimum of 5 seconds and a maximum of 10 seconds.

B. Site Conditions:

1. The temperature of the Control Room varies from approximately 68 to 85 degrees Fahrenheit.
2. The Control Room will typically be unoccupied.
3. The room shall have an air-conditioning unit and wireways and lighting fixtures suspended from the ceiling. Piping shall avoid these devices.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 21 22 00-1, Approval Drawings and Data:

1. Drawings and data required by New Mexico State Fire Marshal for issuance of permit.
    a. Signed and stamped by approving official at State of New Mexico.

2. Commercial product data for each piece of equipment comprising the system including storage cylinders, valves, pressure sensors, room vents (if required) and other appurtenances.

3. Drawings and data:

   a. Shop drawings indicating detailed layout of system locating each component including clean agent cylinders, piping, seismic restraints, pipe supports, anchorage, dampers and fire door (as applicable).

   b. Complete hydraulic flow design calculations derived from a UL listed computer program written specifically for the clean agent used, unless system is pre-engineered. Include analysis calculations to verify system terminal pressures, nozzle flow rates, orifice code number, piping pressure losses, component flow data, and pipe sizes considering actual and equivalent lengths of pipe and elevation changes. Total agent discharge time must be shown and detailed by zone.

   c. Calculations showing the developed pressures of the agent discharge in the zone, the enclosure wall and roof structural strength and the venting calculations (if venting is required).

   d. Calculations showing project specific design of pipe hangers, lateral and longitudinal braces and their supports.

   e. Manufacturer's installation instructions.

   f. List of local companies that can service NOVEC 1230 clean agent system and refill tanks.

4. Test Plan describing procedures to be used to test the suppression system.

C. RSN 21 22 00-2, Final Drawings and Data:

1. As-built drawings:

   a. Provide full size drawings on BOR title block.

   b. Provide CDs in AutoCAD format.

2. Bound service manual which includes:

   a. All submitted data previously approved in RSN 21 22 00-1 above.

   b. Half-size (11- by 17-inch) prints:

      1) As-built drawings

   c. Written description of system design.

   d. Maintenance schedule in tabular form.

   e. Schematic and wiring diagrams.

D. RSN 21 22 00-3, Test Reports:

   a. Test reports after successful completion of tests.

1.05 REGULATORY REQUIREMENTS

A. Obtain permit for the clean agent fire extinguishing system from State of New Mexico Fire Marshal's office.

1. Comply with State of New Mexico requirements for review and approval of design and installation.

2. Arrange for required field inspections of work by Fire Marshal.

   a. Coordinate inspections with COR.

   b. Notify COR, in writing, of date and time of each inspection at least 7 days before scheduled date of inspection.

3. Pay required fees.
   Address:
   State Fire Marshal Division
   1120 Paseo De Peralta
   P.O. Box 1269
   Santa Fe, NM 87504.

1.06 QUALIFICATIONS

A. Designer:

1. Professional engineer registered in the State of New Mexico, experienced in design of this type.

2. Authorized and certified by the equipment manufacturer to determine the requirements of the clean agent fire extinguishing system utilizing the manufacturer's equipment.

B. Manufacturer:

1. Company specializing in manufacturing products specified in this section with minimum 3 years documented experience.

C. Installer:

1. Provide a manufacturer's certified technician with a minimum National Institute for Certification in Engineering Technologies (NICET) Level III certification to supervise installation, adjustment and final connections. The installer shall be trained by the manufacturer to install and test clean agent fire extinguishing systems.

D. Welding Procedures, Welders, and Welding Operators:

1. At Contractor's option, conform either to:

   a. Section IX of ASME BPVC, or

   b. Standard Qualification Procedure of AWS D1.1.

2. Make welding certifications available at request of COR.

1.07 TRAINING OF GOVERNMENT PERSONNEL

A. Furnish training on operation, testing and maintenance of clean agent fire extinguishing suppression system for four designated operation and maintenance personnel within three weeks after completion of contract. Conduct training on-site. Coordinate time and date of training with the COR.

1.08 MAINTENANCE SERVICE

A. Inspect system 6 months and 11 months after system acceptance.

1. Perform inspections per NFPA 2001.
2. At the conclusion of each inspection, provide plant personnel with a completed inspection report. Include in the report a description of any repairs and/or adjustments performed on the system.
3. Perform annual maintenance at 11 month inspection.

PART 2 PRODUCTS

2.01 PIPE AND PIPING

A. General:

1. Steel pipe: ASTM A53 seamless, Grade A or B or ASTM A106, Grade A, B, or C, schedule 40, galvanized.
    a. Verify piping materials with an internal pressure of 360 psi will not cause material stress greater than the materials yield point when calculated according to ASME B31.1.
2. Pipe fittings: ASTM A197, Class 300 malleable or ductile iron galvanized fittings.
    a. Two inches and smaller: Threaded fittings.
    b. 2-1/2 inches and larger: Flanged or grooved connections.
3. Provide all new pipe and fittings of recent manufacture.

B. Valve and Equipment Connections:

1. Install a union immediately downstream of all threaded valves. Install a union adjacent to valve in each connection line for threaded valves having more than two connection points. Install a union adjacent to equipment pipe connections such as pressure switches, etc.

C. Pressure Release Piping and Fittings:

1. Reduction in pipe size not allowed between discharge piping connection and relief valve.

2. Provide all take-offs for pressure release piping from the top of discharge piping.

D. Pipe Hangers and Supports:

1. Provide pipe hangers and supports in accordance with the provisions outlined in ASME B31.1.

2. Design hangers and supports to meet ASCE 7 Chapter 13 - Seismic Design Requirements for Nonstructural Components. Seismic design criteria are shown on drawings 1695-D-101 and 1695-D-102. Provide rigid hangers wherever a change in direction or change in elevation in the piping system occurs. Furnish a rigid hanger for at least every other hanger on long straight runs.

3. Fabricate all hangers from steel.

4. Design hangers and pipe to prevent stresses from being induced into piping during temperature change caused by the clean agent system discharge.

5. Fabricate all piping supports so that they will not be disengaged by the movement of the supported pipe.

6. Do not use one pipeline as a support for another.

E. Sleeves:

1. Sleeves for pipes through non-fire rated walls - Form with steel pipe or No. 18 United States Standard Steel gauge galvanized steel.

F. Wall Seal:

1. FD/FS Link-Seal Modular Seal as manufactured by Pipeline Seal & Insulator, Incorporated, Houston, TX; or equal, having the following essential characteristics:

a. Modular, water tight, mechanical seal, consisting of inter-locking, synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.

b. Stainless steel or zinc plated hardware.

c. UL listed or FM approved.

2.02 CLEAN AGENT SYSTEM COMPONENT REQUIREMENTS

A. Cylinders:

1. Provide cylinder assemblies which conform to the regulations of the United States Department of Transportation. Fit cylinders with a resilient pressure seat type forged brass valve which has a threaded steel anti-recoil protective cap for handling and shipment.

2. Provide a liquid level measuring device.

B. Discharge Valves:

1. Equip each cylinder with a pressure operated discharge valve. Provide each valve with an integral safety relief device to protect the cylinder against excessive internal pressure.
2. Furnish a cylinder valve with a forged brass body with external connections for actuation devices. Provide each valve with a removable pressure gauge or solenoid valve with gauge for pressure reading.
3. Provide a check valve with each cylinder when more than one cylinder is connected to a common manifold. Do not utilize check valves with "O" ring seats since they can be dislodged during discharge.

C. Key Maintenance Switch by Kidde Fire Systems, Website: www.kiddefiresystems.com, Catalog #: K-76-606; or equal, having the following essential characteristics:

1. Keyed maintenance switch allowing disconnection of the suppression system during maintenance operations.
2. Status LED indicators stating the mode of the switch; 'system armed' or 'system inactive'.
3. Surface or flush mounted installation.
4. Key can only be removed when the system is in the 'armed' position.
5. Four-pole double throw switch.
6. Voltage: 24VDC.
7. Operating Temperature Range: 0 degrees Celsius to 49 degrees Celsius.
8. Mechanical life: 100,000 cycles.
9. Switch plate construction shall be stainless steel.
10. Meets NFPA 72 requirements.
11. UL 864 listed.

D. Switches:

1. FMG approved or NRTL listed, where available, 120-Vac or low voltage compatible with controls. Include contacts for connection to control panel. Include tamper switch and pressure switch as required.

E. Distribution System:

1. Lay out piping for maximum flow and to avoid possible mechanical, chemical or other damage.

F. Nozzles:

1. Supply nozzles in quantities sufficient to properly cover the areas being protected in accordance with NFPA 2001.
2. Furnish nozzles of corrosion resistant construction designed specifically for clean agent application.

3. Permanently mark nozzles as to type and orifice.

G. Agent:

1. Provide FK-5-1-12 – Dodecafluoro-2-methylpentan-3-one (NOVEC 1230) halocarbon clean agent gas meeting the requirements of NFPA 2001, or equal with the following characteristics:

a. Dry, non-corrosive, non-damaging and non-deteriorating.

b. Agent suitable for use in normally occupied spaces.

c. Agent shall not contain any hydrofluorocarbons.

d. Agent in a container super pressurized with nitrogen to a maximum working pressure of 360 psia.

e. Ozone Depletion Potential of Zero (0).

f. Atmospheric Lifetime less than 1 year.

g. LC_{50}>800,000 ppm.

h. Agent listed as "Acceptable" on the EPA's Significant New Alternatives Policy (SNAP) list.

H. Controls and Accessories:

1. Provide controls and accessories in accordance with Section 28 31 00 - Fire Detection and Alarm System.

I. Nameplates:

1. Furnish nameplates for equipment, devices and instrumentation components of system.

2. Fabricate nameplates from laminated phenolic resin material conforming to the requirements listed on Standard Drawing 40-D-6234. Minimum 3/32-inch thickness for nameplates mounted on flat surfaces. Minimum 3/16-inch thickness for nameplates mounted on piping or other non-flat surfaces.

3. Lettering:

a. White lettering and a red background.

b. Size: 3/16-inch.

4. Fasteners:

a. Non flat surfaces - Minimum 16 gauge stainless steel wire tie for nameplates.

b. Panel mounted – Self threaded corrosion resistant screws.

2.03 COATINGS

A. Provide coatings for the clean agent fire extinguishing system in accordance with Section 09 96 20 - Coatings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Field verify dimensions of the protected space, pertinent existing equipment and building floor-space before starting work.

B. Install system in accordance with the NFPA 2001, as shown on the drawings, and as recommended by the major equipment manufacturer.

C. Mount clean agent cylinders vertically. Support cylinders with cylinder mounting straps. Arrange cylinders to allow for cylinder removal and inspection of tank volume and pressure.

3.02 CONSTRUCTION

A. Pipe and Piping:

1. Pipe, Fittings and Joints:

   a. Ream all pipe after cutting so that all burrs and sharp edges are removed.

   b. Clean all pipe thoroughly before installation. Pull a wire flue brush through the length several times, followed by clean cloth rags treated with a noncombustible metal cleaner designed for the purpose. Remove all foreign matter and oil by this process. Repeat process until pipe is clean and all contaminants are removed.

   c. Thread preparation: Coat all threaded pipe with an appropriate pipe joint compound or teflon tape. When pipe joint compound is used, coating of the threads must start at least two threads back from the pipe end. Take care on small piping so as not to allow sealant to enter valves or controls.

2. Welding:

   a. Use gas welding or other approved method on all welded pipe 3/4-inch and smaller. Unshielded electric arc welding may be used on pipe larger than 3/4-inch.

   b. Pound all welds to loosen scale and weld beads and then clean.

3. Pipe Reductions: Install so as to permit full flow in each case. All entrance holes from the main pipe run to the fitting must be of proper size and free of sharp edges, ridges or burrs. Use one of the following devices when making reductions in pipe:

   a. Welded - Butt weld concentric reducers or weld-o-lets.

b. Grooved – Commercially available grooved concentric reducers.

4. Reductions – Threaded Pipe:

   a. Provide threaded concentric reducing fittings for all reductions in threaded pipe.

5. Pipe Sleeves:

   a. Provide pipe sleeve at least two sizes larger than the pipe.

   b. Seal around pipe with mechanical seal to prevent clean agent loss and/or leakage.

   c. Sufficient length to pass through entire thickness of walls.

6. Pipe Hangers and Supports:

   a. Attach all piping to rigid hangers by means of U-bolts locked with double nuts, one on each side of hanger. Allow pipe to be free to move longitudinally within the U-bolt except where the piping design requires it to be anchored.

   b. Install all piping supports so that they will not be disengaged by the movement of the supported pipe.

   c. Arrange piping supports so that no excessive bending stresses are induced into the piping from concentrated loads between supports.

   d. The maximum spacing between pipe supports is specified in Table 21 22 00A - Maximum Spacing Between Hangers and Supports for Threaded or Welded Pipe.

Table 21 22 00A - Maximum Spacing
Between Hangers and Supports For
Threaded or Welded Pipe

Nominal Pipe Size (Inches)	Maximum Span (Feet)
1/4	5
1/2	6
3/4	7
1	9
1-1/4	10
1-1/2	11
2	13
2-1/2	14

Table 21 22 00A - Maximum Spacing
Between Hangers and Supports For
Threaded or Welded Pipe

Nominal Pipe Size (Inches)	Maximum Span (Feet)
3	15
4	17

B. Nameplates:

1. Do not use adhesive for attaching nameplates.

3.03 CONTRACTOR FIELD QUALITY TESTING

A. Notify COR, in writing, of date and time the fire protection systems will be ready for testing, at least 10 days before tests are to be conducted. Include the proposed period of time required for complete testing.

B. The Test Plan shall include step-by-step description of all tests to be performed and shall indicate the type and location of test apparatus to be employed. The tests shall demonstrate that the operational and installation requirements of this specification have been met.

C. Provide the service of a manufacturer's certified technician with a minimum NICET Level III certification, or factory trained engineer authorized by the manufacturer to technically supervise and participate during all of the adjustments and tests for the system. All tests shall be witnessed by the Government.

D. Test distribution piping pneumatically for a period of 10 minutes at 40 psig. At the end of 10 minutes, the pressure drop shall not exceed 20 percent of the test pressure.

E. Perform an enclosure integrity test using the door fan method of room pressurization for the zone to determine leakage. The integrity test procedure shall be in accordance with NFPA 2001. The hold period shall be a minimum of 10 minutes. Guidance regarding fan pressurization apparatus design, maintenance and operation is provided by ASTM E779. The Contractor shall be responsible for sealing the Control Room against clean agent loss and/or leakage.

F. Perform an operational test using the door fan method of room pressurization for the zone to demonstrate operation and sizing of pressure relief dampers. Coordinate test with HVAC contractor.

G. Make repairs or install replacement components, when any defects are detected, and repeat the tests as required.

H. Thoroughly test the system upon completion of installation for correct operation and function. Include functional operation tests of all mechanical equipment and careful inspection of all piping and nozzles. Conduct a flow test of short duration, also known as a puff test, with nitrogen to determine that flow is continuous and that all piping and nozzles are free of obstructions.

I. Provide complete written test reports of all tests performed with at least the following information:

1. Date, time, and location of tests.
2. Names and signatures of witnesses to the tests.
3. Room, dimensions and volume.
4. All data generated during tests, including computer printouts.
5. Descriptions of any special techniques utilized by test technician.
6. Test equipment make, model, and serial number.
7. Copy of current calibration, certificate of test equipment.
8. Name and affiliation of testing technician, and signature.

J. After testing, the system shall be in full operation condition.

END OF SECTION

SECTION 22 11 10

PLANT AUXILIARY WATER SYSTEMS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Plant Auxiliary Water Systems:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME A13.1-2007	Scheme for the Identification of Piping Systems
2.	ASME B16.18-2012	Cast Copper Alloy Solder Joint Pressure Fittings
3.	ASME B16.22-2012	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
4.	ASME B31.1-2012	Power Piping
5.	ASME B40.100-2005	Pressure Gauges

B. ASTM International (ASTM)

1.	ASTM B32-2008	Solder Metal
2.	ASTM B88-2009	Seamless Copper Water Tube

C. American Water Work Association (AWWA)

1.	AWWA C508-2009	Swing Check Valves for Waterworks Service
2.	AWWA C550-2013	Protective Epoxy Coatings for Valves and Hydrants

D. Commercial Item Description (CID)

1.	CID A-A-1923A-1995	Shield Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors

E. Manufacturers Standardization Society (MSS)

1.	MSS SP-73-2003	Brazing Joints for Copper Alloy Solder Pressure Fittings
2.	MSS SP-80-2013	Bronze Gate, Globe, Angle and Check Valves
3.	MSS SP-110-2010	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

F. New Mexico Plumbing Code 2009

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals:

B. RSN 22 11 10-1, Approval Data:

1. Commercial product data including catalog illustrations, sizes, material, pressure ratings, manufacturer's installation instructions and complete parts lists for the following:

a. Piping and Appurtenances for the Domestic Water and Service Water Systems.

b. Pipe Hangers and Supports.

c. Accessories.

C. RSN 22 11 10-2, Test Plan:

1. Include step by step instructions, time estimates, and list of required equipment.

D. RSN 22 11 10-3, Final Drawings and Data:

1. Operation and Maintenance Manuals, in booklet form:

a. Submit complete installation, operation and maintenance manuals, including:

1) Maintenance data and schedules.

2) Description of operation and spare parts information.

3) All previously approved data, submitted under RSN 22 11 10-1.

4) Half size (11- by 17-inch) drawings.

5) Any applicable test records or reports.

2. As-Built drawings.

1.04 SYSTEM DESCRIPTION

A. General: The domestic and service water systems are supplied by two supply lines which are fed from the 12.1/12.2 and 12B pipelines. Maximum supply pressures are approximately 100 lb/in^2 and 200 lb/in^2, which are reduced to 75 lb/in^2 with pressure reducing valves.

B. Furnish and install domestic and service water distribution systems including all piping, valves, fittings, gages, and appurtenances to provide a complete operational system.

C. Provide piping and connections for:

1. Evaporative coolers in accordance with Section 23 73 39 - Evaporative Cooling HVAC Unit.

2. Mechanical seal system in accordance with Section 33 12 74 - Mechanical Seal Filtration and Booster System.

3. Plumbing fixtures, accessories, and trim in accordance with this Section and Section 22 42 10 - Plumbing Fixtures.

PART 2 PRODUCTS

2.01 PIPING AND APPURTENANCES

A. Piping and Fittings:

1. Copper Tubing: ASTM B88 Type K.

2. Tube Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.

3. Solder joints:

   a. Provide for joints 2 inches and smaller.

   b. ASTM B32, solder, Grade 95-5 Tin Antimony.

4. Brazed joints:

   1) Provide for joints 2-1/2 inches and larger in conformance with MSS SP-73.

   2) Brazed joints made with flux are acceptable for all line sizes.

   3) Provide a lead-free brazing material.

B. Two-way Ball Valves:

1. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

   a. Standard: MSS SP-110.

   b. SWP Rating: 150 psig.

   c. CWP Rating: 600 psig.

   d. Body Design: Two piece.

   e. Body Material: Forged brass.

   f. Ends: Threaded.

   g. Seats: PTFE or TFE.

   h. Stem: Brass.

   i. Ball: Chrome-plated brass.

   j. Port: Full.

C. Three-way Ball Valves:

1. Three-Piece, Full-Port, Brass Ball Valves with Brass Trim:

    a. Standard: MSS SP-110.

    b. SWP Rating: 150 psig.

    c. CWP Rating: 600 psig.

    d. Body Design: Three piece.

    e. Body Material: Forged brass.

    f. Ends: Threaded.

    g. Seats: PTFE or TFE.

    h. Stem: Brass.

    i. Ball: Chrome-plated brass.

    j. Port: Full.

D. Check Valves:

1. Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.

    a. Standard: AWWA C508.

    b. Pressure Rating: 175 psig.

E. Dielectric Fittings: Combination of copper alloy and ferrous; threaded, solder, or plain end types; and matching piping system materials.

1. Dielectric unions: Factory-fabricated union assembly, designed for 250-psig minimum working pressure at 180 degrees Fahrenheit. Include insulating material that isolates dissimilar metals and ends with inside threads.

2. Dielectric flanges: Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure to suit system pressures.

3. Dielectric couplings: Galvanized-steel couplings with inert and noncorrosive thermoplastic lining, with threaded ends and 300-psig minimum working pressure at 225 degrees Fahrenheit.

F. Air Relief Valve:

1. 3/14-inch calibrated pressure relief valve, adjustable range 50 to 175 psi.

G. Hose Connections:

1. Indoor:

    a. Angle style globe valve:

        1) Threaded connections.

2) Bronze body.

3) Class 150.

b. Lead free construction.

c. Renewable seat:

1) Non-rising stem.

2) Conforming to MSS SP-80.

d. Universal coupling:

1) Quick-acting, quarter turn, twist-lock interlocking claw type.

2) Malleable iron construction.

3) 3/4-inch FNPT connection.

4) Blank end cap.

2. Outdoor Hose Bibbs: Model Z1321-C Ecolotrol Wall Hydrant manufactured by Zurn Plumbing Products Group, 1801 Pittsburg Avenue, Erie, PA 16502, Telephone: 814-455-0921; or equal, having the following essential characteristics:

a. Lead-free construction.

b. Renewable seat.

c. Automatic draining non-freeze hydrant.

d. Integral backflow preventer.

e. Anti-siphon.

f. Female solder and male threaded inlet connections.

g. Vandal resistant.

2.02 BACKFLOW PREVENTERS

A. Reduced Pressure Zone Backflow Preventer for Service Water for Domestic Water Connection: Model LF909M1 manufactured by Watts, 815 Chestnut Street, No. Andover, MA 01845-6098; or equal, having the following essential characteristics:

1. Two-inch diameter.

2. Threaded connections.

3. Bronze body.

4. Working pressure 50 lb/in^2 to 75 lb/in^2.

5. Lead-free construction.

6. Designed for cross connections.

7. Provided with drain line connection with air gap.

2.03 WATER METERS

A. Impeller or nutating disc type.

B. Threaded connections.

C. Bronze body.

D. Class 150.

E. Lead free construction.

F. Maximum error of 1 percent between 0.5 gallons per minute (gpm) and 40 gpm.

G. Maximum 4 lb/in^2 pressure drop at 40 gpm.

2.04 PRESSURE REDUCING VALVES

A. Lead free construction.

B. All bronze body

C. NSF approved.

D. Capable of reducing:

1. The 100 lb/in^2 supply from the 12B pipeline to 75 lb/in^2.
2. The 200 lb/in^2 supply from the 12.1/12.2 pipeline to 75 lb/in^2.

2.05 PIPE HANGERS AND SUPPORTS

A. Pipe Hangers for Copper Tube:

1. Hangers for tube sizes 1/2-inch to 1-1/2 inches: Carbon steel, adjustable tubing ring and malleable iron adjusting nut, both plated with copper-plated finish.
2. Hangers for tube sizes 2 inches to 4 inches: Carbon steel, adjustable clevis with copper-plated finish.

B. Pipe Supports:

1. Copper- plated carbon steel or malleable iron split tubing clamp.

C. Beam C-Clamps:

1. Use where piping is suspended from building steel.
2. Clamp type: Select on the basis of load supported and load configuration.
3. C-Clamps: Provide locknuts and cup point set screws.
4. Top flange C-clamps: use when attaching hanger rod to top flange of structural shapes.

D. Hanger rods: Threaded on both ends or continuous threaded rods of circular cross section. No wire, chain, or perforated straps allowed.

E. Expansion Anchors:

1. Expansion anchors in accordance with CID A-A-1923A, type 4, stainless steel anchors with 3-1/2-inch minimum embedment bolt length.

2.06 ACCESSORIES

A. Pressure Gauge:

1. Standard: ASME B40.100.
2. Case: Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
3. Pressure-element assembly: Bourdon tube unless otherwise indicated.
4. Pressure connection: Brass, with NPS 1/4 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic.
9. Ring: Metal.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Pipe Insulation:

1. Commercially available, designed for specific pipe diameter. Minimum 1/2-inch thickness.
2. Flexible elastomeric with adhesive-backed connection.
3. Mold resistant.
4. Fire-rated.

C. Mechanical Wall Seal:

1. Modular, water-tight, mechanical seal, consisting of interlocking, synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.
2. Stainless steel hardware.

D. Sleeves: Form sleeves for pipes through walls and floor slabs with steel pipe or No. 18 United States Standard Steel gauge galvanized steel.

E. Escutcheons:

1. Chrome-plated finish.
2. Removable, split- type.

F. Plastic Tape Pipe Markers:

1. Flexible, colored vinyl film tape with pressure sensitive adhesive backing compatible with pipe and insulation.
2. Printed markings identifying service, flow direction, and pressure in accordance with ASME A13.1.

G. Nameplates:

1. Provide for equipment, valves, and non-potable water hose bibbs.
2. Fabricate from brass:
   a. Minimum thickness 0.063-inch.
3. Lettering:
   a. White paint or laser etching.
   b. Size: 1-inch.
4. Fasteners: Self-threading corrosion-resistant screws.
5. Chains: Stainless steel construction.
6. Cables for valves.

2.07 COATINGS

A. Paint auxiliary piping systems in accordance with Section 09 96 20 – Coatings.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Provide dielectric connections wherever joining dissimilar metals. Locate unions in accessible places.
2. Make change in directions with pipe fittings.
3. Protection:
   a. Plug or cap open ends of pipe at end of each work day or other stopping point throughout construction.
   b. Tightly cover equipment and protect against dirt, water, chemical, or mechanical damage.

B. Domestic water system: Install in accordance with the New Mexico Plumbing Code.

C. Provide one water meter for domestic water system and one water meter for the service water system.

1. Install in accordance with New Mexico Plumbing Code and manufacturer's instructions:
2. Locate meters as shown on drawing.
3. Ensure meter is positioned to allow for easily reading.

D. Service water system and service air systems: Install in accordance with ASME B31.1.

E. Copper Tubing:

1. Clean outside surface of copper tubing that contacts fittings and inside surfaces of fittings with an abrasive material prior to making connections.
2. Use care to prevent annealing of the tube or fittings when making soldered or brazed connections.
3. When brazing connections of 2-1/2-inch and larger tubing, apply heat uniformly around the entire circumference of the tube and fittings with a multi-flame torch.
4. Wipe excess flux, solder, or brazing material off exterior of tubing and fittings before it hardens.
5. Avoid applying excess flux, solder, or brazing material to the inside surface of the tubes or fittings.
6. Cut tubes square and ream to remove burrs.
7. Fittings and connections:
    a. Bushings not permitted. Make changes in pipe sizes with fittings.
    b. Provide dielectric connections wherever joining dissimilar metals, and locate in accessible places.
    c. Install unions downstream of valves, equipment connections, or apparatus connections.
8. Escutcheons: Provide at finished surfaces where bare or insulated piping passes through floors, walls, or ceilings.
9. Provide sleeves for pipes passing through partitions, walls and floors.

F. Anchors and Supports:

1. Allow for expansion and contraction of water piping throughout the domestic water system.
2. Secure hose bibb handles to stems.
3. Anchor supply pipes for fixtures, faucets, and valves.
4. Maximum spacing between pipe hangers and supports is given in Table 22 11 10A - Maximum Spacing between Hangers and Supports for Hard Drawn Copper Tubing.

Table 22 11 10A - Maximum Spacing between Hangers and Supports for Hard Drawn Copper Tubing

Nominal Pipe Size (Inches)	Maximum Span (Feet)
1/2	5
3/4	6
1	6
1-1/4	7
1-1/2	8
2	8
2-1/2	9
3	10

G. Insulation:

1. Install on exposed portions of the domestic and service water systems located inside the pumping plant.
2. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
    a. Verify that systems to be insulated have been tested and are free of defects.
    b. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.
4. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
5. Install insulation with longitudinal seams at top and bottom of horizontal runs.
6. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
7. Keep insulation materials dry during application and finishing.
8. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
9. Install insulation with least number of joints practical.
10. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
11. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
12. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

a. Seal penetrations with flashing sealant.

b. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

c. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.

d. Seal jacket to wall flashing with flashing sealant.

13. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

14. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

a. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

1) Insulate using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive.

b. When preformed covers are not available, install cut sections of pipe and sheet insulation. Arrange insulation to permit access to packing and to allow operation without disturbing insulation.

15. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

H. Plastic Tape Pipe Markers:

1. Install appropriate plastic tape pipe markers for all exposed piping components, valves, and equipment.

2. Install identifying devices after completion of insulation, coverings, and painting.

3. Align with axis of piping. Install completely around pipe with markings in clear view.

4. Distance between identification: Not to exceed 20 feet on centers on straight runs, including risers and drops.

5. Provide adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

I. Nameplates:

1. Install nameplates indicating valve name or purpose indicated on drawings.

2. Chains or cables shall be provided if valve size or insulation interferes with nameplate installation.

3. Install nameplates reading “NON-POTABLE DO NOT DRINK” above applicable hose bibbs.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. General:

1. Notify COR in writing at least 14 working days prior to testing. Include the following:

   a. Copy of approved test plan.

   b. Date and time the system shall be ready for testing.

   c. Period of time required to complete testing.

2. All tests shall be witnessed by the COR.

3. Test new piping systems after installation.

   a. Furnish materials, supplies, labor, and equipment required for the tests including temporary flanges and plugs required for the tests.

   b. Disconnect or isolate instruments and equipment that are not designed for the test pressures prior to testing piping and reconnect after testing.

   c. Inspect, test and repair work to be concealed and covered prior to concealing or covering.

B. Domestic Water and Service Water Piping:

1. Subject systems to operating tests to demonstrate function and operation to the satisfaction of the COR by operating each device.

2. Perform a water leakage pressure test with water pressurized to 150-lb/in^2. Maintain pressure in each piping system for not less than 3-hours without leaks. Repair leaks in a manner approved by the COR. Retest after repairs.

   a. Remove pressure reducing valve prior to test and reinstall after test is complete.

   b. Use calibrated grade A pressure gauges.

3.03 CLEANING OF DOMESTIC AND SERVICE WATER SYSTEMS

A. Flush piping after pressure tests are completed. Continue flushing until discharge water shows no discoloration.

B. Drain system at low points. Direct flow into gravity drainage system.

C. Remove, clean, and replace screens at faucets, eye-washes, and any other strainers. After flushing and cleaning, prepare systems for service by immediately filling piping with clean, fresh, potable water.

D. Repair any stoppage, discoloration, damage to the finish, furnishings, or parts of the building due to failure to properly clean the piping system.

E. Flush and disinfect system in accordance with Chapter 6 of the New Mexico Plumbing Code.

END OF SECTION

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SECTION 22 13 13
ON-SITE SEWAGE DISPOSAL SYSTEM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. On-site Sewage Disposal System:

1. Payment: Lump sum price offered in the schedule.
   a. Includes cost of earthwork.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A 240/A 240M-13a	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
2.	ASTM D 1784-08	Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
3.	ASTM D 2321	Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
4.	ASTM D 2729-11	Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
5.	ASTM D 3034-08	Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
6.	ASTM D 3212-07(2013)	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
7.	ASTM D 3753-05	Glass-Fiber-Reinforced Polyester Manholes and Wetwells
8.	ASTM F 477-10	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
9.	ASTM F 481-07	Installation of Thermoplastic Pipe and Corrugated Pipe in Septic Tank Leach Fields

B. American Water Works Association (AWWA)

1.	AWWA D120-09	Thermosetting Fiberglass-Reinforced Plastic Tanks

C. Indian Health Service (IHS)

1.	IHS	Navajo Area Indian Health Service Design Criteria, February, 2005

D. Navajo Nation Environmental Protection Agency (NNEPA)

1.	NNEPA	NNEPA Surface and Ground Water Protection Department - Navajo Nation Domestic Wastewater Regulations

E. Underwriters Laboratory (UL)

1.	UL 1316-1994	Glass Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols and Alcohol-Gasoline Mixtures

1.03 SYSTEM DESCRIPTION

A. Treat wastewater from one sink and one toilet.

B. Consist of conveyance piping, septic tank, absorption field with a single lateral and associated earthwork and bedding.

C. Perform primary treatment of sewage to reduce solids and oxygen demand.

D. Refer to drawings 1695-D-182, 1695-D-183 and 1695-D184.

E. The following terminology is used for the on-site wastewater disposal system:

1. Sewer pipe: Pipelines conveying wastewater from the building perimeter to the septic tank and from the septic tank to the absorption field.
2. Septic tank: 1000 gallon fiberglass reinforced plastic structure designed specifically for the storage and distribution of domestic wastewater or flammable liquids.
3. Absorption field equipment: Refers to perforated pipe or semicircular distribution chamber and engineered fill. Wastewater application area is nominally 100 square feet.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 22 13 13-1, Product Approval Data:

1. Shipping, handling, manufacturer’s name, commercial products data, Reference Standard certifications, drawings, illustrations, dimensions and installation procedures for pipes, septic tank, risers, access hatches and distribution chamber (if used). Commercial product data for seals, couplings and warning tape.

C. RSN 22 13 13-2, Test Report:

1. Results of Contractor Quality Testing.

D. RSN 22 13 13-3, O&M Manual:

1. Provide O&M manual detailing procedures for all structures, septic tank, Infiltrator-type system (if used), and access hatches.
2. Provide schedule for maintenance or replacement of parts including part numbers.

E. RSN 22 13 13-4, As-built Drawings:

1. Provide as-built drawings of 1695-D-182, 1695-D-183 and 1695-D-184 for on-site sewage disposal system components installed. To include but not limited to: heights, diameters, elevations to invert, and pipe sizes.

1.05 QUALIFICATIONS

A. Tank Manufacturer: Capable of producing UL 1316 rated tanks.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle equipment and components in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.01 SEWER PIPE

A. Polyvinyl chloride pipe: Gravity flow from building to septic tank and septic tank to absorption field.

1. ASTM D3034, SDR-35, nominal diameter.
2. Cell classification: 12454-B or 12454-C, as defined by ASTM D 1784.
3. Elastomeric Gaskets: in accordance with ASTM F 477.
4. Bell and spigot end style: in accordance with ASTM D 3212.

B. Slip-on Expansion Joint: Model Redflex SL-53 as manufactured by Red Valve Company, Incorporated, 700 North Bell Avenue, Carnegie, PA, 15106, or equal, with the following essential characteristics:

1. Stainless steel mounting bands: ASTM A 240.
2. Molded arch design. Neoprene elastomers suitable for sewage service.
3. Suitable for the line pressures up to 250 lb/in2.
4. Provide four way expansion and deflection.

2.02 WARNING TAPE

A. Sentry Line Reinforced Detectable Marking Tape manufactured by Terra Tape, 9209 Alameda Genoa Road, Houston, TX 77075; or equal, having the following essential characteristics:

1. Tri-layer laminate consisting of HDPE scrim coated with polyolefin pigmented resin, solid aluminum foil core and clear encapsulating film.
2. Non-adhesively laminated.
3. Colorfast and chemically inert.
4. Resistant to alkalies and acids.
5. Puncture and tear resistant.
6. Suitable for burial in soil.
7. Detectable from finished ground surface after burial by inductive or conductive methods using standard pipe locators.

B. Thickness: 7 mils, minimum.

C. Width: 6 inches.

D. Message: Permanently and continuously imprinted with CAUTION SEWER LINE BURIED BELOW.

E. Color: Green.

2.03 SEPTIC TANK

A. Nominal Capacity: 1000 gallons.

B. Fiberglass reinforced plastic construction, 100 percent resin. No sand fillers.

C. AWWA D120 and UL 1316 compliant.

D. H-20 traffic load rating.

E. Dual chamber with interconnector and scum control baffle on inlet and outlet.

F. Two manway openings, 24-inch diameter each. See drawing 1695-D-184.

G. Equipped with factory installed inlet and outlet openings as shown on 1695-D-184.

H. Two 24-inch diameter FRP risers between tank and cover, in FRP or PVC.

I. Access opening (manway) cover, gasketed. Air and watertight.

2.04 FLOOR ACCESS HATCHES

A. Aluminum floor access hatches of size shown on drawings. Size shown on drawings is minimum access opening dimensions.

B. Access Hatches: Series BFDDHA36x36-SAL, as manufactured by Babcock-Davis, Incorporated, 9300 73rd Avenue North, Brooklyn Park, MN 55428, Website:

www.babcockdavis.com: Type J-AL H2O, as manufactured by the Bilco Company, P.O. Box 1203, New Haven, CT 06505, Website: www.bilco.com: or equal, having the following essential characteristics:

1. Frames suitable for embedding in concrete. Gutter-type embedded frame; drainage coupling not required.
2. Top of cover flush with concrete surface.
3. Diamond pattern plate and designed to support AASHTO H-20 wheel loading.
4. Heavy-forged stainless steel hinges with Type 316 stainless steel pins.
5. Compression spring operators enclosed in telescopic tubes or torsion springs to provide ease of operation when opening hatch.
6. Automatic hold-open arm device.
7. Type 316 stainless steel slam lock, released from top by removable key wrench and from underside by fixed handle.
8. Mill finish aluminum with bituminous coating applied top exterior of frame.

1.01 AGGERGATE EMBEDMENT

A. ASTM C 33, coarse sand 100 percent passing 3/8-inch screen and 95 percent passing No. 4 screen.

1.02 PIPE TRENCH BACKFILL

A. Per Section 31 23 02 – Compacting Earth Materials.

2.04 ABSORPTION FIELD EQUIPMENT

A. Adsorption Field Lateral:

1. Perforated pipe, and suitable bedding material to comply with NNEPA.
    a. Optional: gravelless trench distribution chamber (lateral) in contact with absorption field. Model Quick4 chambers as manufactured by Infiltrator Systems, 4 Business Park Road, P.O. Box 768, Old Saybrook, CT 06475: or equal, having the following essential characteristics:
    b. Half-circle or half-oval cross section with open bottom.
    c. Suitable for placement without pea gravel bed.
    d. Rating for minimum 3 square foot (ft^2) of application area per linear foot of chamber.
    e. Approved for use by local Navajo Nation EPA – Public Water Systems Supervision Program.

B. Uncompacted Envelope Material:

1. Provide 100 ft^2 minimum distribution area as shown on drawing 1695-D-182.

a. Gradation: Refer to Table 22 13 13A – Uncompacted Envelope Material

Table 22 13 13A – Uncompacted Envelope Material

Sieve	Dry Weight Percent Passing
3/8	100
4	95 - 100
10	75 – 100
16	50 – 85
30	25 – 60
50	10 – 30
100	2 – 16
200	0 - 3

PART 3 EXECUTION

3.01 INSTALLATION

A. Install On-site Sewage Disposal System According to:

1. Drawings 1695-D-182, 1695-D-183 and 1695-D-184.
2. NNEPA and IHS.

B. Install Conveyance Piping:

1. Free of obstruction and with deflections no greater than manufacturer's recommendations. Cuts shall be square.
2. In accordance with ASTM D 2321, ASTM D 2729, ASTM D 3034, and ASTM D 3212.

C. Install Absorption Field Lateral in accordance with ASTM F481 and as recommended by manufacturer.

D. Install Septic Tank and Manholes in accordance with AWWA D 120 and ASTM D 3753.

E. Place backfill, aggregate embedment, gravel fill and uncompacted envelope material in accordance with 31 23 02 – Compacting Earth Materials. Except do not compact envelope material.

F. Seal all connections watertight per manufacturer's recommendation.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Fill tank to overflow with water.

B. Hold water in tank for a period of at least 24 hours.

C. Inspect the tank over the test period to ensure there is no leakage.

D. Repair all observed leaks to the satisfaction of COR. Repeat as needed until there is no leakage.

E. Test sewer pipe in accordance with the following:

1. Test two sections of pipe;

a. From building to septic tank,

b. From septic tank to absorption field.

1) Plug end(s) of pipe to be tested.

2) Fill pipe length, not in excess of 100 feet, full with water.

3) Attach vertical section to length to be tested. Extend vertical section to 10 feet above pipe centerline.

4) Fill vertical section such that length to be tested has hydrostatic pressure of approximately 10 feet.

5) Observe for leakage through drop of column in vertical section. Drop should not exceed 0.5 gallons in one hour.

c. Repair and or replace pipe as approved by COR.

d. Repeat test until leakage is less than specified rate.

END OF SECTION

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SECTION 22 13 16
PLANT DRAIN, WASTE, AND VENT PIPING SYSTEMS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Plant Drain, Waste, And Vent Piping Systems:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1.	ANSI 1018 - 2001	Performance Requirements for Trap Seal Primer Valves

B. American Society of Mechanical Engineers (ASME)

1.	ASME B16.12-09	Cast-Iron Threaded Drainage Fittings.

C. ASTM International (ASTM)

1.	ASTM A 74-13	Cast Iron Soil Pipe and Fittings
2.	ASTM A 518/A 518M-99(2012)	Corrosion-Resistant High-Silicon Iron Castings
3.	ASTM A 888-13	Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications
4.	ASTM C 564-12	Rubber Gaskets for Cast Iron Soil Pipe and Fittings

D. Commercial Item Descriptions (CID)

1.	CID A-A-1923A-1995	Shield Expansion (Lag, Machine and Externally Threaded Wedge Bolt) Anchors

E. Cast Iron Soil Pipe Institute (CISPI)

1.	CISPI 310-12	Couplings for Use in Connection with Hubless Cast Iron Sanitary and Storm Drain, Waste and Vent Piping Applications

F. International Code Council (ICC)

1.	IBC - 2009	International Building Code

G. Manufacturers Standardization Society (MSS)

1. MSS SP-58-09 Pipe Hangers and Supports

H. New Mexico Plumbing Code 2009

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 22 13 16–1, Approval Drawings and Data:

1. Manufacturer's literature, specifications, and engineering data including dimensions, size, and material of the following:
    a. Piping and fittings.
    b. Floor and equipment drains.
    c. Cleanouts.
2. Drawings at 1/4-inch per foot scale showing materials and dimensions of the complete waste and vent piping system, in Plan and Section views.

C. RSN 22 13 16-2, Test Plan:

1. Detailed test plan including step by step instructions, time estimates, and list of required equipment.

D. RSN 22 13 16-3, Final Drawings and Data:

1. Operation and Maintenance Manuals, in booklet form:
    a. Submit complete installation, operation and maintenance manuals, including:
        1) Maintenance data and schedules.
        2) Description of operation and spare parts information.
        3) All previously approved data, submitted under RSN 22 12 13-1.
        4) Half size (11- by 17-inch) drawings.
        5) Any applicable test records or reports.
2. As-built Drawings:
    a. Provide full size drawings on BOR title block.
    b. Provide CDs in AutoCAD format.

1.04 QUALIFICATIONS

A. Manufacturer's Qualifications:

1. Minimum 5 years of experience producing substantially similar equipment, and shall be able to produce evidence of at least 5 installations in satisfactory operation for at least 5 years.

PART 2 PRODUCTS

2.01 MATERIALS

A. Exposed gravity sanitary waste and vent piping run within the interior of a building shall be hubless cast iron. Concealed gravity waste and vent piping lines shall be service weight cast iron soil pipe with hub and spigot connections. Provide adapters, as required.

B. Piping located in concrete slabs or underground to exterior limits as shown on the Drawings shall be service weight cast iron soil pipe with hub and spigot connections.

C. Floor drains with integral traps shall be furnished with trap primer connections.

2.02 HUB & SPIGOT CAST IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74.

B. Weight: Service Weight.

C. Hub & Spigot Compression Type Joints:

1. Gasket: Neoprene Rubber, ASTM C 564.
2. Lubricant: As recommended by pipe manufacturer.

2.03 HUBLESS CAST IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888.

B. Joints: CISPI 310.

2.04 DRAINS AND CLEANOUTS

A. Heavy Duty Gravity Floor Drains: Fig. No. 2410 manufactured by Jay R. Smith Mfg. Company, 2781 Gunter Park Drive East, Montgomery, AL 36109; Model No. Z-533 manufactured by Zurn Industries, LLC., 1801 Pittsburgh Avenue, Erie, PA 16514; or equal with the following characteristics:

1. Floor Drain and Shower Drain: (FD-1).
    a. Materials:
        1) Grate: Heavy Duty galvanized cast iron grate capable of supporting 5,000 lbs.
        2) Body including sediment bucket: cast iron.
    b. Outlet Connection: Bottom outlet, caulk or no-hub, as required.

B. Gravity Drainage Floor Drains: Fig. No. 2010 manufactured by Jay R. Smith Mfg. Company, 2781 Gunter Park Drive East, Montgomery, AL 36109; Model No. Z-415

manufactured by Zurn Industries, LLC., 1801 Pittsburgh Avenue, Erie, PA 16514; or equal, with the following essential characteristics:

1. Materials:
    a. Body: Enameled cast iron.
    b. Collar: Cast iron, reversible, threaded for strainer heads, enamel coated.
    c. Strainer Head: Round 6-inch nickel bronze grate with bronze body, heel-proof grate, and vandal-proof screws.
2. Outlet Connection: Bottom outlet, caulk or spigot, as required.

C. Sanitary Sewer Floor Drains with integral traps: Fig. No. 2020 manufactured by Jay R. Smith Mfg. Company, 2781 Gunter Park Drive East, Montgomery, AL 36109; or equal, with the following essential characteristics:

1. Materials:
    a. Body: Enameled cast iron.
    b. Collar: Cast iron, reversible, threaded for strainer heads, enamel coated.
    c. Strainer Head: Round 6-inch nickel bronze grate with bronze body, heel proof grate, and vandal proof screws.
2. Outlet Connection: Side outlet, caulk or spigot, as required.
3. Trap primer connection on body with thread to solder adapter.

D. Cleanouts:

1. Cleanout Deck Plate (Traffic Areas): Fig. No. 4223S, manufactured by Jay R. Smith Mfg. Company, 2781 Gunter Park Drive East, Montgomery, AL 36109; Model No. Z-1400-HD manufactured by Zurn Industries, LLC., 1801 Pittsburgh Avenue, Erie, PA 16514; or equal, with the following essential characteristics:
    a. Materials: Cast iron body, flanged housing, cast iron cover with fitting device.
    b. Outlet Connection: Spigot outlet.

E. Trap Primers: Model Z1022 Automatic Trap Primer manufactured by Zurn Industries, LLC., 1801 Pittsburgh Avenue, Erie, PA 16514, Telephone: 814-455-0921; or equal, having the following essential characteristics:

1. Compliant with ANSI 1018.
2. Automatic primer.
3. Vacuum breaker port.
4. Bronze construction with removable top cover.

2.05 PIPE HANGERS AND SUPPORTS

A. Pipe Hangers and Supports:

1. Galvanized zinc plated carbon steel or malleable iron in accordance with MSS SP-58.

B. Expansion Anchors:

1. Expansion anchors in accordance with CID A-A-1923A, type 4, stainless steel anchors with 3-1/2 inch minimum embedment bolt length.

C. Beam C-Clamps:

1. Beam clamps: Use where piping is suspended from building steel.
2. Select clamp on the basis of load supported and load configuration.
3. C-Clamps : provide locknuts and cup point set screws.
4. Top flange C-Clamps: Use when attaching hanger rod to top flange of structural shapes.

D. Hanger rods: Threaded on both ends or continuous threaded rods of circular cross section. No wire, chain, or perforated straps allowed

PART 3 EXECUTION

3.01 GENERAL

A. Protection: Properly cap open ends of pipe at end of each day's work or other stopping point throughout construction. Tightly cover equipment and protect against dirt, water, chemical, and mechanical damage.

3.02 INSTALLATION

A. Install in accordance with IBC and New Mexico Plumbing Code.

B. Provide dielectric connections wherever joining dissimilar metals. Locate unions in accessible places.

C. Install drains and cleanouts in accordance with manufacturer's instructions and recommendations.

D. Install trap primers where shown on the Drawings.

E. Install upstream shut-off valves and access doors for trap primers.

F. Install accessible cleanouts as shown on the Drawings.

G. Waste and vent piping in chases: Pitch uniformly at 1/4-inch per foot grade, unless otherwise shown on the Drawings.

H. Connect new sanitary DWV system to sewage disposal system described in Section 22 13 13 – On-Site Sewage Disposal System.

I. Provide 18 gauge galvanized steel drip pans under pipes that pass above or near electrical control equipment. Furnish with 1-1/2-inch diameter "tell-tale" drains terminating 6 inches above the floor in a corner or near a column.

3.03 CONTRACTOR FIELD QUALITY TESTING

A. Notify COR in writing at least 14 working days prior to flushing and testing. Include the following:

1. Copy of approved Test Plan.
2. Date and time the system shall be ready for testing.
3. Period of time required to complete testing.

B. All tests including flushing shall be witnessed by the COR.

C. Flush pipe thoroughly until discharge is clear and free of all debris.

1. Do not utilize sump pumps during test.
2. Clean air chamber sump and daylight termination points at conclusion of testing.

D. Test piping in accordance with Chapter 7 of New Mexico Plumbing Code:

1. Test gravity drainage and sanitary waste and vent piping system with a minimum of 10-feet of water or 5-lbs/in^2 of air.
2. Conduct pressure test for a period of at least 15 minutes to verify system is tight with no leakage or reduction in pressure.

E. Repair and retest if required.

END OF SECTION

SECTION 22 14 30

SUMP PUMPING SYSTEMS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Plant Auxiliary Water Sump Pumping Systems:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME B16.18-2012	Cast Copper Alloy Solder Joint Pressure Fittings
2.	ASME B16.22-2012	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
3.	ASME B31.1-2012	Power Piping and Process Piping

B. ASTM International (ASTM)

1.	ASTM A74 - 13	Cast Iron Soil Pipe and Fittings
2.	ASTM A888 - 13	Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications
3.	ASTM B32 - 08	Solder Metal
4.	ASTM B88 - 09	Seamless Copper Water Tube
5.	ASTM C564 - 12	Rubber Gaskets for Cast Iron Soil Pipe and Fittings

C. Commercial Item Description (CID)

1.	CID A-A-1923A-1995	Shield Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors

D. Cast Iron Soil Pipe Institute (CISPI)

1.	CISPI 310-12	Couplings for Use in Connection with Hubless Cast Iron Sanitary and Storm Drain, Waste and Vent Piping Applications

E. Manufacturers Standardization Society (MSS)

1.	MSS SP-58-2009	Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application and Installation

2.	MSS SP-73-2003	Brazing Joints for Copper Alloy Solder Pressure Fittings
3.	MSS SP-80-2013	Bronze Gate, Globe, Angle and Check Valves
4.	MSS SP-110-2010	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

F. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250 – 2008	Enclosures for Electrical Equipment (1000 Volts Maximum)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals, and in accordance with 01 33 26 – Electrical Drawings and Data.

B. RSN 22 14 30-1, Approval Data:

1. Commercial product data including catalog illustrations, sizes, material, pressure ratings, manufacturer's installation instructions and complete parts lists for the following:
    a. Sump Pumps:
        1) Commercial product data include pump curve.
        2) Electrical schematics and wiring diagrams.
    b. Piping and appurtenances.
    c. Pipe hangers and supports.
    d. Float or pressure switches.
    e. Alarms.
    f. Accessories.

C. RSN 22 14 30-2, Check Prints:

1. Schematic and wiring diagrams.

D. RSN 22 14 30-3, Test Plan:

1. Include step by step instructions, time estimates, and list of required equipment.

E. RSN 22 14 30-4, Final Drawings and Data:

1. Operation and Maintenance Manuals, in booklet form:
    a. Submit complete installation, operation and maintenance manuals, including:
        1) Maintenance data and schedules.
        2) Description of operation and spare parts information.

3) All previously approved data, submitted under RSN 22 14 30-1.

4) Half size (11- by 17-inch) drawings.

5) Any applicable test records or reports.

2. As-built Drawings:

a. Provide full size drawings on BOR title block.

b. Provide CDs in AutoCAD format.

1.04 SYSTEM DESCRIPTION

A. The air chamber sump pump discharges water collected in the plant gravity drainage system (described in Section 22 13 16 – Plant Drain, Waste, and Vent Piping Systems) to a pipeline that discharges into the drainage ditch described in Section 33 11 16 – Site Water Utility Piping. This sump pump requires use of a rail system and prefabricated basin. This sump basin will be vented through a combination of embedded and exposed cast iron pipe.

B. The equipment vault sump pumps discharges water collected in the vault to a pipeline described in Section 33 11 16 – Site Water Utility Piping. These sump pumps are the submersible drop-in type. Equipment vault sump pumps are located as follows:

1. Chlorine Injection Vault No. 1.
2. Valve Vault No. 1.
3. Flowmeter Vault No. 1.
4. Flowmeter Vault No. 2.

C. Performance Requirements:

1. Install a dedicated 120 Vac power supply to the drainage sump as shown on drawings.
2. A dedicated 120 Vac circuit/receptacle will be installed within 15 feet of the drainage sump pump in each equipment vault
3. The pumps will require level control systems to energize the sump pumps at a predetermined high water level. The levels may be determined with floats or pressure switches. The level control system will de-energize the drainage sump pump when the water level is lowered to a predetermined low water level.

a. The drainage sump pump will utilized a hardwired level control arrangement.

b. The equipment vault sump pumps will require “piggyback” style level controls.

4. A high level alarm will provide local audio alert if the predetermined high water level is exceeded. A signal will also be sent to the SCADA system.

5. In the air chamber sump pump, an oil detection alarm will provide local audio alert if oil is detected in the sump liquid. A signal will also be sent to the SCADA system.

PART 2 PRODUCTS

2.01 SUMP PUMPING UNITS

A. Air chamber sump pump Model 240, with manufactured by Liberty Pumps, 7000 Apple Tree Avenue, Bergen, NY 14416; or equal, having the following essential characteristics:

1. Rated condition: Minimum flow of no less than 30 gallons per minute (gpm) at 5 feet total dynamic head.
2. Shut off head of pump no less than 15 feet.
3. Constructed of watertight cast iron corrosion resistant materials with stainless steel fasteners.
4. Internal check valve not allowed.
5. Pump and motor assembled as an integral unit.
6. Furnish non-clog type cast iron impeller suitable for passing solids up to 1/2-inch diameter.
7. Furnish with integral debris strainer.
8. Furnish a 120-volt, 60-hertz, motor with thermal overload protection and automatic reset.
9. Furnish a 10-foot oil and water resistant power cord for connection to a NEMA 4X control box inside the basin.
10. Furnish automatic float or pressure switch operation utilizing separate floats or switches for pump on and pump off.
11. Furnish NEMA 4X control box inside the basin.
12. Provide NEMA 12x wall mount disconnect switch.
13. Sump pump basin:
    a. High density polyethylene structural foam (PSF), polyethylene or Fiberglass Reinforced polyester (FRP) construction.
    b. Minimum depth as shown on drawing.
    c. Inlet, vent, and discharge locations as shown on drawing.
    d. Steel or aluminum hatch cover with gas tight seal.
    e. Lockable hatch opening with locking lift mechanism.
14. Sump rail system:
    a. Stainless steel guide rail, supports, and plates.

b. Stainless steel retrieval cable.

B. Equipment vault sump pumps Model 243, manufactured by Liberty Pumps, 7000 Apple Tree Avenue, Bergen, NY 14416; or equal, having the following essential characteristics:

1. Rated condition: Minimum flow of no less than 22 gpm at 11 feet total dynamic head.
2. Shut off head of pump no less than 15 feet.
3. Constructed of watertight cast iron corrosion resistant materials with stainless steel fasteners.
4. Internal check valve not allowed.
5. Pump and motor assembled as an integral unit.
6. Furnish non-clog type cast iron impeller suitable for passing solids up to 1/2-inch diameter.
7. Furnish with integral debris strainer.
8. Furnish a 120-volt, 60-hertz, motor with thermal overload protection and automatic reset.
9. Furnish a 15-foot oil and water resistant power cord for connection to a duplex receptacle.
10. Furnish automatic float or pressure switch operation for pump on and pump off.

2.02 ALARMS

A. High Level Alarm:

1. When high level is reached, alarm shall notify operator through the SCADA system and local alarm indicator.
2. 120 volts AC.
3. Mercury free.
4. Adjustable high water level.
5. NEMA 4X enclosure.

B. Oil Indicator Alarm:

1. If oil is detected, alarm shall notify operator through the SCADA system and local alarm indicator.
2. 120 volts AC.
3. Mercury free.
4. NEMA 4X enclosure.

2.03 PIPING AND APPURTENANCES

A. Piping and Fittings:

1. Copper tubing: ASTM B 88 Type K.
2. Tube fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
3. Reducers: Concentric type, copper construction. No bushings are permitted.
4. Solder joints:
   a. Provide for joints 2-inches and smaller.
   b. ASTM B32, solder, Grade 95-5 Tin Antimony.
5. Brazed joints:
   1) Provide for joints 2-1/2 inches and larger in conformance with MSS SP-73.
   2) Brazed joints made with flux are acceptable for all line sizes.
   3) Provide a lead-free brazing material.

B. Check Valve:

1. Cast iron or bronze body.
2. Vertical or horizontal installation.
3. Full flow design.
4. Stainless steel hardware.

2.04 EMBEDDED SUMP VENT PIPING

A. Hub & Spigot Cast Iron Soil Pipe and Fittings:

1. Pipe and fittings: ASTM A 74.
2. Weight: Service Weight.
3. Hub and spigot compression type joints:
   a. Gasket: Neoprene Rubber, ASTM C 564.
   b. Lubricant: As recommended by pipe manufacturer.

2.05 EXPOSED VENT PIPING

A. No-Hub Cast Iron Soil Pipe and Fittings:

1. Pipe and Fittings: ASTM A 888.

B. Joints: CISPI 310.

2.06 PIPE HANGERS AND SUPPORTS

A. Pipe Hangers and Supports for Copper Tube: Carbon steel with copper-plated components in accordance with ASME B31.1 and MSS SP-58.

B. Pipe Hangers and Supports for Exposed Vent Piping:

1. Galvanized zinc plated carbon steel or malleable iron in accordance with MSS SP-58.

2. Beam C-Clamps:

a. Use where piping is suspended from building steel.

b. Select clamp on the basis of load supported and load configuration.

c. C-Clamps : provide locknuts and cup point set screws.

d. Top flange C-Clamps: Use when attaching hanger rod to top flange of structural shapes.

3. Hanger rods: Threaded on both ends or continuous threaded rods of circular cross section. No wire, chain, or perforated straps allowed

C. Expansion Anchors:

1. Expansion anchors in accordance with CID A-A-1923A, type 4, stainless steel anchors with 3-1/2 inch minimum embedment bolt length.

2.07 ACCESSORIES

A. Wall Seal: Link-Seal Modular Seal as manufactured by Pipeline Seal & Insulator, Incorporated, Houston, TX; or equal, having the following essential characteristics:

1. Modular, water tight, mechanical seal, consisting of interlocking, synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.

2. Stainless steel hardware.

B. Sleeves:

1. Form sleeves for pipes through non-fire rated walls and floor slabs with steel pipe or No. 18 United States Standard Steel gauge galvanized steel.

2. Provide sleeves at least two sizes larger than the sump pump discharge pipe.

C. Dielectric Fittings: Combination of copper alloy and ferrous; threaded, solder, or plain end types; and matching piping system materials.

1. Dielectric unions: Factory-fabricated union assembly, designed for 250-psig minimum working pressure at 180 degrees Fahrenheit. Include insulating material that isolates dissimilar metals and ends with inside threads.

2. Dielectric flanges: Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure to suit system pressures.

3. Dielectric couplings: Galvanized-steel couplings with inert and noncorrosive thermoplastic lining, with threaded ends and 300-psig minimum working pressure at 225 degrees Fahrenheit.

2.08 COATINGS

A. Paint pipe in accordance with Section 09 96 20 – Coatings.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Provide dielectric connections wherever joining dissimilar metals. Locate unions in accessible places.

2. Make changes in direction with pipe fittings.

3. Protection:

a. Plug or cap open ends of pipe at end of each work day or other stopping point throughout construction.

b. Tightly cover equipment and protected against dirt, water, chemical, or mechanical damage.

B. Install pumping units and appurtenances as shown on drawings.

C. Install intake of sump pumping unit level with sump floor.

D. Provide necessary pipe fittings to connect pumping unit discharge outlet to discharge piping without putting stress on discharge outlet.

E. Install in accordance with ASME B31.1.

F. Make connections through sump basin using commercially available fittings. No rough-cut fittings allowed.

G. Seal all mounting screws below water high water level using silicone.

H. Provide power from wall mount NEMA 12x wall mount disconnect switch to NEMA 4x control box located inside sump basin (air chamber only).

I. Copper Tubing:

1. Clean outside surface of copper tubing that contacts fittings and inside surfaces of fittings with an abrasive material prior to making connections.

2. Use care to prevent annealing of the tube or fittings when making soldered or brazed connections.

3. When brazing connections of 2-1/2-inch and larger tubing, apply heat uniformly around the entire circumference of the tube and fittings with a multi-flame torch.

4. Wipe excess flux, solder, or brazing material off exterior of tubing and fittings before it hardens.

5. Avoid applying excess flux, solder, or brazing material to the inside surface of the tubes or fittings.

6. Cut tubes square and ream to remove burrs.

7. Fittings and connections:

   a. Bushings not permitted. Make changes in pipe sizes with fittings.

   b. Provide dielectric connections wherever joining dissimilar metals, and locate in accessible places.

   c. Install unions as shown on Drawings.

J. Pipe Hangers and Supports:

1. Install pipe hangers and supports in accordance with ASME B31.1 and MSS SP-58. Arrange piping supports so no excessive bending stresses are induced into the piping from concentrated loads between supports.

2. Provide additional hangers and supports wherever concentrated loads from valves or heavy fittings occur, or at changes in direction of the piping.

K. Provide sleeves for pipes passing through partitions, walls and floors.

L. Wall Seal:

1. Install wall seals in annular space between the discharge pipe and the wall sleeve opening.

2. Uniformly tighten wall seals in a circular pattern or as directed by manufacture's installation instructions.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. General:

1. Notify COR in writing at least 14 working days prior to testing. Include the following:

   a. Copy of approved testing plan.

   b. Date and time the system shall be ready for testing.

   c. Period of time required to complete testing.

2. Tests shall be witnessed by the COR.

3. After specification Section 26 05 90 – Wiring Checkout and Tests is complete, test new operation of sump pumps, level switches, controls, alarms, and piping after installation. Fill sump with water to verify operation of probes.

4. Furnish materials, supplies, labor, and equipment required for the tests including potable water, temporary flanges and plugs required for the tests.

5. Inspect, test and repair work to be concealed and covered prior to concealing or covering.

   a. Operate unit continuously at rated head and discharge for a period of not less than 30 minutes.

   b. Observe pumping unit to detect any excessive vibration, noise or heating.

   c. Pressure test sump pumping system piping with water in accordance with ASME B31.1 at 25 lb/in^2 for a 1-hour period with no leakage or reduction in pressure. If leaks develop, repair and retest for an additional 1-hour period until all leaks have been eliminated

6. Make repairs in a manner approved by the COR. Retest after repairs.

END OF SECTION

SECTION 22 15 10
COMPRESSED AIR SYSTEM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Compressed Air System:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME B1.20.1-1983(2006)	Pipe Threads, General Purpose
2.	ASME A13.1-2007	Scheme for the Identification of Piping Systems
3.	ASME B16.3-2011	Malleable Iron Threaded Fittings – Classes 150 and 300
4.	ASME B31.1-2012	Power Piping and Process Piping

B. ASTM International (ASTM)

1.	ASTM A 53/A 53M-12	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

C. Commercial Item Description (CID)

1.	CID A-A-1923A-1995	Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)

D. Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)

1.	MSS SP-80-2013	Bronze Gate, Globe, Angle and Check Valves
2.	MSS SP-110-2010	Ball Valves Threaded, Socket Welded, Solder Joint, Grooved and Flared Ends

E. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250-2008	Enclosures for Electrical Equipment (1000 Volts Maximum

F. National Fire Protection Association (NFPA)

1.	NFPA 70 - 2011	National Electric Code

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals, and in accordance with Section 01 33 26 – Electrical Drawings and Data.

B. RSN 22 15 10-1, Approval Drawings and Data:

1. Commercial products data for air compressor.
2. Outline and mounting detail drawings, including equipment weights.
3. Assembly drawings, including parts and material lists.
4. Electrical schematics and wiring diagrams.
5. Specifications standard drawing 40-D-6032, completed for air compressor motors.
6. Commercial products data for pipe, fittings, valves, air hose assemblies, flexible metal hose, pipe hangers, pipe supports, and appurtenances.

C. RSN 22 15 10-2, Check Prints:

1. Schematic and wiring diagrams.

D. RSN 22 15 10-3, Test Plan:

1. Include step by step instructions, time estimates, and list of required equipment.

E. RSN 22 15 10-4, Final Drawings and Data:

1. Operation and Maintenance Manuals:
   a. Submit complete installation, operation and maintenance manuals, including maintenance data and schedules, description of operation and spare parts information.
2. Previously approved data, submitted under RSN 22 15 10-1, in booklet form.
3. As-built drawings:
   a. Provide full size drawings on BOR title block.
   b. Provide CDs in AutoCAD format.

1.04 DELIVERY, STORAGE AND HANDLING

A. Cover piping and equipment connections with flange covers, pipe plugs, or other suitable means to prevent the entrance of foreign material during shipment and awaiting installation.

B. Protect equipment from corrosion, deformation, or other damage.

C. Store equipment in an enclosed area, free from contact with soil and weather.

1.05 EXTRA MATERIALS

A. Furnish all spare parts which are interchangeable with, and of the same materials and workmanship as the corresponding original parts of the air compressors. Package spare parts in hermetically sealed containers labeled with manufacturer's name, part description and part number.

B. Furnish the following spare parts for each air compressor:

1. Compressor air filter elements (Total of four per compressor).
2. Compressor oil filter elements (Total of four per compressor).
3. Air/Oil separator elements (Total of four per compressor).
4. Compressor lubricant (2-one gallon containers).

PART 2 PRODUCTS

2.01 COMPRESSOR

A. Integrated compressed air system: Model 273D80HCB23M manufactured by Quincy, 701 N. Dobson Avenue, Bay Minette, AL 36507: or equal, having the following essential characteristics:

1. Heavy-duty, industrial, single-stage, air-cooled, reciprocating type stationary compressor.
2. Minimum 20 acfm capacity at 100 lb/in^2.
3. Integral receiver 80-gallon storage tank.
4. Capable of continuous operation at specified discharge pressure and capacity without overheating.
5. V-belt or direct drive.
6. Air-cooled aftercooler.
7. Pneumatic tank drain
8. Low oil level switch.
9. Sight glass oil gauge.
10. Vibration isolators.
11. Full voltage, across-the-line starter, mounted and wired.
12. Heavy-duty air inlet filter.
13. Intake filter silencer.
14. Complete with all instrumentation to start compressor at 85 lbs/in^2 and stop compressor at 100 lbs/in^2 when operating under start-stop "Automatic" control.
15. NEMA 250, Type 4 control panel enclosure.

16. Motor:

    a. 460 VAC, 3-phase, 60-hertz, totally enclosed fan-cooled (TEFC).

    b. Horsepower rating capable of carrying continuously the maximum possible unit load developed under all operating conditions specified without exceeding the nameplate rating and without benefit of the service factor at an altitude of 6,691.5 feet above sea level.

    c. Designed for across-the-line starting at full voltage.

    d. Suitable for operation in 104 degrees Fahrenheit ambient air temperature.

    e. Maximum temperature rise of the motor windings when the motor is delivering rated output continuously at rated voltage and frequency not to exceed 80 degrees Celsius by resistance for class B, F, or H insulation.

    f. Temperature rise of other parts of the motor: In accordance with the standards for class B insulation.

17. "Hand-Off-Automatic" control modes.

18. Gauges and indicators: 4-1/2-inch dial compressor discharge air pressure gauge and elapsed time hour meter.

19. Safety devices: High pressure safety relief valve and high air/lubricant temperature shutdown system. Sized to relieve at a pressure less than or equal to that manufacturer's pressure rating of the tank.

20. Conforming to NFPA 70.

B. Compressor Terminal Blocks: Type EB-25, manufactured by General Electric Company; Buchanan catalog Nos. B104 through B122; Marathon Electric manufacturing Corporation catalog Nos. 1604 through 1612; or equal, having following essential characteristics:

1. Type: One piece, molded-block with molded-insulating barrier between terminals. Sectional type of terminal blocks not acceptable.

2. Rating: 600 volts, 25 amperes, minimum.

3. Terminals: Binding-head or washer-head screws with serrated or grooved contact surfaces for use with ring-type terminal connectors.

4. Full-size marking strips.

2.02 PIPING COMPONENTS

A. Piping and Fittings:

1. Pipe: ASTM A 53, type E or S, carbon steel, schedule 40, galvanized.

2. Fittings:

    a. 2-inch and smaller: Malleable iron, class 150, galvanized, threaded, in accordance with ASME B16.3. Cut threads on all threaded pipe and

fittings in accordance with ASME B1.20.1. Provide oil resistant joint compound or teflon tape for threaded connections.

b. Unions: Malleable iron or steel, galvanized, threaded connections, brass seats, class 150.

B. Valves:

1. Pressure ratings listed are primary steam ratings.

2. Ball valves:

a. Bronze body, threaded or sweat end connections, full port design, 1/4-turn operation, in accordance with MSS SP-110.

b. First isolation valve downstream of the compressor shall have a locking handle.

3. Air check valves:

a. Provide in the air discharge piping from compressor.

b. "Compact-A-Check" model check valve, as manufactured by Hoerbiger Corporation of America, Incorporated, 3350 Gateway Drive, Pampano Beach, FL 33069; or equal, having following essential characteristics:

1) Designed for pulsating air flow.

2) Stainless steel construction.

3) Instantaneous closing of sealing element to protect against backflow.

4) Minimum pressure rating of 150 lb/in^2.

4. Mechanical Float Controlled Condensate Drain:

a. Fully automatic operation with no external power.

b. Suited for dirty and oily condensate.

c. Manual drain and test valve.

d. No air loss design.

e. Large cross section outlet valve to reduce blockages.

f. Corrosion-resistant wetted parts.

C. Air Hose Assembly:

1. Hose: Multi-purpose, reinforced, two-ply braided hose for air and water service, abrasion resistant cover, 3/4 -inch inside diameter, 200 lb/in^2 working pressure, 75-foot length. Complete with hose couplings:

a. Universal half-hose couplings of quick-acting, 1/4 turn, twist-lock interlocking claw type, malleable iron construction.

b. Fasten with stainless steel clamps on each end of all hoses.

c. Provide matching couplings at all service air piping connection points.

2. Hose Rack: Wall-mounted saddle type, galvanized, 12 gauge steel or thicker construction, 75 feet of 3/4-inch outside diameter coiled hose capacity, mounted with top of rack 4 feet above finished floor.

D. Flexible Metal Hoses:

1. Provide in the air discharge piping from each compressor.

2. Flexible seamless hose reinforced with stainless steel wire braid and threaded end fittings.

3. Same diameter as discharge piping with a length not less than 12 inches.

4. Suitable for pulsating service at a working pressure not less than 250 lb/in^2 at a temperature of 300 degrees Fahrenheit.

5. Pressure rating: marked on outside of hose by manufacturer.

2.03 PIPE HANGERS AND SUPPORTS

A. Pipe Hangers:

1. Hangers for pipe sizes 1/2- to 1-1/2 inch: Galvanized carbon steel, adjustable tubing ring and malleable iron adjusting nut.

2. Expansion anchors: accordance with CID A-A-1923A, type 4, stainless steel anchors with 3-1/2-inch minimum embedment bolt length.

3. Pipe Supports: Galvanized carbon steel or malleable iron split tubing clamp.

B. Beam C-Clamps:

1. Use where piping is suspended from building steel.

2. Clamp type: Select on the basis of load supported and load configuration.

3. C-Clamps: Provide locknuts and cup point set screws.

4. Top flange C-clamps: use when attaching hanger rod to top flange of structural shapes.

C. Hanger rods: Threaded on both ends or continuous threaded rods of circular cross section. No wire, chain, or perforated straps allowed.

2.04 NAMEPLATES

A. Furnish nameplates for equipment and valves.

B. Fabricate from Brass:

1. Minimum thickness for nameplates mounted on flat surfaces: 3/32-inch.

2. Minimum thickness for nameplates mounted on piping or other non-flat surfaces: 3/16-inch.

C. Lettering:

1. White with black background.

2. Size: 3/16-inch.

D. Fasteners:

1. Panel mounted: Self-threading corrosion-resistant screws.

2. Non flat surfaces: Minimum 16 gauge stainless steel wire tie for nameplates or suitable epoxy adhesive.

2.05 PLASTIC TAPE PIPE MARKERS

A. Furnish for piping.

B. Flexible, colored vinyl film tape with pressure sensitive adhesive backing.

C. Printed markings in accordance with ASME A13.1.

D. Identify service type and flow direction.

2.06 COATINGS

A. Paint auxiliary piping systems in accordance with Section 09 96 20 – Coatings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Compressor:

1. Clean, align, level and anchor air compressor at the location shown on the drawings.

2. Mount in accordance with standard drawing 40-D-5599.

3. Connect air compressor to piping system and install all instruments and safety devices.

4. Make electrical connections in compliance with NFPA 70.

5. Lubricate compressor.

6. Pipe condensate to nearest floor drain.

B. Piping:

1. Provide installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing in accordance with ASME B31.1.
2. Install piping straight and true to bear evenly on hangers and supports.
3. Keep interior and ends of new piping thoroughly cleaned of dirt and foreign matter during installation.
4. Blow out entire piping assembly with compressed air after assembly to ensure piping is free of all foreign materials before connection to equipment.
5. Inspect piping before placing installation.
6. Provide insulating type union at connections between ferrous and non-ferrous water piping, valves and piping accessories and where required for connections to electrical equipment.
7. Install an adequate amount of unions in piping systems to allow for future maintenance activities requiring disassembly and reassembly of piping systems.
8. Provide fittings for changes in direction of piping and for connections. Make changes in piping sizes through tapered reducing pipe fittings. Bushings are not permitted.
9. Identification:
    a. Install appropriate plastic tape pipe markers and plastic nameplates for all exposed piping components, valves, and equipment.
    b. Install after completion of insulation and coatings.
    c. Plastic tape pipe markers:
        1) Align with axis of piping. Install completely around pipe with markings in clear view.
        2) Distance between identification is not to exceed 20 feet on centers on straight runs, including risers and drops.
        3) Provide adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
    d. Plastic nameplates:
        1) Fasten securely to equipment or other appropriate location with corrosion-resistant mechanical fasteners or adhesive.
        2) Install with markings in clear view.
10. Install pipe hangers and supports in accordance with ASME B31.1. Arrange piping supports so no excessive bending stresses are induced into the piping from concentrated loads between supports. Install insulating material between dissimilar alloys.
11. Adequately support system piping in order to maintain its integrity during fire conditions.

12. Provide rigidly supported hangers wherever a change in direction or change in elevation in the piping system occurs.

13. Maximum spacing between pipe hangers and supports is given in Table 22 15 10A – Maximum Spacing Between Hangers and Supports.

Table 22 15 10A -Maximum Spacing Between Hangers and Supports

Nominal Pipe Size (Inches)	Maximum Span (Feet)
3/4	7
1	9
1-1/4	10

C. Air Hose:

1. Install a hose rack complete with air hose immediately adjacent to each compressor air piping connection station.

3.02 CONTRACTOR FIELD QUALITY TESTING

1. Test conducted by Contractor and witnessed by COR.

2. Notify COR in writing at least 14 working days prior to flushing and testing. Include the following:

   a. Copy of approved Test Plan.

   b. Date and time the system shall be ready for testing.

   c. Period of time required to complete testing.

3. Compressor Operational Performance Tests:

   a. Initially start and operate compressors in accordance with manufacturer's instructions. Carefully observe that all parts are in proper alignment and are receiving correct lubrication.

   b. Test operation of each compressor to determine that compressor control system functions properly. Set control devices to start each under "Automatic" or "Auto" control and confirm proper functionality.

   c. Make adjustments as required.

   d. Retest if required.

4. Piping:

   a. Test piping systems after installation.

      1) Furnish all materials, supplies, labor, and equipment for making the tests.

2) Furnish and install all temporary flanges and plugs required for tests.

3) Remove all temporary flanges and plugs after for tests.

b. Disconnect or isolate instruments and equipment that are not designed for the test pressures prior to testing piping and reconnect after testing.

c. Test plant compressed air piping with air in accordance with ASME B31.1 at no less than 1.2 times the design pressure (100 lbs/in^2) and no more than 1.5 times the design pressure of the piping system for a 2-hour period with no leakage or reduction in pressure.

d. If leaks develop, repair and retest for an additional 2-hour period until all leaks have been eliminated.

END OF SECTION

SECTION 22 42 10
PLUMBING FIXTURES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Plumbing Fixtures:

1. Payment: Lump sum price offered in Schedule.

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1.	ANSI 61 - 2011	Drinking Water System Components – Health Effects
2.	ANSI A117.1 - 2009	Accessible and Useable Buildings and Facilities
3.	ANSI Z358.1 – 2009	Emergency Eyewash and Shower Equipment

B. American Society of Mechanical Engineers (ASME)

1.	ASME A112.6.1M - 1997 (R2008)	Supports for Off-the-Floor Plumbing Fixtures for Public Use
2.	ASME A112.19.2 - 2008	Ceramic Plumbing Fixtures
3.	ASME A112.19.3 - 2008	Stainless Steel Plumbing Fixtures

C. American Society of Sanitary Engineering (ASSE)

1.	ASSE 1010 - 2004	Water Hammer Arrestors

D. New Mexico Plumbing Code 2009

E. US Federal Government

1.	Public Law 101-336	Americans with Disabilities Act (ADA) 1990, as Amended

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals:

B. RSN 22 42 10-1, Approval Data:

1. Commercial product data including catalog illustrations, sizes, rough-in dimensions, trim finishes, and complete parts lists for items listed under Products.

2. Energy Efficiency – Documentation for Energy Star qualifications for equipment (if applicable).

C. RSN 22 42 10-2, Final Data:

1. Data submitted and approved under RSN 22 42 10-1.

2. Operation and Maintenance Manuals:

a. Complete installation, operation and maintenance manuals, including maintenance data and schedules, description of operation and spare parts information for equipment submitted under RSN 22 42 10-1.

PART 2 PRODUCTS

2.01 FIXTURES

A. Restrooms

1. Water Closets: Tropic FloWise Right Height elongated tank type toilet manufactured by American Standard, 1 Centennial Plaza, Piscataway, NJ 91744, (800) 488-8999; or equal, having the following essential characteristics:

2. ADA compliant

a. Plastic seat risers not permitted as a means of achieving correct ADA height.

3. ASME A112.19.2 compliant vitreous china.

4. Floor mounted

5. Elongated rim.

6. 1.1 gallon per flush.

7. Seat: solid white plastic, open front, elongated, self-sustaining check hinge, chrome plated brass bolts.

8. Lavatories: Model K-12636 manufactured by Kohler Company 444 Highland Drive Kohler, WI 53044, (800) 456-4537; or equal, having the following essential characteristics:

a. White vitreous china construction.

b. Wall-mounted.

c. 20-inch by 27-inch.

d. 4-inch center faucet holes.

e. ADA, ANSI A117.1, and ASME A112.19.2 compliant

f. Drain and Trap:

1) ADA compliant offset drain.

2) Polished chrome finish.

3) Cleanout plug on trap.

9. Lavatory Faucets: Model Z81104-XL, manufactured by Zurn Industries, LLC 2640 South Work Street, Falconer, NY 14733, (800) 997-3876; or equal having the following essential characteristics:

1) Chrome plated brass body

2) Two hole, 4-inch centerset

3) Separate hot and cold wrist blade knobs

4) 1-1/4 inch pop-up drain

2.02 SAFETY EQUIPMENT

A. Drench Shower With Eye/Facewash:

1. Integral surface mount catch pan located immediately below eye/facewash.
2. Stainless steel showerhead and eyewash receptor.
   a. Plastic showerhead and eyewash receptor also allowed if spare plastic parts are provided.
3. Instant action, stay open chrome-plated brass ball valve activated by rigid stainless steel pull rod and foot treadle.
4. 1-1/4-inch galvanized steel water pipe with floor flange support.
5. High visibility paint scheme with universal emergency sign.
6. Eyewash heads with dust covers.
7. Stream control with pressure compensated devices.
8. ANSI Z358.1 compliant.

2.03 WATER HEATERS

A. Electric Water Heater for Lavatory:

1. Model SP4208 Tankless Water Heater manufactured by EEmax, 353 Christian Street, Oxford, CT 06478 or equivalent, having the following essential characteristics:
   a. Capable of supplying 0.5 gpm with a 50 degree Fahrenheit rise
   b. Commercial electric, tankless type with thermostatically controlled adjustable output temperature.
   c. Turn on at 0.5 or gpm or lower.
   d. Minimum 3 year warranty

e. 480 Volt, 3.5 kW.

B. Electric Water Heaters for drench shower with eye/facewash

1. Model EX960T12 EFD "Series Twelve" Tankless Water Heater manufactured by EEmax, 353 Christian Street, Oxford, CT 06478 or equivalent, having the following essential characteristics:

a. Capable of supplying 23 gpm with a 35 degree Fahrenheit rise

b. Commercial electric, tankless type with thermostatically controlled adjustable output temperature.

c. Replaceable nickel chrome cartridge insert heating element.

d. Minimum 3 year warranty.

e. Micro-processing temperature control providing temperature accuracy of +/- 1 degree Fahrenheit.

f. Flow switch activated with first stage for eyewash and second stage for drench shower.

g. 480 Volt, 96 kW.

2.04 OTHER DEVICES AND ACCESSORIES

A. Water Hammer Arrestors: Model 1250XL manufactured by Wilkins, 1747 Commerce Way Paso Robles, CA 93446, (805) 238-7100; or equal, having the following essential characteristics:

1. ASSE 1010 compliant

2. Threaded connection piston type

3. Commercial grade

4. Lead free

5. Sized based on fixture units for the following fixture:

a. Drench shower with eye/facewash

B. Trap Primer:

1. Provide one Sani-Gard Automatic Trap Primer Model Z1022 as Manufactured by Zurn Industries, LLC,1801 Pittsburgh Avenue, Erie, PA or equal, having the following essential characteristics:

a. All bronze body.

b. Integral vacuum breaker.

c. Non-liming internal operating assembly.

d. Gasketed bronze cover.

PART 3 EXECUTION

3.01 PROTECTION

A. Properly plug or cap the open ends of pipe at the end of each work day or other stopping point throughout construction. Equipment shall be tightly covered and protected against dirt, water, chemical or mechanical damage.

3.02 INSTALLATION

A. Install plumbing fixtures, accessories, and trim in accordance with New Mexico Plumbing Code.

B. General:

1. Provide dielectric connections wherever joining dissimilar metals. Locate unions in accessible places.
2. Anchor supply pipes for fixtures, faucets and flush valves.
3. Upon completion and prior to acceptance of the installation, subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency to the satisfaction of the COR.
4. Remove faucet and other strainer screens prior to flushing plumbing system. Clean, and replace after flushing and cleaning.
5. Repair stoppage, discoloration, or damage to the finish, furnishings, or parts of the building, due to failure to properly clean the piping system.
6. Install water hammer arrestors at each plumbing fixture indicated in above.

C. Water Heaters:

1. Install in accordance with Division 26 – Electrical.
2. Provide isolation ball valves within 3-feet of inlet and outlet.
3. Provide unions between isolation ball valves and water heater.
4. Lavatory Unit:
   a. Adjust lavatory water heater setpoint to 110 degrees Fahrenheit or as directed by COR.
   b. Install lavatory unit under sink.

D. Emergency equipment:

1. Disinfect in accordance with Section 22 11 10 - Plant Auxiliary Water Systems.
2. Place caps over eyewash.
3. Hang signs or labels provided by manufacturer.

4. Test flow and temperature according to ANSI Z358.1 and make any required adjustments. Upon completion of adjustments demonstrate compliance to COR

E. Trap Primer:

1. Provide access doors or removable panels.

2. Install for bathroom drain using the domestic water upstream of the toilet as the water source.

END OF SECTION

SECTION 23 00 00

HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC) SYSTEM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Heating, Ventilating, and Air-Conditioning (HVAC) System:

1. Payment: Lump sum price offered in the schedule.

a. Includes Heating, Ventilating, and Air-Conditioning (HVAC) system shown on drawings 1695-D-269 through 1695-D-272.

b. Price includes the cost of providing HVAC equipment and control system(s) as shown on the drawings and in accordance with Division 23 sections.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in lump sum price offered in the schedule for the Heating, Ventilating and Air Conditioning (HVAC) System.

1.02 REFERENCE STANDARDS

A. American Bearing Manufacturers Association (ABMA):

1. ABMA 9-1990 (2000) Load Ratings and Fatigue Life for Ball Bearings.

B. National Electrical Manufacturers Association (NEMA):

1. NEMA MG 1-2009 - 2011 Motors and Generators

1.03 SUBMITTALS

A. Provide motor product data with the RSN that is specific to the equipment that it is serving, including nameplate data, efficiency, electrical ratings and quality testing documentation.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.

B. Protect products from weather and moisture by covering with plastic or canvas.

C. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 PRODUCTS

2.01 PRODUCT REQUIREMENTS FOR MOTORS FURNISHED WITH EQUIPMENT

A. Poly-Phase Motors: NEMA MG 1, Design B, premium efficiency motor, with windings to accomplish starting methods, voltage and number of speeds as indicated on drawings.

1. Service Factor: 1.15.

2. Enclosure: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

3. Designed for continuous operation in 40 degrees Celsius environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

4. Insulation System: NEMA Class F.

5. Bearings: anti-friction ball bearings, rated for minimum ABMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum load. Stamp bearing sizes on nameplate.

6. Sound Power Levels: Conform to NEMA MG 1.

B. Single Phase Motors:

1. Permanent split-capacitor type, otherwise use split-phase start/capacitor run or capacitor start/capacitor run motor.

2. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading rated for minimum ABMA 9, L-10 life of 200,000 hours.

3. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

C. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials as necessary.

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 23 05 29
SUPPORTS FOR EXTERIOR HVAC DUCT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in lump sum price offered in the Schedule for the Heating, Ventilating and Air Conditioning (HVAC) System.

1.02 REFERENCE STANDARDS

A. ASTM International:

1. ASTM A36 / A36M - 12 Carbon Structural Steel

B. American Welding Society (AWS):

1. AWS D1.1-2010 Structural Welding Code

C. Metal Framing Manufacturers Association (MFMA):

1. MFMA 4-2004 Metal Framing Standard

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 23 05 29-1, Approval Data:

1. Product data: Provide manufacturer's catalog data.
2. Shop Drawings: Show fabrication and installation details and include calculations for all exterior duct supports.

1.04 PERFORMANCE REQUIREMENTS

A. Structural Performance: Supports for exterior HVAC duct to withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7

1. Design supports, including stands, to be capable of supporting combined weight of duct and connected systems and components.

1.05 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1

PART 2 PRODUCTS

2.01 DUCT SUPPORTS

A. General Requirements: Welded, shop- or field-fabricated duct support made from structural carbon-steel shapes to support exterior grade-supported ductwork.

B. Stands

1. High-Type, Duct Stand:

a. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for on-grade installation.

b. Bases: recycled rubber with load distribution plate under grouted base.

c. Vertical Members: Two or more protective-coated-steel channels.

d. Horizontal Member: Protective-coated-steel channel.

C. Metal Framing Systems

1. Description: Shop- or field-fabricated duct-support assembly for supporting exterior ductwork

2. Standard: MFMA-4.

3. Channels: Continuous slotted steel channel with inturned lips.

4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

5. Metallic Coating: Electroplated zinc or hot-dipped galvanized

D. Miscellaneous Materials

1. Structural Steel: ASTM A 36, carbon-steel plates, shapes, and bars; black and galvanized.

E. Grout shall be in accordance with 03 63 00 – Epoxy Grout.

PART 3 EXECUTION

3.01 SUPPORT INSTALLATION

A. Install supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

B. Fabricate from welded-structural-steel shapes. Weld steel according to AWS D1.1.

C. Install hangers and supports to allow controlled thermal and seismic movement of duct systems, to permit freedom of movement between anchors.

D. Supports to be connected to ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets.

E. Install building attachments within concrete slabs or attach to structural steel.

F. Support the system without sagging, including supports at each offset or change in direction and at the ends of duct branches over five feet in length.

G. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

H. Grouting: Place grout under supports for equipment and make bearing surface smooth.

3.02 METAL FABRICATIONS

A. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

B. Field Welding: Comply with AWS D1.1 procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

END OF SECTION

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SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in lump sum price offered in the Schedule for the Heating, Ventilating, and Air Conditioning (HVAC) System.

1.02 REFERENCE STANDARDS

A. American Society of Civil Engineers (ASCE)

1. ASCE 7-2010 Minimum design Loads for Buildings and Other Structures

B. ASTM International (ASTM)

1. ASTM A488 / A488M – 12 Steel Castings, Welding, Qualifications of Procedures and Personnel
2. ASTM A603 - 98(2009) Zinc-Coated Steel Structural Wire Rope

C. American Welding Society (AWS)

1. AWS D1.1/D1.1M-2008 Structural Welding Code - Steel

D. International Code Council (ICC):

1. IBC-2009 International Building Code

E. Metal Framing Manufacturing Association (MFMA):

1. MFMA 3-2004 Metal Framing Standard

F. Manufacturer's Standardization Society for the Valves and Fittings Industry (MSS):

1. MSS SP-127-2001 Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 23 05 48 – 1, Approval Data:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

3. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear.

4. Annotate to indicate application of each product submitted and compliance with requirements.

5. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

6. Design Data: For vibration isolation and seismic-restraint details that comply with the performance requirements and design criteria, including analysis data signed and sealed by the New Mexico state-licensed professional engineer responsible for their preparation.

   a. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.

   b. Vibration Isolation Base Details: Electronically detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

   c. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.

   d. Details: Indicate fabrication and arrangement. Electronically detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

C. RSN 23 05 48 – 2, Final Data:

1. Bound copy of signed, stamped, previously approved data.

2. Final Testing and Adjusting Reports

1.04 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Provide and install snubbers, restraint cables, hanger rod stiffener, anchor bolts etc. described by this specification. Utilizing ASCE 7 and the defined site class, assigned seismic user group, building category, component importance factor, component response modification factor, component amplification factor, short

period response acceleration and one second period response acceleration to determine the extent of seismic restraint required for this project.

2. Seismic Design Category B

a. Structural Design Data Loads:

1) Site Class as Defined in the International Building Code (IBC): D

2) Assigned Seismic Use Group or Building Category as Defined in the IBC: III

3) Design Spectral Response Acceleration at Short Periods (0.2 Second): 0.269

4) Design Spectral Response Acceleration at 1-Second Period: 0.091

3. Component Importance Factor: 1.5

4. Component Response Modification Factor: As defined in ASCE 7.

5. Component Amplification Factor: As defined in ASCE 7.

1.05 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC and ASCE 7 unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M.

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear an Anchorage Preapproval number from an International Code Council Evaluation Service (ICC-ES), or preapproval by another agency acceptable to the COR showing maximum seismic-restraint ratings. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a New Mexico state-liscensed professional engineer.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATORS

A. Subject to compliance with the requirements of this section, provide Mason Industries http://www.mason-industries.com; or equal product by Amber/Booth Company http://www.amberbooth.com/; or California Dynamics Corporation http://www.caldyn.com or equal having the following essential characteristics:

1. Housed Spring Mounts: Mason SLR: Housed spring isolator with integral seismic snubbers.

a. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.

b. Base: Factory drilled for bolting to structure.

c. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.

2. Spring Hangers with Vertical-Limit Stop: Mason 3ON, PC30VAR W3ON: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

a. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

c. Minimum Additional Travel: 50 percent of the required deflection at rated load.

d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

f. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

g. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

h. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.02 SEISMIC AND WIND-RESTRAINT DEVICES

A. Subject to compliance with the requirements of this section, provide Mason Industries http://www.mason-industries.com; or equal product by Amber/Booth Company http://www.amberbooth.com/; or California Dynamics Corporation http://www.caldyn.com or equal having the following essential characteristics:

1. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in approved Approval Data Submittal.

a. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

2. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

a. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.

b. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.

c. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.

3. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

4. Restraint Cables: ASTM A 603 galvanized steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

5. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.

6. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

7. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

8. Resilient Isolation Washers and Bushings: One-piece, molded, oil and water-resistant neoprene, with a flat washer face.

9. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E A488. Minimum length of eight times diameter.

10. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E A488.

2.03 FACTORY FINISHES

A. Finish: Color-code or otherwise mark vibration isolation and seismic control devices to indicate capacity range.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

3.02 APPLICATIONS

A. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.

B. Strength of Support and Seismic-Restraint Assemblies: Select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.03 INSTALLATION

A. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

B. Install cables so they do not bend across edges of adjacent equipment or building structure.

C. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the COR if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons and electrical and telecommunications conduit.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

3.05 CONTRACTOR FIELD QUALITY TESTING

A. Tests and Inspections to be performed:

1. Test at least four of each type and size of installed anchors and fasteners as selected by COR.
2. Test to 90 percent of rated proof load of device.
3. Measure isolator restraint clearance.
4. Measure isolator deflection.
5. Verify snubber minimum clearances.

B. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

C. Use test equipment with current calibration.

D. Schedule test with COR, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.

E. Obtain COR’s approval before transmitting test loads to structure. Provide temporary load-spreading members.

F. Prepare test and inspection reports and include in Final Data submittal.

3.06 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.07 HVAC VIBRATION-CONTROL DEVICE SCHEDULE

A. Supported or Suspended Equipment: Fan coils, centrifugal fans, unit heaters, heat pumps and air handling units.

1. Housed spring mounts for floor mount or spring hangers with vertical limit stops for suspended.

a. 1.5 inch deflection for evaporative coolers

b. 0.75 inch deflection for all other equipment

END OF SECTION

SECTION 23 05 53

IDENTIFICATION – HVAC

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in lump sum price offered in the Schedule for the Heating, Ventilating and Air Conditioning (HVAC) System.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1. ASME A13.1-2007 Scheme for the Identification of Piping Systems

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 23 05 53-1, Approval Data:

1. Product data: Provide manufacturer's catalog data.
2. Shop drawings: Provide list of wording, symbols, letter size, and color coding for mechanical identification.

1.04 EXTRA MATERIALS

A. Spare Parts and Maintenance Products: Supply two containers of spray-on adhesive.

PART 2 PRODUCTS

2.01 HVAC EQUIPMENT NAMEPLATES

A. Plastic Nameplates:

1. Product Description: Laminated three-layer plastic with engraved white letters on black contrasting background color.
2. Provide in accordance with standard drawing 40-D-6234.
3. Provide for the following:
   a. Evaporative Cooling Units.
   b. Packaged Terminal Heat Pump Units.
   c. Fans.

d. Unit Heaters.

2.02 CONTROL EQUIPMENT NAMEPLATES

A. Plastic Nameplates:

1. Product Description: Laminated three-layer plastic with engraved white letters on black contrasting background color.
2. Provide in accordance with standard drawing 40-D-6234.
3. Provide for all HVAC control panels.

2.03 DUCT MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install identifying devices after completion of coverings and painting.

B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or a combination of mechanical fasteners and adhesive.

C. Identify service and flow direction. Install in clear view and align with axis of piping.

D. Locate identification not to exceed 20 feet on centers on straight runs of piping and ductwork including risers and drops, adjacent to each damper, tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in lump sum price offered in the Schedule for the Heating, Ventilating and Air Conditioning (HVAC) System.

1.02 REFERENCE STANDARDS

A. Associated Air Balance Council (AABC):

1.	AABC MN-1-2002	Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

1.	ASHRAE 111-2008	Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.

C. Natural Environmental Balancing Bureau (NEBB 2005):

1.	NEBB -2005	Testing, Adjusting, and Balancing of Environmental Systems.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 23 05 93 – 1 Final Data:

1. Certified Testing Adjusting and Balance Reports that include the following:
   a. Qualification Certification that indicates compliance with the requirements of this specification section.
   b. Test Reports: Indicate data on one of the following:
      1) AABC MN-1 National Standards for Total System Balance forms
      2) Forms prepared following ASHRAE 111.
      3) NEBB 2005 Report forms.
2. Furnish reports in hard cover, letter size, 3-ring binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and

side. Include set of reduced drawings and schematics with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with one of the following:

1. AABC MN-1.
2. Total System Balance ASHRAE 111.
3. NEBB 2005 Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

B. Maintain one copy of selected document on site.

C. Prior to commencing work, calibrate each instrument to be used.

1.05 QUALIFICATIONS

A. Perform Work under supervision of one of the following:

1. AABC Certified Test and Balance Engineer.
2. NEBB 2005 Certified Testing, Balancing and Adjusting Supervisor.
3. Registered Professional Engineer experienced in performance of this work.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify systems are complete and operable before commencing work. Verify the following:

1. Systems are started and operating in safe and normal condition.
2. HVAC control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Dampers are in place and in normal position.

8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.

3.02 PREPARATION

A. Furnish instruments required for testing, adjusting, and balancing operations.

B. Make instruments available to COR to facilitate spot checks during testing.

3.03 INSTALLATION TOLERANCES

A. Air Outlets and Inlets: Adjust to within plus 10 percent or minus 5 percent of design to space.

3.04 ADJUSTING

A. Verify recorded data represents actual measured or observed conditions.

B. Permanently mark settings of dampers and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

D. Report defects and deficiencies noted during performance of services, preventing system balance.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by COR.

3.05 GENERAL AIR SYSTEM PROCEDURE

A. Make air flow rate measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.

B. Measure air quantities at air inlets and outlets.

C. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.

D. Vary total system air quantities by adjustment of fan speeds. Vary branch air quantities by damper regulation.

E. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

F. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.

G. Adjust outside air automatic dampers, outside air, and exhaust dampers for design conditions.

H. Measure temperature conditions across outside air, and exhaust dampers to check leakage.

I. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches differential static pressure between spaces.

3.06 PROCEDURES FOR AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Where sufficient space in ducts is unavailable for Pitot tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.

b. Measure static pressure directly at the fan outlet or through the flexible connection.

c. Measure inlet static pressure of fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.

3. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

a. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors.

b. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of branch ducts.
    a. Where sufficient space in branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
    a. Re-measure each branch duct after all have been adjusted. Continue to adjust branch ducts to indicated airflows within specified tolerances.

C. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
    a. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.07 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data.
1. Manufacturer's name, model number, and serial number.
    a. Motor horsepower rating.
    b. Motor rpm.
    c. Efficiency rating.
    d. Nameplate and measured voltage, each phase.
    e. Nameplate and measured amperage, each phase.
    f. Starter thermal-protection-element rating.

3.08 PROCEDURES FOR DIRECT EVAPORATIVE COOLER

A. Measure, adjust, and record the following data.
1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop across unit.
5. Test drain and fill mechanism.
6. Test overflow alarm.

3.09 PROCEDURES FOR CHLORINE DETECTION SYSTEM

A. The chlorine system is to be tested under Division 46; however, the following tests are to be preformed of its interaction with the HVAC system. Test and record the following data:

1. Activation of Disinfection building's exhaust fan and verification that the associated inlet louver control damper has opened, with a chlorine concentration above 0.5 ppm. See HVAC controls sequences on the drawings.

    a. Test detector using appropriate span gas. Follow manufacturer's recommended safety procedures.

3.10 SCHEDULES

A. List of Equipment Requiring Testing, Adjusting, and Balancing:

1. Exhaust fans.
2. Ventilation fans.
3. Evaporative coolers.
4. Air inlets and outlets.
5. Chlorine detection system.
6. Electric heating equipment.

3.11 REPORT FORMS TO BE INCLUDED IN FINAL DATA

1. Title Page:

    a. Name of Testing, Adjusting, and Balancing Agency.

    b. Address of Testing, Adjusting, and Balancing Agency.

    c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency.

    d. Project name.

    e. Project location.

    f. Project Contractor.

    g. Report date.

2. Summary Comments:

    a. Design versus final performance.

    b. Notable characteristics of system.

    c. Description of systems operation sequence.

    d. Summary of outdoor and exhaust flows to indicate building pressurization.

    e. Nomenclature used throughout report.

f. Test conditions.

3. Instrument List:
   a. Instrument.
   b. Manufacturer.
   c. Model number.
   d. Serial number.
   e. Range.
   f. Calibration date.
4. Electric Motors:
   a. Manufacturer.
   b. Model/Frame.
   c. HP/BHP and kW.
   d. Phase, voltage, amperage; nameplate, actual, no load.
   e. RPM.
   f. Service factor.
   g. Starter size, rating, heater elements.
   h. Sheave Make/Size/Bore.
5. Evaporative Cooling Units:
   a. Identification/number.
   b. Location.
   c. Manufacturer.
   d. Model number.
   e. Serial number.
   f. Capacity.
   g. Air flow, design and actual.
   h. Entering air wet and dry bulb temperature, design and actual.
   i. Leaving air wet and dry bulb temperature, design and actual.
   j. Static pressure drop, design and actual.
6. Air Inlets and Outlets:
   a. Identification/number.
   b. Location.
   c. Size.
   d. Air flow, specified and actual.

7. Chlorine Detection System:
    a. Span gas used.
    b. Concentration setpoint.
    c. Validation of exhaust fan and inlet louver operation.
8. Electric Heating Units:
    a. Heating setpoint, design and actual.
9. Duct Leak Test:
    a. Description of ductwork under test.
    b. Duct design operating pressure.
    c. Duct design test static pressure.
    d. Duct capacity, air flow.
    e. Maximum allowable leakage duct capacity times leak factor.
    f. Test apparatus:
        1) Blower.
        2) Orifice, tube size.
        3) Orifice size.
        4) Calibrated.
    g. Test static pressure.
    h. Test orifice differential pressure.
    i. Leakage.

END OF SECTION

SECTION 23 07 13

DUCT WRAP INSULATION

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in price offered in the schedule for Heating, Ventilating, and Air-Conditioning (HVAC) System.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM):

1. ASTM E 84-2012	Surface Burning Characteristics of Building Materials
2. ASTM E 96-2010	Water Vapor Transmission of Materials
3. ASTM C 553-2011	Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
4. ASTM C 1136-2010	Flexible, Low Permeance Vapor Retarders for Thermal Insulation
5. ASTM C 1290-2011	Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
6. ASTM D 1644-2001 (2006)	Nonvolatile Content of Varnishes

B. Military Specifications and Standards

1. MIL-PRF-19565C-1980	Coating Compounds, Thermal Insulation, Fire- And Water-Resistant, Vapor-Barrier
2. MIL-A-3316C-1987	Adhesives, Fire-Resistant, Thermal Insulation

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 23 07 13 – 1 Approval Data:

1. Submit manufacturer’s product data. Include thermal conductivity, water-vapor permeance thickness, and jackets.

2. Installer certifications.

1.04 DEFINITIONS

A. Concealed Duct: Duct located within chases, soffits, ceiling plenums, and other concealed locations of a similar fashion.

B. Exposed Duct: Duct exposed to view within the conditioned spaces.

C. Conditioned Space: Space with active heating and cooling.

1.05 QUALIFICATIONS

A. Skilled mechanics that have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

1.06 COORDINATION

A. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and finishes and for space required for maintenance.

PART 2 PRODUCTS

2.01 FACTORY-APPLIED JACKETS

A. All Service Jacket (ASJ): White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.02 INSULATION MATERIALS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to the COR. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of the accepted testing agency.

1. Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

D. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290. Provide insulation with factory-applied ASJ.

2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. For indoor applications, adhesive shall have a VOC content of 80 g/L or less.

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less.

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Water-vapor permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service temperature range: Minus 20 to plus 180 degrees Fahrenheit.
3. Solids content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
4. Color: White.

2.05 SEALANTS

A. FSK Jacket Flashing Sealants:

1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 degrees Fahrenheit.
3. Color: Aluminum.
4. For indoor applications, sealants shall have a VOC content of 420 g/L or less.

2.06 TAPES

A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.07 SECUREMENTS

A. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel.

B. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.063-inch soft-annealed, galvanized steel.

PART 3 EXECUTION

3.01 DUCT INSULATION SCHEDULE, GENERAL

A. Apply duct insulation after pressure testing each duct systems. Insulation application may begin on segments that have satisfactory test results.

B. Plenums and ducts requiring insulation:

1. Outdoor air.

a. Mineral-Fiber Blanket (for use with round duct): 3 inches thick and 1.5-lb/cu. feet nominal density.

3.02 CONTRACTOR FIELD QUALITY TEST

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

C. Install insulation with longitudinal seams at top and bottom of horizontal runs.

D. Install multiple layers of insulation with longitudinal and end seams staggered.

E. Keep insulation materials dry during application and finishing.

F. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

G. Install insulation with least number of joints practical.

H. Seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

I. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

J. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

a. Apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

5. Apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.04 PENETRATIONS

A. Insulation installation at aboveground exterior wall penetrations: terminate insulation inside wall surface and seal with joint sealant.

3.05 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket insulation installation on ducts and plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

   b. On duct sides with dimensions larger than 18-inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

   d. Do not over-compress insulation during installation.

   e. Impale insulation over pins and attach speed washers.

   f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. Install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1-inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

   b. Install vapor stops for ductwork and plenums operating below 50 degrees Fahrenheit at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap un-faced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

END OF SECTION

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SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in lump sum price offered in the schedule for the Heating, Ventilating and Air Conditioning (HVAC) System.

1.02 REFERENCE STANDARDS

A. The Instrumentation, Systems, and Automation Society (ISA):

1.	ISA 50.00.01 1975 (2002)	Compatibility of Analog Signals for Electronic Industrial Process Instruments

B. National Electric Manufacturers Association (NEMA):

1.	NEMA ICS7 – 2006	Adjustable Speed Drives
2.	NEMA ICS 61800-2 - 2005	Adjustable-Speed Electrical Power Drive Systems, Part 2: General Requirements - Rating Specifications for Low-Voltage Adjustable Frequency AC Power Drive Systems
3.	NEMA MG1 - 2011	Motors and Generators

C. National Fire Protection Association (NFPA):

1.	NFPA 70-2011	National Electrical Code

D. Underwriters Laboratories

1.	UL 489 – 2013	Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals, and in accordance with 01 33 26 – Electrical Drawings and Data.

B. RSN 23 09 00-1, Approval Drawings and Data:

1. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

a. Controlled Systems:

1) Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, as described in Section 01 33 26 – Electrical Drawings and Data.

2) Wiring diagrams as described in Section 01 33 26 – Electrical Drawings and Data.

3) Written description of sequence of operation including schematic diagram.

C. RSN 23 09 00-2, Check Prints

1. Schematic and wiring diagrams.

D. RSN 23 09 00-3, Final Drawings and Data:

1. Operation and Maintenance Data:

a. Bound copy of signed, stamped, previously approved data from submittal RSN 23 09 00-1 in a three-ring hard cover binder.

1) As-built record drawings.

2. Provide the following for the Variable Frequency Drive (VFD):

a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.

b. Manufacturer's written instructions for setting field-adjustable overload relays.

c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.

d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

3. Final drawings as described in Section 01 33 26 – Electrical Drawings and Data.

1.04 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows.

a. Space temperature: Plus or minus 1 degree Fahrenheit.

b. Ducted air temperature: Plus or minus 1 degree Fahrenheit.

c. Outside air temperature: Plus or minus 2 degree Fahrenheit.

d. Temperature differential: Plus or minus 0.25 degree Fahrenheit.

e. Air pressure (space): Plus or minus 0.01-inch wg.

f. Electrical: Plus or minus 5 percent of reading.

1.05 SEQUENCE OF OPERATION

A. See mechanical drawings for control drawings and sequence of operation. These drawings show general intent and minimum requirements. If more real or virtual points are required to provide the sequences noted, it is the Contractor's responsibility to provide the additional equipment, accessories and programming time necessary to perform these sequences.

B. Where control drawings and sequence of operation are not identified, provide industry standard sequences and control devices to accommodate proper system operation and safety control of all devices specified in Division 23.

C. Unless specifically noted otherwise modulate/staging down sequences shall be the opposite of the modulate/staging up sequence shown.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

1.07 COORDINATION

A. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation. If more 120v power circuits are required than shown on the drawings due to additional equipment required by the Contractor, the cost of additional power circuits and the coordination of these power circuits with Division 26 shall be the responsibility of the instrumentation and controls contractor. All wiring shall comply with the Division 26 specifications.

PART 2 PRODUCTS

2.01 CONTROL SYSTEM

A. All HVAC instrumentation and controls shall be provided by a single source of responsibility.

2.02 ANALOG CONTROLLERS

A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.

B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 degree Fahrenheit, and single- or double-pole contacts.

C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.

1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

2.03 VARIABLE FREQUENCY DRIVES (VFD)

A. To be provided with the pumping plant relief fan EF-3.

B. General Requirements for VFDs: Comply with NEMA ICS 7 and NEMA ICS 61800-2.

C. Application: Variable torque.

D. VFD Description: Variable-frequency power converter (rectifier, dc bus, and inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled as a complete unit; arranged to provide self-protection, protection, and variable-speed control of a three-phase induction motor by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."

E. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

F. Output Rating: Three-phase; 10- to 60-hertz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

G. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of VFD input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 5 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFD frequency rating.
4. Minimum Efficiency: 97 percent at 60-hertz, full load.
5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
6. Ambient Temperature Rating: Not less than 14 degrees Fahrenheit and not exceeding 104 degrees Fahrenheit.
7. Humidity Rating: Less than 95 percent (noncondensing).
8. Altitude Rating: 6,500 feet minimum,
9. Overload Capability: 1.1 times the base load current for 60 seconds.
10. Starting Torque: Minimum 100 percent of rated torque from 3- to 60-hertz.

11. Speed Regulation: Plus or minus 5 percent.

12. Output Carrier Frequency: Selectable; 0.5- to 15-kHz.

13. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

H. Inverter Logic: Microprocessor based, isolated from all power circuits.

I. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.

2. Maximum Speed: 80 to 100 percent of maximum rpm.

3. Acceleration: 0.1 to 999.9 seconds.

4. Deceleration: 0.1 to 999.9 seconds.

5. Current Limit: 30 to minimum of 150 percent of maximum rating.

J. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.

2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.

3. Under- and overvoltage trips.

4. Inverter overcurrent trips.

5. Instantaneous line-to-line and line-to-ground overcurrent trips.

6. Loss-of-phase protection.

7. Reverse-phase protection.

8. Short-circuit protection.

9. Motor over temperature fault.

K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

L. Integral Input Disconnecting Means and OCPD: UL 489, instantaneous-trip circuit breaker with door-mounted handle mechanism.

1. Disconnect Rating: Not less than 115 percent of VFD input current rating.

M. Controls and Indication:

1. Status Lights: Door-mounted LED indicators displaying the following conditions.

a. Power on.

b. Run.

c. Overvoltage.

d. Line fault.

e. Overcurrent.

f. External fault.

2. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

   a. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.

3. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFD door and connected to display VFD parameters including, but not limited to:

   a. Output frequency (Hz).

   b. Motor speed (rpm).

   c. Motor status (running, stop, fault).

   d. Motor current (amperes).

   e. Motor torque (percent).

   f. Fault or alarming status (code).

   g. PID feedback signal (percent).

   h. Set point frequency (Hz).

   i. Motor output voltage (V ac).

4. Control Signal Interfaces:

   a. Electric Input Signal Interface:

      1) A minimum of two programmable analog inputs: 4- to 20-mA dc.

      2) Two multifunction programmable digital inputs.

   b. Output Signal Interface: A minimum of one programmable analog output signals, which can be configured for any of the following:

      1) Output frequency (Hz).

      2) Output current (load).

      3) Motor torque (percent).

      4) Motor speed (rpm).

      5) Set point frequency (Hz).

5. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.

a. Number of Loops: One

N. Optional Features:

1. Damper control circuit with end of travel feedback capability.

O. Enclosure: NEMA Type 4X.

2.04 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:

1. Accuracy: Plus or minus 0.5 degree Fahrenheit at calibration point.

2. Wire: Twisted, shielded-pair cable.

3. Insertion Elements in Ducts: Single point, 18 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 square feet.

4. Averaging Elements in Ducts: 72 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 square feet.

C. Room Sensor Pressure Transmitters/Transducers:

1. Static-Pressure Transmitter: Non-directional sensor with suitable range for expected input, and temperature compensated.

a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.

b. Output: 4 to 20 mA.

c. Building Static-Pressure Range: 0- to 0.25-inch wg.

D. Room Sensor Cover Construction: Manufacturer's standard locking covers.

1. Set-Point Adjustment: Exposed where called for on drawings.

2. Set-Point Indication: Exposed where called for on drawings.

3. Thermometer: Exposed where called for on drawings.

4. Color: White.

5. Orientation: Vertical.

E. Room sensor accessories include the following:

1. Insulating Bases: For sensors located on exterior walls.

2. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base or metal wire.

3. Adjusting Key: As required for calibration and cover screws.

2.05 STATUS SENSORS

A. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

B. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01-2002, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

C. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

D. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

E. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2 to 10 V dc, feedback signal.

2.06 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

1. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
3. Spring-Return Motors for Dampers Larger than 25 square feet: Size for running and breakaway torque of 150 in. x lbf.

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Valves: Size for torque required for valve close off at maximum pump differential pressure.
2. Dampers: Size for running torque calculated as follows:
    a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
    b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
    c. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.

d. Dampers with 3- to 4-inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.

3. Coupling: V-bolt and V-shaped, toothed cradle.

4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.

5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.

6. Power Requirements (Two-Position Spring Return): 24-V ac.

7. Temperature Rating: Minus 22 to plus 122 degrees Fahrenheit.

8. Run Time: 120 seconds.

2.07 DAMPERS

A. Dampers: AMCA-rated, parallel-blade design in mixing box applications and opposed-blade design elsewhere; 0.108-inch- minimum thick, galvanized-steel or 0.125-inch-minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.

1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.

2. Operating Temperature Range: From minus 40 to plus 200 degrees Fahrenheit.

3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.

2.08 CONTROL CABLE

A. All control devices and panels containing low voltage power sources shall inherently comply with NEC Class 2 requirements (current limiting), or shall be supplied with branch circuit fusing to limit control circuit current to NEC Class 2. All control transformers shall be of the inherent current limiting type, or shall be installed with primary disconnects and overload protection.

B. Shielded Cable: Twisted shielded cable shall be used where called for and where required to properly protect the control system from false signals and electrical noise. Shielding shall be fine braided tinned copper (90 percent coverage) or aluminum foil (100 percent coverage).

C. Minimum Requirements:

1. Communication Cable: Twisted shielded pair, 18-gauge.

2. Analog Input: Twisted shielded two, three, or four-wire as required, 18-gauge.

3. Binary Input: 18-gauge.

4. Analog Output: Twisted shielded, 18-gauge.

5. Binary Output: 18-gauge.

2.09 EVAPORATIVE COOLING HVAC UNIT CONTROLS

A. Factory-provided. See Section 23 73 39 – Evaporative Cooling HVAC Units.

PART 3 EXECUTION

3.01 SYSTEM PERFORMANCE

A. The system shall be complete in all respects, put in operation, tested and calibrated prior to occupied conditions. Provide time for occupancy adjustments after the building is occupied. The contractor is responsible for providing all sequences of operations specified herein or on the mechanical drawings even if equipment and controls are provided by others. For sequences specified in other sections, if equipment and controls are provided by others, the contractor shall still be responsible for verifying sequences of controls and coordination.

3.02 EXAMINATION

A. Verify that duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.03 INSTALLATION

A. Install software in control units. Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Calibrate all sensors for the project elevation.

C. Connect and configure equipment and software to achieve sequence of operation specified.

D. Verify location of thermostats, and other exposed control sensors with drawings and room details before installation.

E. Install thermostats and temperature sensors where they will be unaffected by the sun. Avoid mounting on outside wall. Where such devices must be mounted on an outside wall, provide an insulating base.

F. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

G. Sensors shall be installed to sense the correct temperature of the controlled medium only, within the vibration and velocity limits of the sensing element. Thermally isolate elements from brackets and supports to respond to air temperature only. Seal all duct penetrations air tight.

H. Sensors and other control devices shall be installed to be readily accessible and to permit quick and easy replacement. Flush mount with metal covers suitable for painting to match finished surface.

I. Locate exterior atmospheric pressure sensing control devices above wind eddy carried by the building structure and roof equipment.

J. Static pressure sensors shall be located in a section of duct or pipe with minimal turbulence.

K. Current Sensor: Current sensors shall be mounted in the starter cabinet of the controlled equipment. After controlled equipment has received factory start-up, provide adjustment on current sensor set point. For controlled equipment which operates with varying current draw, set point shall be made so that the full operating range of the current draw does not cause spurious trips of the status point. If necessary, install the sensor with multiple wraps of power wiring through the sensor to amplify the change in current in order to detect belt, bearing our coupling loss.

L. Install automatic dampers according to Section 23 33 00 - Air Duct Accessories.

M. The Disinfection Plant Chemical Exhaust system to be controlled from the gas detection system specified under Division 46.

N. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

O. Install labels and nameplates to identify control components as noted below and according to Section 23 05 53 - Identification for HVAC Piping and Equipment.

1. Identification: Tag or color-code all wiring at each end and necessary junction points and match the tagging numbers or color-coding shown on the control drawings. Clearly label as to function and setting. Identification shall cross-reference the control diagrams.

3.04 SAFETIES

A. Low Temperature Detection Thermostats: Each supply system with water coils taking outside air shall have a low temperature detection thermostat, set at 35ºF, located on the downstream side of the coil. Where multiple coil sections are used, provide one thermostat for each coil section. Wire thermostats to protect unit in both hand/manual and automatic operation. When temperature drops below set point, thermostat shall stop fan(s), open heating valve, open return air damper(s) and close outside air damper(s). Control must function independently of the DDC system.

B. Duct Smoke Detectors: Each air-moving system with a design capacity greater than 2,000 cfm shall have a smoke detector provided in the duct upstream of any filters, or air conditioning devices (coils, evaporative cooling media, etc). Wire the smoke detector(s) to shut down the unit in both hand (manual) and automatic operation. When smoke is detected, the detector(s) shall stop fan(s), open relief hood air damper(s) and close

outside air damper(s). Control must function independently of the local unit control system.

1. Location of the smoke detectors shall be as shown on drawings, provided and installed by Division 28. Where not shown on drawings the default location shall be in the air handling unit outside air section.
2. Wiring of detectors to fire alarm panel by Division 28.

3.05 VARIABLE FREQUENCY DEVICE (VFD) INSTALLATION

A. Coordinate layout and installation of VFD with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Wall-Mounting Controllers: Install on wall with disconnect operating handle not higher than 79 inches above finished floor unless otherwise indicated, and by bolting units ensuring air flow to the back of the VFD lightweight structural-steel channels bolted to wall ensuring air flow to the back of the VFD.

C. Identify VFD, components, and control wiring. Comply with requirements for identification specified in Division 26

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label VFD with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

3.06 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 26.

B. Install building wire and cable according to Division 26.

C. Install signal and communication cable according to the following:

1. Conceal cable in conduit unless run in raceway. Flexible conduit shall be limited to 2-foot lengths maximum.
2. All wiring shall be installed in a neat and workmanlike manner.
3. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
4. Number-code or color-code conductors for future identification and service of control system.
5. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

6. Cable shall not be installed closer than six feet from high power transformers or run parallel within six feet of electrical high power cables. Care shall be taken to route the cable as far from interference generating devices as possible.

7. Temperature control wiring shall not be run in conduit with power wiring. Analog or communication wiring shall not be run in the same conduit which has highly inductive loads such as contactors or coils.

8. Grounding: per Division 26.

9. Wiring of control devices by others: Control devices carrying full load current furnished by this specification Division and wired by Division 26 shall be located at the device being controlled, unless otherwise shown on the drawings.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.07 CONTRACTOR FIELD QUALITY CONTROL

A. Perform the following field tests.

1. Operational Test: After electrical circuitry has been energized, start HVAC equipment to confirm proper unit operation. Remove and replace malfunctioning units and retest.

2. Test and adjust controls and safeties.

3. Test each point through its full operating range to verify that safety and operating control set points are s required.

4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.

5. Test each system for compliance with sequence of operation.

6. Test software and hardware interlocks.

B. Calibrate test instruments.

C. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.08 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.

2. Make three-point calibration test for both linearity and accuracy for each analog instrument.

3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.

4. Control System Inputs and Outputs:

   a. Check analog inputs at 0, 50, and 100 percent of span.

   b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.

   c. Check digital inputs using jumper wire.

   d. Check digital outputs using ohmmeter to test for contact making or breaking.

   e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Pressure:

   a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.

   b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

6. Temperature:

   a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.

   b. Calibrate temperature switches to make or break contacts.

7. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.

8. Provide diagnostic and test instruments for calibration and adjustment of system.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.09 TRAINING

A. Engage a factory-authorized service representative to train maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Provide a minimum of 8 hours of training. The training session shall be conducted at the building. Two copies of the as-built drawings and operation and maintenance manuals shall be provided at the training session.

END OF SECTION

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SECTION 23 31 00

HVAC DUCTS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in lump sum price offered in the Schedule for the Heating, Ventilating and Air Conditioning (HVAC) System.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM):

1.	ASTM A603 - 09	Zinc-Coated Steel Structural Wire Rope
2.	ASTM A653 / A653M - 2011	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3.	ASTM C534 - 2011	Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
4.	ASTM C920 - 2011	Elastomeric Joint Sealants
5.	ASTM D1784 - 2011	Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
6.	ASTM D2412 - 2011	External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
7.	ASTM D2564 - 2012	Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems

B. Code of Federal Regulations (CFR)

1.	40 CFR 59-2008	Consumer and Commercial Products, Group IV: Control Techniques Guidelines in Lieu of Regulations for Miscellaneous Metal Products Coatings, Plastic Parts Coatings, Auto and Light-Duty Truck Assembly Coatings, Fiberglass Boat Manufacturing Materials, and Miscellaneous Industrial Adhesives

C. National Fire Protection Association (NFPA):

1.	NFPA 90A-2012	Installation of Air Conditioning and Ventilating Systems.

D. Sheet Metal and Air Conditioning Contractors (SMACNA):

1.	SMACNA 008-2008	IAQ Guidelines for Occupied Building's Under Construction
2.	SMACNA 1143-1985	HVAC Air Duct Leakage Test Manual.
3.	SMACNA 1966-2005	HVAC Duct Construction Standard - Metal and Flexible.

E. Underwriters Laboratories Inc.(UL):

1.	UL 181-2005	Factory-Made Air Ducts and Connectors.
2.	UL 723-2008	Tests for Surface Burning Characteristics of Building Materials

1.03 PERFORMANCE REQUIREMENTS

A. Variations of duct configuration or sizes are not permitted except by written permission by the Government.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers. Maintain temperatures during installation of duct sealant.

1.05 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.01 GENERAL METAL DUCT

A. General Fabrication Requirements: Comply with SMACNA 1966 based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints and Longitudinal Seams: Select joint and seam types and fabricate according to SMACNA1966 for static-pressure class, applicable sealing requirements, duct-support intervals, and other provisions.

C. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA1966 for static-pressure class, applicable sealing requirements, duct-support intervals, and other provisions.

2.02 SINGLE WALL RECTANGULAR DUCTS

A. Galvanized Steel Ducts: ASTM A653/A653M galvanized steel sheet, lock-forming quality. Coating Designation of G90. All duct exposed to view shall have Mill phosphatized finish.

2.03 SINGLE WALL SPIRAL ROUND DUCTS

A. Product Description: UL 181, Class 1, round spiral lockseam duct constructed of ASTM A653/A653M galvanized steel sheet, lock-forming quality. Coating Designation of G90. Shall have Mill phosphatized finish.

2.04 DOUBLE WALL RECTANGULAR DUCTS

1. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
2. Outer Duct: 16-gauge galvanized steel sheet with all transverse joints and longitudinal seams welded watertight. Duct to be installed per SMACNA 1966 instructions for double wall ductwork in all other regards.
3. Equipment Connection: Duct to be connected to evaporative cooler using flexible duct connectors per SMACNA 1966 instructions for double wall ductwork and rooftop installation applications.
4. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A.
    a. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
5. Inner Duct: Minimum 0.028-inch solid galvanized sheet steel.
    a. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA 1966 for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions.
    b. Longitudinal Seams: Select seam types and fabricate according to SMACNA1966 for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions.

2.05 PVC DUCTS AND FITTINGS

A. Duct and Fittings:

1. Round Duct: Comply with cell Classification 12454-B in ASTM D 1784, with external loading properties of ASTM D 2412.
2. Round Fittings: Socket end molded of same material, pressure class, and joining method as duct.

B. Joining Materials: PVC solvent cement complying with ASTM D 2564.

1. Use PVC solvent cement that has a VOC content of 510 g/L or less.

2. Use adhesive primer that has a VOC content of 550 g/L or less.

2.06 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

1. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

2.07 HANGERS AND SUPPORTS

A. Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA 1966

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports: Galvanized-steel shapes and plates.

PART 3 EXECUTION

3.01 DUCTWORK FABRICATION

A. Fabricate and support ducts in accordance with SMACNA 1966. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Increase duct sizes gradually, not exceeding 15 degrees divergence unless shown otherwise on drawings.

C. Seal joints between duct sections and duct seams with welds, gaskets, mastic adhesives, mastic plus embedded fabric systems, or tape.

1. Sealants, Mastics and Tapes: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.
2. All sealing products must bear UL approval markings.

3.02 DUCT SCHEDULE

A. Duct leakage, pressure and seal classification criteria based upon SMACNA 1143.

B. Fabricate ducts with galvanized sheet steel unless specified otherwise below.

C. Supply Ducts:

1. Ducts Connected to Evaporative Cooling Units:
    a. Metal, Double Wall.
    b. Pressure Class: Positive 2-inch w.g.
    c. Minimum SMACNA Seal Class: A.
    d. SMACNA Leakage Class for Rectangular: 6.
    e. SMACNA Leakage Class for Round: 6.

D. Exhaust Ducts:

1. Ducts Connected to Exhaust Fans:

a. Metal, Single Wall.

b. Pressure Class: Negative 2-inch w.g.

c. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.

d. SMACNA Leakage Class for Rectangular: 12.

e. SMACNA Leakage Class for Round: 6.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fans:

a. Metal, Single Wall.

b. Pressure Class: Positive or negative 2-inch w.g.

c. Minimum SMACNA Seal Class: A.

d. SMACNA Leakage Class for Rectangular: 12.

e. SMACNA Leakage Class for Round: 6.

2. Underground:

a. Schedule 40 PVC.

b. Minimum SMACNA Seal Class: A.

c. SMACNA Leakage Class for Round: 6.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA 1966.

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

c. Mitered Type RE 2 with vanes complying with SMACNA 1966.

2. Round Duct: Comply with SMACNA 1966

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA 1966. Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12-inches and Smaller in Diameter: Stamped or pleated.

c. Round Elbows, 14-inches and Larger in Diameter: Standing seam.

3.03 INSTALLATION

A. Construct ductwork to NFPA 90A.

B. Install round ducts in maximum practical lengths.

C. Install ducts with fewest possible joints.

D. Install factory or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1-inch.

H. Where ducts pass through interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

I. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA 008.

J. Use crimp joints with or without bead or beaded sleeve couplings for joining round duct sizes 8-inch and smaller.

K. Hanger and Support Installation:

1. Comply with SMACNA 1966 to determine rectangular duct hangers minimum size and minimum hanger sizes for round duct.
2. Hanger Spacing: Comply with SMACNA 1966 for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
3. Hangers Exposed to View: Threaded rod and angle or channel supports.
4. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets.
5. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

L. Use double nuts and lock washers on threaded rod supports.

M. Exhaust outlet locations to be as shown on drawings. Maintain the following separations:

1. Minimum Distance from Property Lines: 3 feet.

2. Minimum Distance from Building Openings: 3 feet.

3. Minimum Distance from Outside Air Intakes: 10 feet.

N. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

O. Any scratched or damaged ductwork shall be repaired in accordance with Section 09 96 20 – Coatings.

3.04 INTERFACE WITH OTHER PRODUCTS

A. Install openings in ductwork where required to accommodate thermometers and controllers. Install Pitot tube openings for testing of systems. Install Pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.

3.05 CLEANING

A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air flow, clean one half of system completely before proceeding to other half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in lump sum price offered in the Schedule for the Heating, Ventilating and Air Conditioning (HVAC) System.

1.02 REFERENCE STANDARDS

A. Air Movement and Control Association International, Inc. (AMCA)

1.	AMCA 500-2007	Louvers, Dampers, and Shutters.

B. Sheet Metal and Air Conditioning Contractors (SMACNA)

1.	SMACNA 1966-2005	HVAC Duct Construction Standard - Metal and Flexible.

C. Underwriters Laboratories, Inc. (UL)

1.	UL 181-2005	Factory-Made Air Ducts and Connectors

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 23 33 00 – 1, Approval Data:

1. Submit manufacturer’s product data on each type of duct accessory.

1.04 QUALITY ASSURANCE

A. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

1.05 DELIVERY, STORAGE AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

B. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

C. Protect from weather and construction dust.

D. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.06 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.01 BACK-DRAFT DAMPERS

A. Multi-Blade, Parallel-action, gravity-balanced, Galvanized 16-gage thick steel.

B. Blades, maximum 6-inch width, with felt or flexible vinyl sealed edges. Blades linked together in rattle-free manner with 90-degree stop, steel ball bearings, and plated steel pivot pin.

C. Furnish dampers with adjustment device to permit setting for varying differential static pressure.

D. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

2.02 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1-inch thick insulation with sheet metal cover.

1. Less than 12 inches square, secure with sash locks.
2. Up to 18 inches square: Furnish two hinges and two sash locks.
3. Up to 24 x 48 inches: Three hinges and two compression latches.
4. Larger sizes: Furnish additional hinge.
5. Access panels with sheet metal screw fasteners are not acceptable.

2.03 TURNING VANES

A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

B. Fabricated in accordance with SMACNA 1966.

C. Vane Construction: Double wall.

2.04 FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 degrees Fahrenheit.

2.05 VOLUME CONTROL DAMPERS

A. Fabricated in accordance with SMACNA 1966.

B. Multi-Blade Damper: Fabricated with opposed blade pattern with maximum blade sizes 8 x 72-inch. Assemble center and edge crimped blades in prime coated or galvanized frame channel with suitable hardware.

C. End Bearings: Except in round ductwork 12-inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or sintered bronze bearings. Furnish closed end bearings on ducts having pressure classification over 2 inches wg.

D. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

2.06 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.07 STATIC PRESSURE GAGES

A. Dial Gages: 3-1/2-inch diameter dial in metal case, diaphragm actuated, black figures on white background, front calibration adjustment, 2 percent of full scale accuracy.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with SMACNA 1966. Refer to Section 23 31 00 - HVAC Ducts for duct construction and pressure class.

B. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts; this includes all duct divisions, splits, 45 degree takeoffs and round duct spin or high performance takeoffs. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

C. Install backdraft and/or control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan, or as noted on the control drawing. Where dampers are not noted on the control drawings install backdraft damper on inlet.

D. Access Doors: Install access doors every 50 feet of straight duct and as indicated on drawings.

E. Install access doors with swing against duct static pressure.

F. Access door sizes shall be as noted or as required for proper access and service to the equipment. Minimum sizes shall be as follows:

    a. Two-Hand Access: 12 by 6 inches.

G. Install permanent duct test holes and plugs where required for testing and balancing purposes.

H. Any scratched or damaged metal air duct accessories shall be repaired in accordance with Section 09 96 20 – Coatings.

I. Install flexible connectors to connect ducts to equipment.

END OF SECTION

SECTION 23 33 13
DRAFT CONTROL DAMPER

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in applicable prices offered in the schedule for other items of work.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 23 33 13-1, Approval Data:

1. Installation methods.
2. Technical data.

C. RSN 23 33 13 – 2, Final Data:

1. Operation and Maintenance Data.
2. Bound copy of signed, stamped, previously approved data.

PART 2 PRODUCTS

2.01 DRAFT CONTROL DAMPER

A. Temperature operating range: 40 degrees Fahrenheit to 150 degrees Fahrenheit.

B. Draft Control Damper: The following draft control dampers are acceptable:

1. Model MG-1, size as shown on the drawings. Manufactured by Field Controls, LLC, 2630 Airport Road, Kinston, NC, 28504, Website: www.fieldcontrols.com, or equal with the following essential characteristics:
   a. Construction:
      1) Material: Galvanized steel.
      2) Coating: Baked enamel.
   b. Double acting leaf opens to relieve positive or negative vent system pressures.
   c. Adjustments using weights, accurate from 0.01- to 0.1-inch water gauge static pressure.

PART 3 EXECUTION

3.01 GENERAL

A. Install draft damper per manufacturer's recommendations and as shown on the drawings.

B. Initially adjust weights to positive and negative 0.05-inch water gauge static pressure.

C. Protect damper when applying foam insulation to prevent interference with damper operation.

END OF SECTION

SECTION 23 34 00
HVAC FANS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in lump sum price offered in the Schedule for the Heating, Ventilating and Air Conditioning (HVAC) System.

1.02 REFERENCES

A. Air Movement and Control Association International, Inc. (AMCA):

1.	AMCA 204 - 2005	Balance Quality and Vibration Levels for Fans.
2.	AMCA 210 - 2007	Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

B. Underwriters Laboratories Inc.(UL):

1.	UL 705 - 2004	Power Ventilators

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals, and in accordance with 01 33 26 – Electrical Drawings and Data.

B. RSN 23 34 00-1, Approval Data:

1. Submit manufacturer’s product data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements. Include submittal requirements of 23 05 13 – Common Motor Requirements for HVAC Equipment.

C. RSN 23 34 00-2, Final Data:

1. Operation and Maintenance Data. Submit manufacturer’s operation and maintenance manuals including instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

2. Bound copy of signed, stamped, previously approved data.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect motors, shafts, and bearings from weather and construction dust.

1.05 EXTRA MATERIALS

A. Furnish two sets of belts for all belt-driven fans.

PART 2 PRODUCTS

2.01 INLINE CENTRIFUGAL FANS (VF-1)

A. Centrifugal Fan Unit: Direct driven with galvanized steel housing lined with 1/2-inch acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge opening, integral inlet and outlet duct collar.

B. Wheel: Centrifugal forward curved type constructed of injection molded or polypropylene resin.

C. Motor: Open drip proof type with permanently lubricated sealed bearings and thermal overload protection, mounted on rubber-shear isolators.

D. Performance Ratings: Conform to AMCA 210.

E. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

F. Balance Quality: Conform to AMCA 204.

G. See schedule on drawings for additional information.

2.02 PROPELLER FANS (EF-3)

A. Construction:

1. Impeller: Shaped steel or steel reinforced aluminum blade with hubs, statically and dynamically balanced, keyed and locked to shaft, directly connected to motor or furnished with V-belt drive.
2. Frame: One piece, square steel with die formed venturi orifice, mounting flanges and supports, with baked enamel finish.

B. Accessories to be provided.

1. Integral Housing: 18-gauge galvanized steel wall housing.
2. Inlet Guard Safety Screens: Expanded galvanized metal over inlet, motor, and drive comply with OSHA regulations.

C. Performance Ratings: Conform to AMCA 210.

D. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

E. Balance Quality: Conform to AMCA 204.

F. Provide the pumping plant relief air fan EF-3 with a variable frequency drive (VFD) to control the motor speed. Coordinate the motor provided with the VFD. See specification section 23 09 00 – Instrumentation and Controls for HVAC for VFD specifications.

G. See schedule on drawings for additional information.

2.03 VANE AXIAL FANS (EF-4)

A. Description: Direct- or belt-driven axial fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, curb base, and accessories.

B. Housing: Heavy-gage, spun-aluminum, dome top and outlet baffle; square, one-piece, hinged, aluminum base.

C. Fan Wheel: Steel hub and blades.

D. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features.

E. Mounting Pedestal: four-legged steel channel support.

F. Performance Ratings: Conform to AMCA 210.

G. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

H. Balance Quality: Conform to AMCA 204.

I. See schedule on drawings for additional information.

2.04 CEILING-MOUNTING VENTILATORS (EF-1,2)

A. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.

B. Housing: Steel, lined with acoustical insulation.

C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

D. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.

E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

F. Rubber-in-shear vibration isolators.

G. Performance Ratings: Conform to AMCA 210.

H. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

I. Balance Quality: Conform to AMCA 204.

J. See schedule on drawings for additional information.

2.05 CEILING-MOUNTED DESTRATIFICATION FANS (SF-1 THRU 4)

A. Description:

1. Axial fan designed to be suspended from ceiling and mounted up to 30 feet in height.
2. Designed to deliver columnar laminar flow of air from ceiling to floor.

B. Construction:

1. Impeller: Blades shall have serrated trailing edge and winglet and shall be constructed of PA6 glass–fiber reinforced plastic.
2. Frame: Fire resistant enclosure with no exposed blades.

C. Accessories to be Provided:

1. Electrical: Variable speed controllable from a direct digital controller via a 0-10 VDC or 4-20 mA interface or via a direct in-line speed controller.
2. Mounting Hardware: 200-lb. working load main cable attachment system and separate cable stabilization tether.
3. Integral Housing: 18-gauge galvanized steel wall housing.
4. Inlet Guard Safety Screens: Expanded galvanized metal over inlet, motor, and drive comply with OSHA regulations.

PART 3 EXECUTION

3.01 INSTALLATION

A. Secure wall fans with cadmium plated steel lag screws to structure.

B. Install backdraft dampers on inlet to roof and wall exhaust fans.

C. Suspended Fans: Install flexible connections between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one-inch flex between ductwork and fan while running.

D. Install safety screen where inlet or outlet is exposed.

E. Provide sheaves required for final air balance.

3.02 CLEANING

A. Vacuum clean inside of fan cabinet.

3.03 PROTECTION OF FINISHED WORK

A. Do not operate fans until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

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SECTION 23 37 00

AIR INLETS AND OUTLETS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in lump sum price offered in the schedule for the Heating, Ventilating and Air Conditioning (HVAC) System.

1.02 REFERENCE STANDARDS

A. Air Movement and Control Association International, Inc. (AMCA):

1. AMCA 500-2007 Louvers, Dampers, and Shutters.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):

1. ASHRAE 70-2006 Rating the Performance of Air Outlets and Inlets.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 23 37 00 –1, Approval Data:

1. All Equipment:

a. Manufacturer’s product data that includes sizes, finish, and type of mounting.

C. RSN 23 37 00-2, Sample Color Kit:

1. Finish color palette.

D. RSN 23 37 00 – 3, Final Data:

1. Bound copy of signed, stamped, previously approved data.

PART 2 PRODUCTS

2.01 SUPPLY DIFFUSERS

A. Double Deflection Supply Grille: SD-1.

1. Type: 18-gage steel frame, individually adjustable aluminum airfoil blades on 1.25-inch centers, mitered corners.

B. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.

2.02 STATIONARY LOUVERS

A. Type: Blades on 45 degree slope with center baffle and return bend, heavy channel frame.

B. Fabrication: 18-gage thick galvanized steel welded assembly, with factory baked enamel finish. Finish color to be selected by the Governement from approval data submittal.

C. Bird Screen: Bird screen with 1/2-inch square mesh for exhaust and 3/4-inch for intake.

D. Free Area Required: 54 percent.

1. Meet the maximum static pressure losses listed on drawing schedule. Performance data to be AMCA 500 certified.

E. See schedule on drawings for additional information.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install diffusers to ductwork with airtight connection.

B. Outlets and Inlets:

1. Drawings indicate general arrangement of ducts, fittings, and accessories.
2. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop.
3. Make final locations where indicated, as much as practical.
4. GRDs shall have two No. 12 gauge hangers connected to the structure above.

END OF SECTION

SECTION 23 73 39

EVAPORATIVE COOLING HVAC UNITS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in lump sum price offered in the schedule for the Heating, Ventilating and Air Conditioning (HVAC) System.

1.02 REFERENCE STANDARDS

A. Air Movement and Control Association International, Inc.(AMCA)

1. AMCA 210-2007	Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
2. AMCA 500-2012	Laboratory Methods of Testing Dampers and Louvers

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

1. ASHRAE 62.1-2010	Ventilation for Acceptable Indoor Air Quality
2. ASHRAE 90.1-2010	Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. American Society of Sanitary Engineers (ASSE)

1. ASSE 1015-2009	Performance Requirements for Double Check Backflow Prevention Assemblies

D. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)

1. MSS SP-110-2010	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved, and Flared Ends

E. National Fire Protection Association (NFPA)

1. NFPA 70-2011	National Electrical Code
2. NFPA 90A-2011	Installation of Air Conditioning and Ventilating Systems

F. Underwriters Laboratories Inc.(UL)

1. UL 900-2004	Test Performance of Air Filter Units.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals, and in accordance with 01 33 26 – Electrical Drawings and Data.

B. RSN 23 73 39-1, Approval Drawings and Data:

1. Manufacturer's product data that includes rated capacities, furnished specialties, and accessories. Include submittal requirements of 23 05 13 – Common Motor Requirements for HVAC Equipment.

2. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, materials of construction and location and size of each field connection. Prepare the following:

   a. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

   b. Wiring Diagrams Power, signal, and control schematic and wiring as described in 01 33 26 – Electrical Drawings and Data.

3. Coordination Drawings: Mounting details electronically drawn to scale, that show size and location of unit mounting rails and anchor points and methods for anchoring units to structure.

C. RSN 23 73 39-2, Check Prints:

1. Schematic and wiring diagrams.

D. RSN 23 73 39-3, Final Drawings and Data:

1. Operation and Maintenance Data to include in emergency, operation, and maintenance manuals.

2. Bound copy of signed, stamped, previously approved data.

1.04 COORDINATION

A. Coordinate size, location, installation, and structural capacity of equipment support.

1.05 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set.

2. Evaporative media: One set.

3. Fan belts: Two sets for each fan.

PART 2 PRODUCTS

2.01 EVAPORATIVE COOLING UNIT

A. General:

1. Factory-assembled, prewired, self-contained unit consisting of cabinet, supply fan, controls, filters, louvers and evaporative cooling package to be installed outside the building. Unit to be rated for outdoor use.
2. Unit shall be factory assembled and shipped in multiple sections for field assembly. The manufacturer shall furnish all necessary gasketing and hardware for reassembly in the field.
3. Unit to have single point power connection that includes evaporative cooler pump, supply fans, GFI convenience receptacle, 24 V control transformer. Connection point to be on the exterior of the unit.
4. GFI convenience receptacle.
5. Provide Manufacturer's disconnect switch.
6. Provide 24-volt control transformer to power control dampers.
7. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
8. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
9. ASHRAE 90.1 Compliance: Applicable requirements in ASHRAE 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
10. See schedule on drawings for additional information.

B. Base:

1. Unit base frame shall be heavy duty 11-gauge galvanized rectangular steel tubing, fitted with C-Channel cross support members. The base shall include a Double Bottom 2-inch thick insulated floor. Base rails shall be fitted with lifting lugs as required. The unit base floor shall be heavy-duty walk-on type fabricated from 16-gauge galvanized steel with 20-gauge galvanized steel under liner. Floor insulation shall be 4-inch 1-1/2 # density fiberglass completely encapsulated between the two layers.

C. Cabinet:

1. Cabinet: Single-wall, 18-gauge galvanized- or aluminized-steel panels lined with polymer, formed to ensure rigidity and supported by galvanized-steel channels or structural channel supports and having a stainless-steel reservoir with overflow and drain with full-port, brass-fitted ball valve.
    a. External Casing and Cabinet Finish: Baked enamel over corrosion-resistant-treated surface in color to match fan section.

2. Access Panels: Piano hinged with cam-lock fasteners for furnace and fan motor assemblies on both sides of unit.

3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Supply-Air Fan:

1. Fan Type: Backwards inclined, Centrifugal, rated according to AMCA 210; statically and dynamically balanced, galvanized steel; mounted on solid-steel shaft with heavy-duty, self-aligning, permanently lubricated ball bearings.

2. Drive: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly.

3. Mounting: Fan wheel, motor, and drives shall be mounted in fan casing with seismically-restrained 2-inch deflection isolators.

E. Air Filters:

1. Comply with NFPA 90A.

2. Cleanable Filters: MERV 8, 1-inch- thick, cleanable metal mesh.

F. Evaporative Cooling Section:

1. Media: UL 900, Class 2, 12-inch- thick glass-fiber media with rigidizing agents, fungicides, and wetting agents. Minimum 90 percent contact factor at 500 feet per minute velocity.

2. Water-Circulation System: Submersible centrifugal sump pump with inlet strainer, brass balancing valve located in pump discharge, and thermally protected motor; water distribution troughs or piping at top of media pads; and bronze float-operated, makeup water and bleed-off valves. Provide secondary distribution header for media taller than 78-inch.

3. Automatic Fill and Drain Kit: Water supply and drain, solenoid valves for initial sump fill and for draining sump.

4. Wet section shall be provided with a flush line piped into the sump overflow. The bleed function shall be controlled with a normally closed solenoid valve and 24-hour adjustable 48-position timer. Timer shall be fully adjustable to increase or decrease the number of bleed events based on water conditions at the site.

5. Comply with applicable requirements in ASHRAE 62.1.

G. Valves:

1. Pressure Reducing Valve:

a. Diaphragm-Operated, Pressure-Reducing Valves:

1) Body: Bronze or brass.

2) Disc: Glass and carbon-filled PTFE.

3) Seat: Brass.

4) Stem Seals: EPDM O-rings.

5) Diaphragm: EPT.

6) Low inlet-pressure check valve.

7) Inlet Strainer: Removable without system shutdown.

8) Valve Seat and Stem: Noncorrosive.

9) Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2. Ball Valve:

a. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1) Description:

a) Standard: MSS SP-110.

b) SWP Rating: 150 psig.

c) CWP Rating: 600 psig.

d) Body Design: Two piece.

e) Body Material: Bronze.

f) Ends: Threaded.

g) Seats: PTFE or TFE.

h) Stem: Bronze.

i) Ball: Chrome-plated brass.

j) Port: Full.

3. Backflow Preventer:

a. Double-Check, Backflow-Prevention Assemblies:

1) Standard: ASSE 1015.

2) Operation: Continuous-pressure applications unless otherwise indicated.

3) Pressure Loss: 5 psig maximum, through middle third of flow range.

4) Size: 1-inch.

5) Body: Bronze.

6) End Connections: Threaded.

4. Control Valves:

a. Service water control valve:

1) Nickel-plated forged brass body rated at no less than 400 pounds per square inch, stainless steel ball and blowout proof stem, female NPT end fittings, with a dual EPDM O-ring packing design, fiberglass reinforced Teflon seats, and a TEFZEL flow characterizing disc.

b. Evaporative cooler drain control valve:

1) ANSI Class 125 cast iron body, stainless steel stem, bronze plug, bronze seat, and a TFE V-ring packing.

H. Controls:

1. Factory-wired, fuse-protected control transformer, connection for power supply and field-wired unit to remote control panel.

2. Control Panel: Manufacturer-provided, Surface-mounted remote panel, with engraved plastic cover, and the following lights and switches:

a. On-off-auto switch.

b. Supply-fan operation indication.

c. Damper position indication.

d. Space Thermostat:

1) Accuracy: Plus or minus 0.5 degrees Fahrenheit at calibration point.

2) Wire: Twisted, shielded-pair cable.

3) Provide insulated base to accommodate installation on columns

e. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.

1) Accuracy: Plus or minus 0.5 degrees Fahrenheit at calibration point.

2) Wire: Twisted, shielded-pair cable.

f. Fan-Discharge Thermostat: Stops fan when discharge-air temperature is below setpoint.

1) Duct insertion type. Single point, 18 inches long.

2) Accuracy: Plus or minus 0.5 degrees Fahrenheit at calibration point.

g. Cooling operation indicating light.

h. Dirty-filter indication operated by unit-mounted differential pressure switch.

i. Safety-lockout indicating light.

j. Ionization-Type Smoke Detectors: To be provided by Fire Alarm contractor.

1) Smoke detectors, located in outside air supply, shall stop fans when the presence of smoke is detected.

k. Fan Control: Interlock supply fan to open associated relief control dampers.

l. Outdoor-Air Damper Control, 100 Percent Outdoor-Air Units: Outdoor-air damper shall open when supply fan starts, and close when fan stops.

m. Outside Air Dampers: AMCA 500 rated, airfoil blade design; 0.108-inch-minimum thick, galvanized-steel or 0.125-inch- minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.

1) Secure blades to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.

2) Operating Temperature Range: From minus 40 to plus 200 degrees Fahrenheit.

3) Edge Seals, Low-Leakage Applications: Use inflatable blade edging and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per square feet of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D-2007.

n. Evaporative Cooling Controls:

1) Capabilities:

a) Start and stop water-circulation-system sump pump to maintain space temperature with wall-mounting, field-wired sensor and unit-mounted control adjustment.

b) Automatic Fill Control: A switch in the unit control panel to close sump drain valve and open makeup water valve.

c) Automatic Drain Control: Opens sump drain valve and closes makeup water valve from a switch in the unit control panel when an outside thermostat senses 40 degrees Fahrenheit or less.

2) Sequence of Operation: See HVAC Details drawing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

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

3.02 CONNECTIONS

A. Piping Connections: Drawings indicate general arrangement of piping, fittings, and specialties. Install piping to allow service and maintenance. Comply with requirements in Division 22 for valves and accessories on piping connections to evaporative cooling units.

B. Duct Connections: Drawings indicate the general arrangement of ducts. Connect supply and outside air ducts to evaporative cooling unit with flexible duct connectors.

C. Install controls and equipment shipped by manufacturer for field installation.

END OF SECTION

SECTION 23 81 00

DIRECT EXPANSION REFRIGERATION AIR CONDITIONERS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in lump sum price offered in the schedule for the Heating, Ventilating and Air Conditioning (HVAC) System.

1.02 REFERENCE STANDARDS

A. Air-Conditioning Heating and Refrigeration Institute (AHRI)

1.	ARI 210/240-2008	Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
2.	ARI 270-2009	Sound Rating of Outdoor Unitary Equipment.
3.	ARI 310/380-2004	Packaged Terminal Air Conditioners and Heat Pumps.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

1.	ASHRAE 15-2010	Safety Standard for Refrigerant Systems.
2.	ASHRAE 62.1-1992	Ventilation for Acceptable Indoor Air Quality.
3.	ASHRAE 90.1-2010	Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ASTM International (ASTM)

1.	ASTM B280-2008	Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

D. National Electrical Manufacturers Association (NEMA)

1.	NEMA MG 1-2009	Motors and Generators.

E. National Fire Protection Association (NFPA)

1.	NFPA 70-2011	National Electrical Code
2.	NFPA 90A-2008	Installation of Air Conditioning and Ventilating Systems.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals, and in accordance with 01 33 26 – Electrical Drawings and Data.

B. RSN 23 81 00 – 1, Approval Drawings and Data:

1. Submit manufacturer's product data indicating:

a. Cooling and heating capacities.

b. Dimensions.

c. Weights.

d. Rough-in connections and connection requirements.

e. Duct connections.

f. Electrical requirements with electrical characteristics and connection requirements.

g. Controls.

h. Accessories.

i. Compliance with ASHRAE 90.1.

j. Sound ratings.

C. RSN 23 81 00 – 1, Check Prints.

D. RSN 23 81 00 – 2, Final Drawings and Data:

1. Operation and Maintenance Data. Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

2. Bound copy of signed, stamped, previously approved data.

1.04 QUALITY ASSURANCE

A. Performance Requirements: Energy Efficiency Rating (EER) not less than prescribed by ASHRAE 90.1 when used in combination with compressors and evaporator coils when tested in accordance with ARI 210/240.

B. Cooling Capacity: Rate in accordance with ARI 210/240.

C. Sound Rating: Measure in accordance with ARI 270.

D. Insulation and adhesives: Meet requirements of NFPA 90A.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.

B. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.

C. Protect units from weather and construction traffic by storing in dry, roofed location.

PART 2 PRODUCTS

2.01 PACKAGED TERMINAL HEAT PUMP UNIT, PTHP-1,2

A. Description: Factory-assembled and -tested, self-contained, packaged terminal heat pump with room cabinet, electric refrigeration system, heating, and temperature controls; fully charged with refrigerant and filled with oil; with hardwired chassis. To comply with minimum efficiency requirements of ASHRAE 90.1.

B. Cabinet: 0.052-inch thick steel with removable front panel with concealed latches.

1. Mounting: Wall with wall sleeve. Galvanized steel with polyester finish.
2. Discharge Grille: Punched-louver discharge grille allowing four-way discharge-air pattern.
3. Louvers: Extruded aluminum with enamel finish; white color.
4. Finish: Epoxy coating.
5. Access Door: Hinged door in top of cabinet for access to controls.
6. Cabinet Extension: Matching cabinet in construction and finish, allowing diversion of airflow to adjoining room; with grille.

C. Refrigeration System: Direct-expansion indoor coil with capillary restrictor; and hermetically sealed scroll compressor with vibration isolation and overload protection.

1. Indoor and Outdoor Coils: Seamless copper tubes mechanically expanded into aluminum fins.
2. System to include an accumulator, constant-pressure expansion valve, reversing valve and refrigerant charge of R-410A.

D. Indoor Fan: Forward curved, centrifugal; with motor and positive-pressure ventilation damper with concealed manual operator.

E. Condensate Drain: Drain pan to direct condensate to piped discharge.

1. Comply with ASHRAE 62.1 for drain pan construction and connections.

F. Outdoor Fan: Forward curved, centrifugal type with separate motor.

G. Indoor and Outdoor Fan Motors: Two speed; comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Fan Motors: Permanently lubricated split capacitor.

H. Control Module: Remote-mounted digital panel with touchpad temperature control and with touchpad for heating, cooling, and fan operation.

I. Unit Performance Ratings: Factory test to comply with ARI 310/380.

J. See schedule on drawings for additional information.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install wall sleeves in finished wall assembly; seal and weatherproof. Provide any modifications or accessories necessary to accommodate wall thickness.

END OF SECTION

SECTION 23 82 39

ELECTRIC HEAT UNITS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in lump sum price offered in the schedule for the Heating, Ventilating and Air Conditioning (HVAC) System.

1.02 REFERENCE STANDARDS

A. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

1.	ASHRAE 62.1-2010	Ventilation for Acceptable Indoor Air Quality

B. Underwriter's Laboratories, Inc. (UL)

1.	UL 499-2005	Electric Heating Appliances
2.	UL 1030-2004	Sheathed Heating Elements
3.	UL 2021-1997	Fixed and Location Dedicated Electric Room Heaters

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals, and in accordance with 01 33 26 – Electrical Drawings and Data.

B. RSN 23 82 39-1, Approval Data and Drawings:

1. Manufacturer's product data indicating:
    a. Heating capacity.
    b. Throw distance.
    c. Dimensions.
    d. Materials of construction.
    e. Weights.
    f. Electrical requirements with electrical characteristics and connection requirements.
    g. Controls.
    h. Accessories.

i. Include submittal requirements of section 23 05 13 – Common Motor Requirements for HVAC Equipment.

C. RSN 23 82 39-2, Check Prints.

D. RSN 23 82 39-3, Final Data and Drawings:

1. Operation and Maintenance Data. Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

2. Bound copy of signed, stamped, previously approved data.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Accept units and components on site in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.

B. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.

C. Protect units from weather and construction traffic by storing in dry, roofed location.

1.05 COORDINATION

A. Coordinate installation with building structure.

PART 2 PRODUCTS

2.01 PROPELLER UNIT HEATERS

A. Description: An assembly including casing, coil, fan, and motor in with adjustable, vertical discharge configuration louvers.

B. Cabinet: Removable panels for maintenance access to controls.

C. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and tested propeller unit heater before shipping.

D. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

E. Electric-Resistance Heating Elements: Nickel-chromium heating wire, free from expansion noise and 60-hertz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16-inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 degrees Fahrenheit at any point during normal operation.

1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.

2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

F. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

G. Wall mounting bracket.

H. Control Devices:

1. Unit Mounted on-off PID thermostat.

2. Non-fused disconnect switch and a 24 VAC Class II transformer/relay package.

I. See schedule on drawings for additional requirements.

2.02 FAN FORCED ELECTRIC CONVECTORS

A. Description: Factory-packaged units constructed according to UL 499, UL 1030, and UL 2021.

B. Fan: vane axial type with down flow outlet. Include fan delay switch.

C. Heating Elements: Nickel-chromium-wire heating element enclosed in metallic sheath mechanically bonded into fins, with high-temperature cutout and sensor running the full length of element. Element supports shall eliminate thermal expansion noise.

D. Front and Top Panel: Minimum 0.0677-inch- thick steel with exposed corners rounded; removable front panels with tamper-resistant fasteners braced and reinforced for stiffness.

E. Housing: Minimum 0.0428-inch- thick steel.

F. Insulation: 1/2-inch thick, fibrous glass on inside of the back of the enclosure.

G. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, minimum size 6 by 7 inches, integral with enclosure.

H. Enclosure Style: Wall recessed. Four-inch deep.

1. Front Inlet Grille: Extruded-aluminum linear bar grille; pencil-proof bar spacing.

a. Mill-finish aluminum.

2. Top Outlet Grille: Extruded-aluminum linear bar grille; pencil-proof bar spacing.

a. Mill-finish aluminum.

b. Painted to match enclosure.

I. Unit Controls: Unit-mounted thermostat with minimum range of 35 to 60 degrees Fahrenheit.

J. Accessories: Integral disconnect switch, recessing flanges finished to match enclosure or overlapping front cover for fully recessed units, and rubber gaskets to seal cabinet at wall.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.

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

3.02 INSTALLATION

A. Install propeller unit heaters level and plumb.

B. Install Electric Convector units on wall at mounting height called out for on drawings.

C. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers. Vibration hangers are specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

3.03 CLEANING

A. Vacuum clean coils and inside of unit cabinet.

END OF SECTION

SECTION 25 00 01
SYSTEM CONTROL AND MONITORING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. System Control and Monitoring:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

1.	IEEE 802.3-2008	Local and Metropolitan Area Networks - Specific Requirements Part 3: Carrier Sense Multiple Access with Collision Detection Access Method and Physical Layer Specifications
2.	IEEE C2-2007	National Electric Safety Code (NESC)
3.	IEEE C37.90.2	Trial-Use Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers
4.	IEEE C62.41	Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

B. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250 - 2008	Enclosures for Electrical Equipment (1000 Volts Maximum)
2.	NEMA FU 1 – 2007	Low Voltage Cartridge Fuse
3.	NEMA ICS 1	General Standards for Industrial Control and Systems
4.	NEMA WC 70 – 2009	Non-shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy

C. International Electrical Testing Association (NETA)

1.	NETA ETT-2010	Certification of Electrical Testing Personnel

D. National Fire Protection Association, Inc. (NFPA)

1.	NFPA 70 – 2011	National Electrical Code (NEC)

1.03 DEFINITIONS

A. COG: City of Gallup.

B. NTUA: Navajo Tribal Utility Authority.

C. NGWSP: Navajo-Gallup Water Supply Project.

D. Facility Systems:

1. Pumping plant, tank control, HVAC control, Chlorine injection, Communications and security systems, and all necessary systems for complete SCADA operation of the Pumping Plant.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 25 00 01-1, Approval Data - Monitoring and Control Systems Technical Specialist Work Summary:

1. Include description of previously completed similar projects.

C. RSN 25 00 01-2, Approval Drawings and Data:

1. Drawings in government format:
    a. Layout of equipment in each Control Room Cabinet.
    b. Schematic and wiring diagrams of connected equipment.
    c. Networking diagram.
2. Bill of Materials.
3. Manufacturer’s product data.

D. RSN 25 00 01-3, Approval Data - Software Development Documentation:

1. Include the following for each of the Facilities Systems:
    a. I/O points data base.
    b. All logic diagrams.
    c. All variables.
    d. One line diagram (proposed LCD display) for each screen provided as part of the HMI.
    e. HMI graphical screenshots.
    f. Operator’s Workstation:
        1) Data base.
        2) One line diagrams (proposed touch panel display) for each screen.
        3) All variables.

2. Plant SCADA software, including HMI, Historian, Alarm and Events, and Web Server applications.

E. RSN 25 00 01-4, Approval Data - Design Coordination Meeting Agenda:

1. Include color copies of all paperwork needed for review and discussion.

F. RSN 25 00 01-5, Check Prints:

1. Schematic and wiring diagrams.

G. RSN 25 00 01-6, Approval Data - Final Drawings, Documentation, and Operations and Maintenance Manuals:

1. Include:

a. Final drawings of all approved layouts, schematic diagrams, and wiring diagrams including “as-built” changes.

b. Final version of approved software documentation including “as-built” changes.

c. Operations and Maintenance Manuals.

d. Spare parts list.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handle and store all hardware in accordance with manufacturer’s instructions. Include copy of these instructions with equipment at time of shipment.

1.06 PROJECT CONDITIONS

A. Ambient Temperature Range: -30 degrees Celsius to 40 degrees Celsius.

B. Relative Humidity: 0 to 90 percent.

C. Altitude: 6,800 feet.

D. Wind:

1. Maximum sustained: 45 knots.

2. Maximum gust: 60 knots.

1.07 PERFORMANCE REQUIRMENTS

A. Hardware:

1. The PLC’s shall communicate with the workstation, server, and radios via Modbus TCP/IP.

2. Radio shall communicate in accordance with Section 27 01 01 – Radio Equipment.

3. The system shall communicate with a contractor provided view only station located at NTUA headquarters.

4. The PLC's shall communicate with the pumps and butterfly valves via Modbus.

   a. The master shall be setup to query for status of the valves and pumps continuously.

5. All input signals inputs shall terminate in the Shared I/O Termination Cabinet as shown on drawing 1695-D-284.

   a. Signal splitters shall be utilized to provide both COG and NTUA connection to an analog point.

   b. A common redundant 24 VDC power supply located inside the I/O Termination Cabinet shall provide power for all discrete signals.

   c. All shared points need to have an individual termination block so that disconnection from COG or by NTUA will not interrupt either connected system.

6. Determine the size and ratings of the following:

   a. Fuses.

   b. Power supplies.

   c. Surge suppression devices.

   d. Uninterruptable Power Supply (UPS).

7. Environmental Controls:

   a. Furnish circulation fans in solid state control system enclosures.

   b. Over-temperature switches shall be utilized to provide special cooling if required to maintain operating temperatures within the manufacturer's specified range.

8. Where the PLC is utilized to control multiple systems of equipment, the PLC components (I/O modules, power supplies, etc.) shall be assigned so that the failure of any one component does not affect equipment on all systems.

9. The system memory must be easily expandable for future expansion of the SCADA system data.

10. Failure of any PLC, remote I/O hardware, or network communication link must be individually alarmed at HMIs.

11. Any additional equipment not specified in these specifications but necessary to make the system complete and operational shall be provided by the Contractor at no cost to the Government.

B. Software:

1. Section 25 00 02 – Programmable Controller describes the general concept of the water supply system. The Contractor shall develop detailed software based on

process control drawings, these specifications, and design coordination meetings to make a fully functional water supply system.

2. Drawings 1695-D-282 and 1695-D-306 give a general overview and tank level control setpoints.

3. Control of programs: Protect access to PLC program loading with password protection or with locked, key operated selector switches.

4. Design PLC system with high noise immunity to prevent occurrence of false logic signals resulting from switching transients, relay, and circuit breaker noise or conducted and radiated radio frequency interference.

5. Provide all software not mentioned specifically, but essential for the system to meet all the functional requirements. The Contractor is responsible for determining what additional information may be required to complete the configuration tasks, and for obtaining this information from the COR.

6. All Contractor generated software shall be provided with extensive documentation and descriptions listed within the software for turnover. This shall include a description for each rung.

7. The HMI screens shall display the status of all system processes tied into the control and monitoring system. This includes all processes controlled via the master PLC, and all water conveyance processes.

8. The HMI screen shall match at both Tohlakai Pumping Plant and Fort Defiance monitoring station.

9. The Contractor shall design all displays, which shall be subject to Government's review and approval. The Contractor shall submit color hard copies of each applicable HMI screen. It is anticipated that a minimum number of 10 screens will be required.

10. The Contractor shall provide the following access levels in the software:

    a. Status access:

        1) Access at:

            a) Operator's workstation located at Tohlakai Pumping Plant.

            b) Operator's workstation located at Fort Defiance.

        2) View only access to all plant displays and trends.

        3) No access to process control or alarm acknowledgment.

    b. Operator access:

        1) Access via operator's workstation only.

        2) Access to all plant displays, trends, process control and alarm acknowledgement.

    c. Administrator:

        1) Access via operator's workstation or plant server.

2) Access to all plant displays, trends, process control and alarm acknowledgement.

3) Access to view and modify SCADA software.

C. Incorporate the following minimum safety measures.

1. Watchdog function to monitor:

a. Internal processor clock failure.

b. Processor memory failure.

c. Loss of communication between processor and I/O modules.

d. Processor ceases to execute logic program.

2. Safety function wiring: Emergency shutdown switches shall not be wired into the controller.

3. Initial safety conditions:

a. Utilize program module to dictate output states in a known and safe manner prior to running of control program.

b. Utilize program each time PLC is re-initiated and the control program activated.

4. Monitoring of internal faults and display:

a. Internal PLC system status and faults shall be monitored and displayed.

1) Monitored items shall include:

a) Memory ok/loss of memory.

b) Processor ok/processor fault.

c) Scan time overrun.

5. Operator intervention:

a. Logic system failure shall not preclude proper operator intervention.

1) Safety shutdown of equipment or a system shall require manual operator intervention before the equipment or system operation may be reestablished.

1.08 DESIGN COORDINATION MEETINGS

A. Conduct a minimum of three design coordination meetings with both the Contractor and Government in attendance.

1. Two design coordination meeting will be held at the Governments facilities in Farmington, NM or mutually agreed upon location.

2. One design coordination meeting will be held at the construction site or mutually agreed upon location.

B. Conduct monthly design coordination conference calls with both the Contractor and Government in attendance.

C. The purpose of the meetings will be to discuss coordination issues, programming and control logic algorithms, specific details of the plant operation, report generation, and HMI screen configurations.

D. Design coordination meetings shall be scheduled at a mutually agreed upon date.

E. The Contractor is responsible for providing all equipment and paperwork needed for review and discussion of the design coordination subjects.

F. Any additional meetings shall be mutually agreed upon.

1.09 EXTRA MATERIALS

A. Spare Parts:

1. Provide minimum 20 percent spare parts for the following:
    a. Fuses.
    b. Disconnecting terminal blocks.
    c. Transient protection modules.
    d. Analog signal splitters.
    e. Power supplies.
2. One spare printer toner cartridge.
3. Spare parts shall be identical and interchangeable with similar parts furnished under this specification.
4. Spare parts shall be packed in containers suitable for long term storage.
5. Spare parts shall bear labels clearly designating the contents of equipment or components for which they are intended.
6. Recommended spare parts list applicable to all equipment furnished under these specifications. List shall include name of each part, component, module, or printed circuit card; item part number, manufacturer's name and address, quantity recommended, and approximate price (current at time list is prepared) of each item.

PART 2 PRODUCTS

2.01 PLANT SERVER

A. Rack-mounted chassis, server class computer, set-up to run SCADA, Historical, and Web server software as specified in this contract.

B. Processor:

1. Sized to provide for all features required under this contract.
2. 50 percent, minimum, of central processor and I/O time shall be available for future processing tasks.
3. Fastest processor available at time of purchase.

C. Main Memory:

1. Ram: 8GB, minimum.

D. Operating System:

1. Microsoft® Windows Server® Edition, provide highest supported edition by SCADA software manufacturer.

E. Provide data storage capacity to perform the following functions:

1. Complete software backup storage.
2. Database archiving.

F. Hard Drive Configuration:

1. 1 Terabyte capacity internal redundant HDDs.
2. No single point of failure
3. RAID 1 controller.
4. Modular attached hard drives.
5. Sized to record 730 days of historical data.

G. Optical Drives: Internal DVD +/- RW Drive.

H. Networking:

1. On-Board Dual-Port Gigabit Ethernet adaptor (1/100/1000).
   a. Support TCP/IP network protocols.
2. Two serial ports.

I. Video Card:

1. VGA and DVI outputs.
2. 1600x1200 pixels.

J. Rack-mount Monitor:

1. 20-inch monitor.
2. 1600x1200 pixels.
3. Integrated keyboard and mouse.

K. Power Supply:

1. 120 VAC, 60-hertz.
2. Redundant power supplies.
3. Hot-swappable.

L. Other Software:

1. Microsoft® Office Professional Suite.
2. Adobe® Acrobat Professional.
3. Antivirus.
4. SCADA software suite.

M. Provide a means of accessing software installed on the plant server from operator workstation computer for personnel with administrator level access.

2.02 OPERATOR WORKSTATIONS

A. Tower chassis computer, set-up to run operator interface software as specified in this contract.

B. Processor:

1. Sized to provide for all features required under this contract.
2. 50 percent, minimum, of central processor and I/O time shall be available for future processing tasks.
3. Fastest processor available at time of purchase.

C. Hard Drive Configuration:

1. 1 Terabyte capacity internal HDD.

D. Main Memory:

1. Ram: 8GB, minimum.

E. Optical Drives: Internal DVD +/- RW Drive.

F. Operating System:

1. Microsoft® Windows, provide highest supported edition by SCADA software manufacturer.

G. Networking:

1. On-Board Dual-Port Gigabit Ethernet adaptor (1/100/1000).
   a. Support TCP/IP network protocols.
2. Two serial ports.

H. Video Card:

1. Dual DVI outputs.
2. 1600x1200 pixels.

I. Monitors:

1. Dual 20-inch monitors.
2. 1600x1200 pixels.

J. Input Devices:

1. USB keyboard.
2. USB mouse.

K. Power Supply:

1. 120 VAC, 60-hertz.

L. Other Software:

1. Microsoft® Office Professional Suite.
2. Adobe® Acrobat Professional.
3. Antivirus.
4. SCADA software client.
5. Software auto dialer.

M. Sound card.

N. Speakers.

O. Uninterruptable Power Supply (UPS):

1. Type: Stand-alone tower.
2. Minimum status display:
3. On line.
4. On battery.
5. Overload.
6. Input voltage: 120 volts, 60-hertz.
7. Output voltage: 120 volts, 60-hertz.
8. Sized to provide 30 minutes of power for the Operators Workstation.

2.03 SCADA SOFTWARE

A. Vijeo Citect software as manufactured by Schneider-Electric; or Wonderware HMI/SCADA software as manufactured by Invensys Incorporated, Lake Forest, CA, Website: www.wonderware.com; or equal, having the following essential characteristics:

B. General:

1. The software shall be an off the shelf software suite containing a minimum of the following programs: human machine interface (HMI) server/client software, Alarm and Events, Historical database, report generation, and a web server.
2. The software shall be compatible with Microsoft Windows Server, Windows XP Professional, and Windows 7 Professional operating systems.
3. The software shall be of a server-client type, with distributed networking and synchronization.
4. The software shall have an open architecture which allows for interaction with other software programs not of the same manufacturer.
5. The software shall be easily modified and expanded.
6. The software licenses shall allow for an unlimited number of graphic displays and operator logins.
7. The software shall be licensed to collect all plant I/O points and tags, plus 200 percent for future expansion.
8. The software shall be a field proven, real-time system.
9. HMI software:
    a. Shall utilize object oriented software, such that the objects will represent real world devices such as PID loops, Motors, Pumps, Valves, and etc.
    b. Critical plant status and alarms shall be displayed.
    c. Any control operation shall normally be accomplished through use of the keyboard and mouse.
    d. Graphics Display: Shall include world-coordinate system (WCS) which permits multiple windows display, zooming, panning, and decluttering.
    e. Date display: Display date in form of “YYYY-MM-DD” on every format.
    f. Time display: Display time of day in form “hours:minutes:seconds” on every format. Update time display automatically once every second.
    g. Page title: Each format shall have an appropriate page title.
    h. Trending:
        1) Allow for multiple analog values to be displayed in x-y format.
        2) Display both historical and real-time data directly on the same screen.

3) Allow for export of trending data to a file which is readily accessed from standard spreadsheet software.

i. Shall be licensed to a minimum of five clients.

10. Alarm and Events:

a. Allow for alarm monitoring for all discrete and analog inputs/outputs and communication links.

b. Alarms shall be color coded to the state and priority of the alarm.

c. Alarms shall indicate acknowledged alarms, unacknowledged alarms, and unacknowledged alarms which have returned to normal.

11. Historical Database:

a. Data shall be able to be archived for long-term storage and retrieval.

b. Historical data of less than 90 days shall be stored in a format readily accessible to HMI and Web Server software.

c. The system shall be capable of logging all system activity, such as operator login, operator action, and system errors.

d. Historical database will receive and process all field data.

12. Report Generation:

a. Base bid on the generation of the following reports:

1) Formatted reports.

a) Each report shall contain daily, weekly, and monthly average calculated values.

b) Each report shall contain up to 20 measured parameters.

2) List of all entries initiated by operator including the following:

a) Console key changes.

b) Beginning and final values of setpoint and output changes.

c) Mode changes (i.e., auto to manual).

d) Time change was made.

3) Event list:

a) Description of selected events.

b) Time of event.

b. Custom report capabilities:

1) User configurable.

2) Contain selected information from any log, event, or alarm list.

3) Capable of producing custom log report for periodic and on-demand printing of a list of process or calculated variables.

4) Reports shall not require software programming by the user to setup.

c. Control of programs:

Protect access to configuration via password protection.

2.04 INDUSTRIAL NETWORK SWITCH(S)

A. Industrial, managed Ethernet switch.

B. Physical Features:

1. Copper ports:
   a. Twelve 10/100BaseTX, RJ-45, minimum.
2. Fiber ports: two 100BaseFX, single-mode 1310nm, ST connectors.
3. Status indicators on each port.
4. Power: redundant inputs.
5. Enclosure: Metal case.

C. Network Features:

1. IEEE 802.3 compliance.
2. IEEE 802.3af/at compliance.
3. Full/Half Duplex operation on all ports.
4. 100-Mbps throughput, minimum.

2.05 ROUTER

A. Provide industrial router with integrated firewall and VPN.

B. Physical Features:

1. 4 - 10/100BaseT Ethernet ports, minimum.
2. Ports:
   a. WAN: 1 RJ-45.
   b. LAN: 1 RJ-45.
3. Power: redundant inputs.
4. Metal Enclosure.

C. Network Features:

1. Ethernet.
2. IP Routing.

3. Stateful Firewall, NAT.
4. IPSec VPN encryption.
5. SNMP and Web based management.

2.06 NETWORK PRINTER

A. Color laser printer.

B. No less than 25 pages per minute, single-sided.

C. Print Quality:
1. 1200 X 600 dpi, minimum.

D. Communication ports, minimum:
1. USB 2.0.
2. 10/100BaseTX Ethernet.

E. Media:
1. Plain Paper:
a. 8-1/2- by 11-inch.
b. 11- by 17-inch.

2.07 PLANT CONTROL CABINETS

A. Designation: Single Door Floor-Standing.

B. NEMA 250, Type 12.

C. Size: 72 inches x 36 inches x 24 inches (H x W x D).

D. Constructed of sheet metal no lighter than 12-gauge.

E. Seams continuously welded and ground smooth; no holes or knockouts.

F. Continuous hinge on door.

G. Finish:
1. Manufacturer’s standard coating.

H. Back panel.

I. Ventilation kit.

J. Light kit.

2.08 INDUSTRIAL NETWORK CABINET

A. 19-inch standard size.

B. 42U minimum.

C. Lockable.

D. Mesh cooling design.

E. Built-in utility outlets to plug into UPS.

2.09 DC POWER SUPPLY

A. Type:

1. Switch-mode power supply.
2. Din-Rail mountable.

B. Input Voltage: 100-240 VAC.

C. Output Voltage: 24 VDC plus-and-minus 1 percent.

D. Output Current: 5 Amps, minimum.

E. Connection Type: Screw clamp.

F. Operating Temperature Range: -20 degrees Celsius to 60 degrees Celsius.

2.10 UPS DEDICATED RECEPTACLE STRIP

A. Provide adequate receptacles for each enclosure.

B. Voltage: 120 volts, 60-hertz.

C. Current: 20 amperes.

D. UL listed.

2.11 SCADA CABINET UNINTERUPTABLE POWER SUPPLY (UPS)

A. Type: Tower.

B. Minimum status display and outputs to Plant PLC:

1. On line.
2. On battery.
3. Overload.
4. Replace battery.

C. UPS trouble output to Plant PLC.

D. Input voltage: 120 volts, 60-hertz.

E. Output voltage: 120 volts, 60-hertz.

F. Batteries:

1. Leak-proof.
2. Hot-swappable, user replaceable.
3. Maintenance-free sealed Lead-Acid battery with suspended electrolyte.

G. Sized to provide at least 200 percent of full load current for all the following equipment inside the SCADA cabinet and inside the Network Cabinet for at least 30 minutes:

1. Everything inside SCADA equipment cabinet.
2. Power supplies in Shared Termination Cabinet
3. SCADA server.
4. All networking equipment.
5. All fiber equipment.
6. Security and Surveillance System.
7. Telephone System.

2.12 FIBER BYPASS UNIT

A. Provide an optical fiber bypass unit.

B. Physical Features:

1. Fiber ports:
   a. Two channel 100BaseFX, single-mode 1310nm, ST connector, minimum.
2. Power: redundant 24 VDC inputs.
3. Low power consumption.
4. Optical Switching Time: 10 ms, maximum.
5. Enclosure: Metal case.

2.13 OPERATOR'S CONSOLE

A. Provide two operator's workstations:

1. Installed inside the Control Room as shown on drawing 1695-D-109.
2. Installed at Fort Defiance office as designated by COR.

B. Operator's console shall be of a heavy duty construction for use in industrial applications.

C. Sized to accommodate system control and monitoring equipment provided under this section and the surveillance monitoring equipment provided under Specifications Section 25 02 01 - Security and Surveillance Equipment.

2.14 ENCLOSURE WIRE

A. Insulated conductors used to connect components external to enclosure are in accordance with Section 26 05 10 – Conductors and Cables and Section 27 15 00 - Communications Cabling.

2.15 FABRICATION

A. Internal Wiring:

1. Wire system control and monitoring enclosure as shown on Drawings:
   a. 1695-D-284.
   b. 1695-D-305.
2. Provide wiring duct system with removable covers for performing wiring within enclosure.
3. Install with wiring duct covers accessible for removal and replacement.
4. Do not attach wiring to duct system covers.
5. Wiring within ducts shall be accessible for operation, maintenance, removal, and replacement.
6. Design wiring duct system with capacity to wire all devices, present and future that can practicably be mounted in enclosure.

B. Wire Connections:

1. Make connections at device terminals or terminal blocks. Maximum two wires per termination point.
2. Install incoming 120-volt branch circuits on adjacent terminal block terminals.
3. Install ring tongue connectors for terminations at terminal blocks and electrical devices. Use pin-type terminal connectors where use of ring tongues is not practical such as terminations at selector switches, pushbuttons, indicating lamps, and auxiliary relays.
4. Do not terminate wire without terminal connector.
5. Wire splices are not acceptable.

C. Terminal Blocks:

1. Arrange terminal blocks to segregate signal types and account for spare space.
2. Arrange terminal blocks to allow external cabling to be supported.

3. Mount terminal blocks at least 3 inches from panel edges and other devices. Mount adjacent rows of terminal blocks with 12 inches separation minimum. Access to front of terminal blocks shall be unobstructed.
4. Machine lettered terminal numbers on terminal block marking strips. Do not use hand lettering.
5. Identify vertical columns of terminal blocks with a single letter such as “A”, “B”, or “C”. Vertical columns may contain more than 12 termination points.
6. Terminals:
    a. Binding-head or washer-head screws with serrated or grooved contact surfaces.
    b. Spring-clamp type terminal blocks are not acceptable.
7. Voltage rating: 300 Volts.
8. Current rating: 20 Amps.
9. Analog Inputs shall be of disconnecting switch type terminal blocks.

D. Cable and Wire Identification:
1. Color: White.
2. Install wire markers on conductor end.
3. Print conductor designation first followed by conductor destination and terminal number.
4. Lettering: Machine typed. Do not print wire markers by hand.

E. DIN Rail Disconnects: Provide disconnect for each 120 Volt circuit entering enclosure.

F. 4-20 mA Signal Splitters: Provide signal splitters for each 4-20 mA analog signal entering enclosure.

G. Fuse Block and Fuses:
1. Type: Finger-Safe terminal block.
2. DIN-Rail mountable.
3. Fuse:
    a. Rated for size required.
    b. 250 Volts, current limiting.

H. Ground Bus:
1. Material: Copper.
2. Size: Sufficient to attach equipment ground conductors.
3. Length: Sufficient to attach equipment ground conductors plus 20 percent spare.

4. Insulated mounting bracket.

2.16 SURGE SUPPRESSION

A. 4- to -20 mA Transient Protection Modules:

1. Triple stage hybrid protection.
2. Surge Current (8/20 microsecond wave form): 10 kA, minimum.
3. Clamping Voltage: 30 VDC.
4. Response Time: Less than 5 nanoseconds.
5. Throughput Resistance: 12 Ohms, maximum.
6. Automatically resets after each transient.

B. Line Voltage Surge Protection Device:

1. Rated Voltage: 120-volt, 60-hertz.
2. Rated Current: 15 amperes.
3. Single-phase service.
4. Surge Current (8/20 microsecond wave form): 10 kA, minimum.
5. Clamping Voltage: 270 volts.
6. Maximum Continuous Operating VAC (MCOV): 115 percent rated line voltage.
7. Response Time: Less than 5 nanoseconds.
8. Modes of Protection: L-N, L-G, N-G.
9. Automatically resets after each transient.

C. For automation equipment in outdoor enclosures, surge suppression is required for all power supply inputs and wiring leaving the enclosure, including digital I/O, analog I/O, and communication wiring.

2.17 NAMEPLATES

A. Attach nameplate to enclosure with self-tapping screws. Use of adhesives for attaching nameplates is not acceptable.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer’s recommendations, with suitable and secure fasteners.

B. Install PLC equipment inside the SCADA equipment cabinet in the Control Room as shown on drawing 1695-D-284.

C. Install networking and SCADA equipment inside the Network Cabinet in the Control Room as shown on drawing 1695-D-284.

D. Terminate all hardwired I/O from plant within the Shared I/O Termination Cabinet as shown on drawing 1695-D-284.

1. Segregate I/O by type and for ease of connection from both COG and NTUA PLC terminations.

2. Separate I/O by equipment type.

E. All connections shall be made to place the control and monitoring system into operation.

F. Line power for all control and monitoring equipment shall be supplied from the Contractor provided UPS system(s).

G. All networking cabling shall provide a designated and easily identified to-and-from location marker at each end of the cable.

H. Make cable and conduit connections. Use watertight conduit hubs for conduit connections.

I. Make grounding and bonding connections in accordance with Section 26 05 20 – Grounding and Bonding and NFPA 70.

J. Control Cable and Wire Identification: In accordance with Section 26 05 10 – Conductors and Cables and Section 27 15 00 – Communications Cabling.

K. Provide all software and associated programming/configuration required to meet performance requirements of the Contract Documents.

1. At substantial completion of the Project:

a. Turn current licenses for all software over to the Government in the Bureau of Reclamation’s name and install the latest version, upgrade or service pack for all software.

2. Provide the respective software supplier's Comprehensive Support Contract for all software covering a full one year warranty period following substantial completion which shall provide no cost software upgrades, service packs and tech support from the software supplier.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Perform field wiring checkout and test in accordance with Section 26 05 90 – Wiring Checkout and Tests.

B. Perform system testing in accordance with Section 25 08 10 – Automation System Testing, Acceptance, and Training.

3.03 TRAINING

A. Perform system training in accordance with Section 25 08 10 – Automation System Testing, Acceptance, and Training.

END OF SECTION

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SECTION 25 00 02

PROGRAMMABLE CONTROLLER

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Installing and Programming Government-Furnished Controller:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1.	ANSI - ISO/IEC 9797-1999	Information Technology - Security Techniques Message Authentication Codes
2.	ISO/IEC 13817-1	Information Technology - Programming Languages, Their Environments and System Software Interface

B. International Organization for Standardization (ISO)

1.	ISO 17799-2000	Information Technology - Code of Practice for Information Security Management

C. National Fire Protection Association, Inc. (NFPA)®

1.	NFPA 70 – 2011	National Electrical Code (NEC)®

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 – Electrical Drawings and Data.

B. Drawings and data in sufficient detail to show full compliance with this specification and applicable codes.

C. RSN 25 00 02-1, Approval Drawings:

1. Layout drawings.
2. Wiring drawings.
3. Schematic drawings.

D. RSN 25 00 02-2, Approval Data:

1. Software overview drawings and descriptions.
2. Data flow chart.

E. RSN 25 00 02-3, Final Drawings, Documentation, and Operations and Maintenance Manuals:

1. Include:

a. Final drawings of all approved and provided layouts, schematic diagrams, and wiring diagrams including "as-built" changes.

b. Final version of approved software documentation including "As-built" changes.

c. Operations and Maintenance Manuals.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Handle and store programmable controllers in accordance with manufacturer's instructions. Include copy of these instructions with equipment at time of shipment.

1.05 PERFORMANCE REQUIREMENTS

A. Function:

1. Monitoring and/or control of pumps, butterfly valves, tank levels, instruments, chlorination system, security system, and fire system.

2. The pump control strategy attempts to operate the pumping plant pumps at their maximum efficiency by maintaining a water supply through Reach 12.1/12.2.

3. Provide tank level control signal to the Twin Lakes pumping facility.

B. Programmable Logic Controllers (PLC):

1. Pumping plant PLC.

a. Remote I/O:

1) 12.1 Air chamber PLC.

2) 12B Air chamber PLC.

2. Chlorine system PLC.

a. Remote I/O:

1) Chlorine Building PLC.

3. Twin Lakes Pumping Facility.

C. PLC Functions:

1. Remote manual and remote auto control of pumps and butterfly valves.

2. Lockout control for all pumps that will shutdown the pump when running in local or remote mode.

3. Provide lockout control to the Twin Lakes pumping facility.

4. Calculate motor run time.

5. Calculate pump unit time between starts.
6. Provide pump control in accordance with Section 33 16 14 – Air Chambers.
7. Provide control of chlorine system in accordance with Section 46 31 10 – Chlorine Disinfection System.

D. Level and Flow Monitoring:

1. Monitor level in the upstream tank (Tank 1) and the downstream tank (Blackhat tank).
2. Monitor flow rate through gravity feed on Reach 12B, pumped flow through Reach 12.1/12.2, and flow to Twin Lakes turnout.
3. High and low alarms for each level and flow measurement.

E. Manifold Pressure Monitoring:

1. Monitor manifold pressures on plants suction and discharge lines.
2. Monitor pump manifold pressure before and after each pump for plant manifold pressure comparison to provide valve malfunction indication.
3. High and low alarms for each pressure.
4. Valve malfunction alarm if pressure on the plant suction and discharge lines does not match the pressures at each pump.

F. Plant Facility Control:

1. Monitor fire panel.
2. Monitor security intrusion system.
3. Large alarm display on HMI screen for any fire or security alarm that would easily get the attention of an operator at the fort Defiance control room.
4. Status alarms for the UPS system(s).
5. Status alarms for SCADA equipment malfunctions.

G. Multiple Pump Start Interlock:

1. Provide software interlock with an operator adjustable time delay to ensure that only one pump is called to run at a time.
2. Provide an operator adjustable time delay to enable the next pump to run when start conditions have been satisfied for more than one pump.
3. Provide a user adjustable interlock to determine the number of pumps allowed to run.

H. Pump Alternator Control:

1. Sequence control for pumps so that the operator can assign the start and stop sequence for each of the 3 pumps.

2. If a running pump fails, or a pump fails to start when called, call the next pump in the sequence.
3. Provide operator adjustable start and stop level setpoints to be adjusted in elevation units for both the upstream tank and downstream tank.
4. If downstream tank is below an adjustable level setpoint and the upstream tank is above an adjustable level, the next pump in the sequence shall be called to start.
5. Provide operator adjustable pump alternator to equalized run time on available pumps.

I. Pump Start Interlock:

1. Upstream tank level above low water level elevation setpoint.
2. Downstream tank level below high level elevation setpoint.
3. Plant inlet manifold pressure OK.
4. Air chamber not in Lockout.
5. One 12.1 Air chamber isolation valve is full open.
6. Valve 1 is full open.
7. Valve 2 is full closed.
8. Valve 4 is full open, Pump 1 only.
9. Check mechanical seal water pressure OK.

J. Operation Procedure:

1. Filling line 12.1/12.2 to Blackhat tank, Pump 1 only:
   a. Manual control only.
2. Normal/Auto Start-up:
   a. Verify Pump Start Interlock is met.
   b. Start Pump.
   c. Soft Start bypass contactor ON.
   d. Open valve 2.
3. Normal/Auto Shutdown:
   a. Close valve 2.
   b. Valve 2 is full closed.
   c. Stop Pump.

K. Design the software to allow three pumps to operate. Disable software portion for the third unit operation.

1.06 DESIGN COORDINATION MEETINGS

A. In accordance with Section 25 00 01 – System Control and Monitoring.

B. The intention of the design conferences are to determine any hardware, software, or compatibility issues with the government furnished controllers.

PART 2 PRODUCTS

2.01 GOVERNMENT FURNISHED PROGRAMMABLE CONTROLLER

A. In accordance with 01 64 40 – Government-Furnished Products.

B. The Modicon M340 Programmable Automation Controller PAC/PLC with accessories shall meet the following requirements:

1. Din rail:
    a. Chassis.
    b. 24 VDC Power Supply.
2. 20 percent spare I/O capacity.
3. Ethernet capable.
4. Remote I/O chassis for Chlorination building ruggedized for outside atmospheric conditions.
5. Remote I/O chassis' for Air Chamber Control ruggedized for outside atmospheric conditions.

2.02 INTERPOSING RELAYS

A. Type: General Purpose Relay.

B. Double-Pole, Double-Throw (DPDT).

C. Contact Rating: 10 Amps, 120 VAC/DC, minimum.

D. Coil Voltage: 24 VDC or 120 VAC, as required.

2.03 INSULATED CONDUCTORS

A. Insulated conductors used to wire the programmable controllers shall be in accordance with the requirements of Section 26 05 10 – Conductors and Cables and Section 27 15 00 – Communications Cabling.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install programmable controller in the SCADA equipment cabinet at eye level. See drawing 1695-D-284.

B. Install remote I/O chassis in the Chlorination building fire panel enclosure as shown on drawing 1695-D-238.

C. Remote I/O chassis' shall be installed in air chamber control panel as shown on drawing 1695-D-249.

D. Install Twin Lakes facility programmable controller at a location designated by the COR and in accordance with Section 26 27 16 – Electrical Cabinets and Enclosures.

E. Make all connections to place the programmable controllers into operation.

F. For connections to the programmable controllers which run outside the pumping plant building, surge suppression is required, including digital and analog I/O.

G. Drawings 1695-D-313 through -326 show the intended rack layout and wiring connections. The contractor is responsible for determining the final installed layout, wiring connections and schematic diagrams based on field installed equipment and design coordination meetings.

H. Each signal in the pumping plant shall be terminated in the shared I/O cabinet such that the signal is shared between two PLC's. The disconnection of a signal going to one PLC shall not disturb the signal going to the other PLC.

I. Power for the programmable controller shall be available from a rack mounted power supply from the uninterruptable power supply UPS.

J. I/O wiring shall be made from the shared Termination Cabinet to terminal blocks in the SCADA equipment cabinet.

K. Make wire between the SCADA equipment cabinet terminal blocks and the programmable controller's field wiring arms with NEC type SIS No. 18 AWG switchboard wire.

L. Make cable and conduit connections. Use watertight conduit hubs for conduit connections.

M. Make grounding and bonding connections in accordance with Section 26 05 20 – Grounding and Bonding and NFPA 70.

N. Control Cable and Wire Identification: In accordance with Section 26 05 10 – Conductors and Cables.

O. Input/Output Lists:

Location	Description	Type	Signal
Air Chamber 12.1	Air Chamber 12.1A High Water LO	DI	120 VDC
Air Chamber 12.1	Air Chamber 12.1A Low Water LO	DI	120 VDC
Air Chamber 12.1	Air Chamber 12.1A Valve Full Open	DI	120 VDC
Air Chamber 12.1	Air Chamber 12.1A Valve Full Close	DI	120 VDC
Air Chamber 12.1	Air Chamber 12.1A Compressor Running	DI	120 VDC
Air Chamber 12.1	Air Chamber 12.1B High Water LO	DI	120 VDC
Air Chamber 12.1	Air Chamber 12.1B Low Water LO	DI	120 VDC
Air Chamber 12.1	Air Chamber 12.1B Valve Full Open	DI	120 VDC
Air Chamber 12.1	Air Chamber 12.1B Valve Full Close	DI	120 VDC
Air Chamber 12.1	Air Chamber 12.1B Compressor Running	DI	120 VDC
Air Chamber 12.B	Air Chamber 12.BA High Water LO	DI	120 VDC
Air Chamber 12.B	Air Chamber 12.BA Low Water LO	DI	120 VDC
Air Chamber 12.B	Air Chamber 12.BA Valve Full Open	DI	120 VDC
Air Chamber 12.B	Air Chamber 12.BA Valve Full Close	DI	120 VDC
Air Chamber 12.B	Air Chamber 12.BA Compressor Running	DI	120 VDC
Air Chamber 12.B	Air Chamber 12.BB High Water LO	DI	120 VDC
Air Chamber 12.B	Air Chamber 12.BB Low Water LO	DI	120 VDC
Air Chamber 12.B	Air Chamber 12.BB Valve Full Open	DI	120 VDC
Air Chamber 12.B	Air Chamber 12.BB Valve Full Close	DI	120 VDC
Air Chamber 12.B	Air Chamber 12.BB Compressor Running	DI	120 VDC
Chlorine Sys: Feed Bldg	CL2BLDG Tank 1 Weight	AI	4-20 mA
Chlorine Sys: Feed Bldg	CL2BLDG Tank 2 Weight	AI	4-20 mA
Chlorine Sys: Feed Bldg	CL2BLDG Tank 3 Weight	AI	4-20 mA
Chlorine Sys: Feed Bldg	CL2BLDG Tank 4 Weight	AI	4-20 mA
Chlorine Sys: Feed Bldg	CL2BLDG Tank 5 Weight	AI	4-20 mA
Chlorine Sys: Feed Bldg	CL2BLDG Tank 6 Weight	AI	4-20 mA
Chlorine Sys: Feed Bldg	CL2BLDG FeedRm CL2Gas Level	AI	4-20 mA
Chlorine Sys: Feed Bldg	CL2BLDG StorArea CL2Gas Level	AI	4-20 mA
Chlorine Sys: Feed Bldg	CL2BLDG Tank 1 Leak	DI	24 VDC
Chlorine Sys: Feed Bldg	CL2BLDG Tank 2 Leak	DI	24 VDC
Chlorine Sys: Feed Bldg	CL2BLDG Tank 3 Leak	DI	24 VDC
Chlorine Sys: Feed Bldg	CL2BLDG Tank 4 Leak	DI	24 VDC
Chlorine Sys: Feed Bldg	CL2BLDG Tank 5 Leak	DI	24 VDC
Chlorine Sys: Feed Bldg	CL2BLDG Tank 6 Leak	DI	24 VDC
Chlorine Sys: Feed Bldg	CL2BLDG SwOvr T1T2 Full Open	DI	24 VDC
Chlorine Sys: Feed Bldg	CL2BLDG SwOvr T1T2 Full Close	DI	24 VDC
Chlorine Sys: Feed Bldg	CL2BLDG SwOvr T3T4 Full Open	DI	24 VDC
Chlorine Sys: Feed Bldg	CL2BLDG SwOvr T3T4 Full Close	DI	24 VDC
Chlorine Sys: Feed Bldg	CL2BLDG SwOvr T5T6 Full Open	DI	24 VDC
Chlorine Sys: Feed Bldg	CL2BLDG SwOvr T5T6 Full Close	DI	24 VDC
Chlorine Sys: Feed Bldg	CL2BLDG Feed Room CL2Gas Alarm	DI	24 VDC
Chlorine Sys: Feed Bldg	CL2BLDG StorArea CL2Gas Alarm	DI	24 VDC
Chlorine Sys: PumpingPlant	CL2PP Pipeline 12.1 Feed Ctlr 1	AI	4-20 mA
Chlorine Sys: PumpingPlant	CL2PP Pipeline 12.1 Feed Ctlr 2	AI	4-20 mA
Chlorine Sys: PumpingPlant	CL2PP Pipeline 12.B Feed Ctlr 1	AI	4-20 mA

Location	Description	Type	Signal
Chlorine Sys: PumpingPlant	CL2PP Pipeline 12.B Feed Ctlr 2	AI	4-20 mA
Chlorine Sys: PumpingPlant	CL2PP Pipeline 12 Feed Ctlr 1	AI	4-20 mA
Chlorine Sys: PumpingPlant	CL2PP Pipeline 12 Feed Ctlr 2	AI	4-20 mA
Chlorine Sys: PumpingPlant	CL2PP Pre-Storage CL2 Residual	AI	4-20 mA
Chlorine Sys: PumpingPlant	CL2PP Post-Storage CL2 Residual	AI	4-20 mA
Chlorine Sys: PumpingPlant	CL2PP 12.B Pipeline CL2 Residual	AI	4-20 mA
Chlorine Sys: PumpingPlant	CL2PP 12.1 Pipeline CL2 Residual	AI	4-20 mA
Chlorine Sys: PumpingPlant	CL2PP 12.1 Water Flow Totalizer	AI	4-20 mA
Chlorine Sys: PumpingPlant	CL2PP 12.B Water Flow Totalizer	AI	4-20 mA
Chlorine Sys: PumpingPlant	CL2PP 12 Water Flow Totalizer	AI	4-20 mA
Chlorine Sys: PumpingPlant	CL2PP 12.1 Water Supply Full Open	DI	24 VDC
Chlorine Sys: PumpingPlant	CL2PP 12.1 Water Supply Full Close	DI	24 VDC
Chlorine Sys: PumpingPlant	CL2PP 12.B Water Supply Full Open	DI	24 VDC
Chlorine Sys: PumpingPlant	CL2PP 12.B Water Supply Full Close	DI	24 VDC
Chlorine Sys: PumpingPlant	CL2PP Pre-storage Water Supply Full Open	DI	24 VDC
Chlorine Sys: PumpingPlant	CL2PP Pre-storage Water Supply Full Close	DI	24 VDC
Chlorine Sys: PumpingPlant	CL2PP 12.1 Water Supply Valve Fail	DI	24 VDC
Chlorine Sys: PumpingPlant	CL2PP 12B Water Supply Valve Fail	DI	24 VDC
Chlorine Sys: PumpingPlant	CL2PP Pre-storage Water Supply Valve Fail	DI	24 VDC
Chlorine Sys: PumpingPlant	CL2PP 12.1 Water Supply Open	DO	24 VDC
Chlorine Sys: PumpingPlant	CL2PP 12.1 Water Supply Close	DO	24 VDC
Chlorine Sys: PumpingPlant	CL2PP 12.B Water Supply Open	DO	24 VDC
Chlorine Sys: PumpingPlant	CL2PP 12.B Water Supply Close	DO	24 VDC
Chlorine Sys: PumpingPlant	CL2PP Pre-storage Water Supply Open	DO	24 VDC
Chlorine Sys: PumpingPlant	CL2PP Pre-storage Water Supply Close	DO	24 VDC
Plant: Air Chambers	Air Chamber Sump Lift Stn High Alarm	DI	24 VDC
Plant: Bus	DCA Bus KWH	AI	MB TCP/IP
Plant: Bus	DCA Bus Voltage	AI	MB TCP/IP
Plant: Bus	DCA Bus Undervoltage	DI	MB TCP/IP
Plant: Fire Alarm	Plant Fire System Trouble	DI	24 VDC
Plant: Fire Alarm	Plant Fire System Alarm	DI	24 VDC
Plant: FlowMtrs:	Flowmeter Reach 12.1 TotalizerA	DI	24 VDC
Plant: FlowMtrs:	Flowmeter Reach 12.1 TotalizerB	DI	24 VDC
Plant: FlowMtrs:	Flowmeter Reach 12.1 Flow Direction	DI	24 VDC
Plant: FlowMtrs:	Flowmeter Reach 12.B TotalizerA	DI	24 VDC
Plant: FlowMtrs:	Flowmeter Reach 12.B TotalizerB	DI	24 VDC
Plant: FlowMtrs:	Flowmeter Reach 12.B Flow Direction	DI	24 VDC
Plant: FlowMtrs:	Flowmeter Twin Lakes TotalizerA	DI	24 VDC
Plant: FlowMtrs:	Flowmeter Twin Lakes TotalizerB	DI	24 VDC
Plant: FlowMtrs:	Flowmeter Twin Lakes Flow Direction	DI	24 VDC
Plant: Level	Black Hat Tank Level	AO	4-20mA
Plant: Level	Tank 1 Level	AI	4-20mA
Plant: Manifolds:	Inlet Manifold 12 Pressure	AI	4-20 mA
Plant: Manifolds:	Inlet Manifold 12 Flow	AI	4-20 mA
Plant: Manifolds:	Outlet Manifold 12.B Pressure (Future)	AI	4-20 mA
Plant: Manifolds:	Outlet Manifold 12.B Flow (Future)	AI	4-20 mA
Plant: Manifolds:	Outlet Manifold 12.1 Pressure	AI	4-20 mA

Location	Description	Type	Signal
Plant: Mechanical	12.1 Mechanical Seal Water Pump On	DI	24 VDC
Plant: Motor Bus	MCE Bus 1 KWH	AI	MB TCP/IP
Plant: Motor Bus	MCE Bus 1 Voltage	AI	MB TCP/IP
Plant: Motor Bus	MCE Bus 2 KWH	AI	MB TCP/IP
Plant: Motor Bus	MCE Bus 2 Voltage	AI	MB TCP/IP
Plant: Motor Bus	MCE Bus 1 Undervoltage	DI	MB TCP/IP
Plant: Motor Bus	MCE Bus 2 Undervoltage	DI	MB TCP/IP
Plant: PLC	UPS Power Trouble	DI	24 VDC
Plant: Power Generator	Xfer Switch Normal Mode	DI	MB TCP/IP
Plant: Power Generator	Xfer Switch Emergency Mode	DI	MB TCP/IP
Plant: Power Generator	Generator Remote Test	DO	MB TCP/IP
Plant: Power Generator	Generator Remote Engine start	DO	MB TCP/IP
Plant: Power Generator	Generator Transfer Inhibit	DO	MB TCP/IP
Plant: Power Generator	Generator Re-transfer Inhibit	DO	MB TCP/IP
Plant: Unit 1 Pump	P1 Unit is Running	DI	MB RTU
Plant: Unit 1 Pump	P1 RVSS Fault	DI	MB RTU
Plant: Unit 1 Pump	P1 Unit Lockout Soft Start	DI	MB RTU
Plant: Unit 1 Pump	P1 Interlocks Bypassed	DI	MB RTU
Plant: Unit 1 Pump	P1 Auto Mode	DI	MB RTU
Plant: Unit 1 Pump	P1 Seal Water Pressure OK	DI	MB RTU
Plant: Unit 1 Pump	P1 Start/Stop	DO	MB RTU
Plant: Unit 1 Pump	P1 Start/Stop Interlock	DO	MB RTU
Plant: Unit 1 Valving	P1V1 ISO Suction Position	AI	MB RTU
Plant: Unit 1 Valving	P1V2 Control Discharge Position	AI	MB RTU
Plant: Unit 1 Valving	P1V4 ISO Discharge Position	AI	MB RTU
Plant: Unit 1 Valving	P1V5 ISO Discharge Position	AI	MB RTU
Plant: Unit 1 Valving	P1V7 ISO Discharge Position	AI	MB RTU
Plant: Unit 1 Valving	P1 Inlet Pressure Switch	DI	24 VDC
Plant: Unit 1 Valving	P1 Outlet Pressure Switch	DI	24 VDC
Plant: Unit 1 Valving	P1V1 ISO Suction Full Open	DI	MB RTU
Plant: Unit 1 Valving	P1V1 ISO SuctionFull Closed	DI	MB RTU
Plant: Unit 1 Valving	P1V1 Selector Switch in LOCAL	DI	MB RTU
Plant: Unit 1 Valving	P1V1 Selector Switch in REMOTE	DI	MB RTU
Plant: Unit 1 Valving	P1V1 Torq Sw Tripped - Open Dir	DI	MB RTU
Plant: Unit 1 Valving	P1V1 Torq Sw Tripped - Closed Dir	DI	MB RTU
Plant: Unit 1 Valving	P1V1 Valve Not Moving on Command	DI	MB RTU
Plant: Unit 1 Valving	P1V2 Control Discharge Full Open	DI	MB RTU
Plant: Unit 1 Valving	P1V2 Control Discharge Full Close	DI	MB RTU
Plant: Unit 1 Valving	P1V2 Selector Switch in LOCAL	DI	MB RTU
Plant: Unit 1 Valving	P1V2 Selector Switch in REMOTE	DI	MB RTU
Plant: Unit 1 Valving	P1V2 Torq Sw Tripped - Open Dir	DI	MB RTU
Plant: Unit 1 Valving	P1V2 Torq Sw Tripped - Closed Dir	DI	MB RTU
Plant: Unit 1 Valving	P1V2 Valve Not Moving on Command	DI	MB RTU
Plant: Unit 1 Valving	P1V4 ISO Discharge Full Open	DI	MB RTU
Plant: Unit 1 Valving	P1V4 ISO Discharge Full Close	DI	MB RTU
Plant: Unit 1 Valving	P1V4 Selector Switch in LOCAL	DI	MB RTU
Plant: Unit 1 Valving	P1V4 Selector Switch in REMOTE	DI	MB RTU

Location	Description	Type	Signal
Plant: Unit 1 Valving	P1V4 Torq Sw Tripped - Open Dir	DI	MB RTU
Plant: Unit 1 Valving	P1V4 Torq Sw Tripped - Closed Dir	DI	MB RTU
Plant: Unit 1 Valving	P1V4 Valve Not Moving on Command	DI	MB RTU
Plant: Unit 1 Valving	P1V5 ISO Discharge Full Open	DI	MB RTU
Plant: Unit 1 Valving	P1V5 ISO Discharge Closed	DI	MB RTU
Plant: Unit 1 Valving	P1V5 Selector Switch in LOCAL	DI	MB RTU
Plant: Unit 1 Valving	P1V5 Selector Switch in REMOTE	DI	MB RTU
Plant: Unit 1 Valving	P1V5 Torq Sw Tripped - Open Dir	DI	MB RTU
Plant: Unit 1 Valving	P1V5 Torq Sw Tripped - Closed Dir	DI	MB RTU
Plant: Unit 1 Valving	P1V5 Valve Not Moving on Command	DI	MB RTU
Plant: Unit 1 Valving	P1V7 ISO Discharge Full Open	DI	MB RTU
Plant: Unit 1 Valving	P1V7 ISO Discharge Full Close	DI	MB RTU
Plant: Unit 1 Valving	P1V7 Selector Switch in LOCAL	DI	MB RTU
Plant: Unit 1 Valving	P1V7 Selector Switch in REMOTE	DI	MB RTU
Plant: Unit 1 Valving	P1V7 Torq Sw Tripped - Open Dir	DI	MB RTU
Plant: Unit 1 Valving	P1V7 Torq Sw Tripped - Closed Dir	DI	MB RTU
Plant: Unit 1 Valving	P1V7 Valve Not Moving on Command	DI	MB RTU
Plant: Unit 1 Valving	P1V1 ISO Suction Open	DO	MB RTU
Plant: Unit 1 Valving	P1V1 ISO Suction Close	DO	MB RTU
Plant: Unit 1 Valving	P1V2 Control Discharge Open	DO	MB RTU
Plant: Unit 1 Valving	P1V2 Control Discharge Close	DO	MB RTU
Plant: Unit 1 Valving	P1V4 ISO Discharge Open	DO	MB RTU
Plant: Unit 1 Valving	P1V4 ISO Discharge Close	DO	MB RTU
Plant: Unit 1 Valving	P1V5 ISO Discharge Open	DO	MB RTU
Plant: Unit 1 Valving	P1V5 ISO Discharge Close	DO	MB RTU
Plant: Unit 1 Valving	P1V7 ISO Discharge Open	DO	MB RTU
Plant: Unit 1 Valving	P1V7 ISO Discharge Close	DO	MB RTU
Plant: Unit 2 Pump	P2 Unit is Running	DI	MB RTU
Plant: Unit 2 Pump	P2 RVSS Fault	DI	MB RTU
Plant: Unit 2 Pump	P2 Unit Lockout Soft Start	DI	MB RTU
Plant: Unit 2 Pump	P2 Interlocks Bypassed	DI	MB RTU
Plant: Unit 2 Pump	P2 Auto Mode	DI	MB RTU
Plant: Unit 2 Pump	P2 Seal Water Pressure OK	DI	MB RTU
Plant: Unit 2 Pump	P2 Start/Stop	DO	MB RTU
Plant: Unit 2 Pump	P2 Start/Stop Interlock	DO	MB RTU
Plant: Unit 2 Valving	P2V2 Control Discharge Position	AI	MB RTU
Plant: Unit 2 Valving	P2 Inlet Pressure Switch	DI	24 VDC
Plant: Unit 2 Valving	P2 Outlet Pressure Switch	DI	24 VDC
Plant: Unit 2 Valving	P2V1 ISO Suction Full Open	DI	24 VDC
Plant: Unit 2 Valving	P2V1 ISO Suction Full Close	DI	24 VDC
Plant: Unit 2 Valving	P2V2 Control Discharge Full Open	DI	MB RTU
Plant: Unit 2 Valving	P2V2 Control Discharge Full Close	DI	MB RTU
Plant: Unit 2 Valving	P2V2 Selector Switch in LOCAL	DI	MB RTU
Plant: Unit 2 Valving	P2V2 Selector Switch in REMOTE	DI	MB RTU
Plant: Unit 2 Valving	P2V2 Torq Sw Tripped - Open Dir	DI	MB RTU
Plant: Unit 2 Valving	P2V2 Torq Sw Tripped - Closed Dir	DI	MB RTU
Plant: Unit 2 Valving	P2V2 Valve Not Moving on Command	DI	MB RTU

Location	Description	Type	Signal
Plant: Unit 2 Valving	P2V2 Control Discharge Open	DO	MB RTU
Plant: Unit 2 Valving	P2V2 Control Discharge Close	DO	MB RTU
Plant: Unit 3 Pump	P3 Unit is Running	DI	MB RTU
Plant: Unit 3 Pump	P3 RVSS Fault	DI	MB RTU
Plant: Unit 3 Pump	P3 Unit Lockout Soft Start	DI	MB RTU
Plant: Unit 3 Pump	P3 Interlocks Bypassed	DI	MB RTU
Plant: Unit 3 Pump	P3 Auto Mode	DI	MB RTU
Plant: Unit 3 Pump	P3 Seal Water Pressure OK	DI	MB RTU
Plant: Unit 3 Pump	P3 Start/Stop	DO	MB RTU
Plant: Unit 3 Pump	P3 Start/Stop Interlock	DO	MB RTU
Plant: Unit 3 Valving	P3V2 Control Discharge Position (Future)	AI	MB RTU
Plant: Unit 3 Valving	P3 Inlet Pressure Switch (Future)	DI	24 VDC
Plant: Unit 3 Valving	P3 Outlet Pressure Switch (Future)	DI	24 VDC
Plant: Unit 3 Valving	P3V1 ISO Suction Full Open (Future)	DI	24 VDC
Plant: Unit 3 Valving	P3V1 ISO Suction Closed (Future)	DI	24 VDC
Plant: Unit 3 Valving	P3V2 Control Discharge Full Open (Future)	DI	MB RTU
Plant: Unit 3 Valving	P3V2 Control Discharge Closed (Future)	DI	MB RTU
Plant: Unit 3 Valving	P3V2 Selector Switch in LOCAL	DI	MB RTU
Plant: Unit 3 Valving	P3V2 Selector Switch in REMOTE	DI	MB RTU
Plant: Unit 3 Valving	P3V2 Torq Sw Tripped - Open Dir	DI	MB RTU
Plant: Unit 3 Valving	P3V2 Torq Sw Tripped - Closed Dir	DI	MB RTU
Plant: Unit 3 Valving	P3V2 Valve Not Moving on Command	DI	MB RTU
Plant: Unit 3 Valving	P3V2 Control Discharge Open (Future)	DO	MB RTU
Plant: Unit 3 Valving	P3V2 Control Discharge Close (Future)	DO	MB RTU
Plant: Vaults:	CL Inj Vault No.1 Water Level	DI	24 VDC
Plant: Vaults:	Valve Vault No.1 Water Level	DI	24 VDC
Plant: Vaults:	Flowmeter Vault No.1 Water Level	DI	24 VDC
Plant: Vaults:	Flowmeter Vault No.2 Water Level	DI	24 VDC
Plant:Security	Security Sys Intrusion Alarm	DI	24 VDC
Twin Lakes Facility: Pumps	Pump Enable	DO	TBD

1. Input/output lists provided above may vary by 20 percent during construction.

3.02 FIELD QUALITY CONTROL

A. Perform field wiring checkout and test in accordance with Section 26 05 90 – Wiring Checkout and Tests.

B. Perform system testing in accordance with Section 25 08 10 – Automation System Testing, Acceptance, and Training.

3.03 TRAINING

A. Perform system training in accordance with Section 25 08 10 – Automation System Testing, Acceptance, and Training.

END OF SECTION

SECTION 25 08 10

AUTOMATION SYSTEM TESTING, ACCEPTANCE, AND TRAINING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in the price offered in the schedule for System Control and Monitoring.

1.02 REFERENCE STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE C2-2007 National Electric Safety Code (NESC)

B. International Electrical Testing Association (NETA)

1. NETA ETT-2010 Certification of Electrical Testing Personnel

C. National Fire Protection Association, Inc. (NFPA)

1. NFPA 70 – 2011 National Electrical Code (NEC)

1.03 DEFINITIONS

A. FAT: Factory Acceptance Test.

B. SPAT: System Performance Availability Test.

C. OAT: On-Site Availability Test.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 25 08 10-1, FAT Procedure and Start Date.

C. RSN 25 08 10-2, FAT Test Report:

1. Certification of performance and results of the FAT.

D. RSN 25 08 10-3, SPAT Procedure and Start Date.

E. RSN 25 08 10-4, SPAT Test Report:

1. Certification of performance and results of the SPAT.

F. RSN 25 08 10-5, OAT Procedure and Start Date.

G. RSN 25 08 10-6, OAT Report:

1. Certification of performance and results of the OAT.

H. RSN 25 08 10-7, Training Plan.

PART 2 PRODUCTS

2.01 FACTORY ACCEPTANCE TEST (FAT)

A. Prior to FAT, the Contractor shall burn in the equipment for a minimum of 72 hours at 120 degrees Fahrenheit. The Contractor shall provide certification of this prior to starting the FAT.

B. Government will witness test. Notify COR in writing at least 20 days prior to the beginning of the FAT.

C. The purpose of the FAT is to demonstrate the functionality, performance and stability of the hardware and software.

D. The test shall verify that all hardware and software meet the requirements of the specifications and drawings.

E. Contractor shall not ship control and monitoring system equipment until receipt of written authorization by COR.

F. Government will provide written acceptance after the FAT to proceed to the SPAT.

PART 3 EXECUTION

3.01 SYSTEM PERFORMANCE AVAILABILITY TEST (SPAT)

A. Government will witness test. Notify COR in writing at least 20 days prior to the beginning of the SPAT.

B. The purpose of the SPAT is to demonstrate the functionality, performance and stability of the hardware and software before proceeding to the OAT.

C. Government will provide written acceptance after the SPAT to proceed to the OAT.

3.02 ON-SITE AVAILABILITY (OAT)

A. The system shall undergo a 30-day on-site availability test under full plant process operation, without a single non-field repairable hardware/software malfunction.

B. Government will furnish a discrepancy list to the Contractor 20 days after satisfactory completion of the OAT.

C. Contractor shall resolve discrepancy, deliver all required documentation and complete all other contract requirements associated with the control and monitoring system.

D. Government will provide final acceptance.

3.03 TRAINING

A. At a minimum, the training shall include the following:

1. Administrator: personnel responsible for maintaining the HMI/SCADA system.
2. Operations: personnel responsible for daily plant operations and maintaining controller hardware and instrumentation systems.

B. Administrator Training:

1. Goal: Upon completion of administrator training, administrator is capable of maintaining, updating and modifying all Contractor furnished software at a basic level.
2. The training shall cover HMI, Historian, Alarm and Events, Web access, and PLC programming software.
3. Hands-on training:
    a. Location: Pumping Plant Facility.
    b. Sessions: 3, minimum.
        1) Following SPAT and prior to OAT.
            a) At a mutually agreed upon date.
            b) Duration: At least 3 work days.
            c) Number of trainees: 3.
        2) Following OAT.
            a) At a mutually agreed upon date.
            b) Duration: At least 1 day.
        3) Three months following OAT.
            a) At a mutually agreed upon date.
            b) Duration: At least 4 hours.

C. Operator Training:

1. Goal: Upon completion of operator training, operator is capable of operating monitoring, annunciation, and control systems.
2. Hands-on training:
    a. Location: Pumping Plant Facility.
    b. Sessions: 2, minimum.

1) Following SPAT and prior to OAT.
   a) At a mutually agreed upon date.
   b) Duration: At least1 work days.
2) Following OAT.
   a) At a mutually agreed upon date.
   b) Duration: At least 4 hours.

3.04 CONTRACTOR FIELD QUALITY TESTING

A. Perform field wiring checkout and test in accordance with Section 26 05 90 – Wiring Checkout and Tests.

END OF SECTION

SECTION 26 05 02

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include cost in applicable prices offered, in the schedule, for those items requiring electrical equipment and materials.
2. Payment under the various items includes cost of:
    a. Performing required design.
    b. Furnishing recently certified calibrated testing equipment.
    c. Performing testing.
    d. Transporting and storing equipment and materials.
    e. Modifying and relocating equipment.
    f. Placing, leveling, and grouting channel bases.
    g. Assembling, adjusting, and installing equipment.
    h. Painting equipment and materials.
    i. Brackets, fasteners, bolts, nuts, lock washers, and other accessories required for mounting or installing electrical equipment and materials.
    j. Drilling holes in steel structures (other than tubular structures) as required for mounting or installing electrical equipment and materials.
    k. Furnishing, handling, and storing spare parts for electrical equipment.
    l. Furnishing special tools and appliances for maintenance and adjustment of equipment.
    m. Making electrical connections; furnishing all miscellaneous materials, which are required for making the connections to electrical equipment. The Contractor estimates the number of connections to be made to the equipment based on prior knowledge or experience with similar equipment. No additional compensation will be allowed the Contractor in the event that actual connections exceed the number estimated by the Contractor at the time of bidding.
    n. Performing wiring checkout and tests.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A 123/A 123M-12	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
2.	ASTM A 153/A 153M-09	Zinc Coatings (Hot-Dip) on Iron and Steel Hardware

B. Institute of Electrical and Electronics Engineers (IEEE)

1.	IEEE C2-2012	National Electric Safety Code (NESC)

C. National Electrical Installation Standards (NEIS)

1.	NECA 1- 2010	Good Workmanship in Electrical Contracting

D. National Fire Protection Association (NFPA)

1.	NFPA 70-2011	National Electrical Code (NEC)

1.03 EXTRA MATERIALS

A. Provide to Government special tools and equipment necessary to properly install, adjust, test, and check operation of electrical equipment. Furnish all additional tools and equipment as necessary to properly install, adjust, and check the operation of electrical equipment.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Conform to NFPA 70 and IEEE C2.

B. Furnish all electrical materials and equipment.

C. Galvanize mounting brackets, bolts, nuts, and washers for major items of electrical equipment such as the outdoor unit substations and the motor control centers in accordance with ASTM A 123 and ASTM A 153.

D. Provide galvanized steel or non-corrosive metal for mounting bolts, nuts, and washers for minor items of electrical equipment and lighter weight items. Do not use cadmium-plated mounting hardware.

E. Change designs as required where Contractor-furnished electrical equipment and materials differ in size, type, ratings, or other physical properties from designs in these specifications. CO will approve changes at Contractor's expense, unless Contractor can demonstrate that changes are necessary regardless of manufacturer.

F. Provide special tools and appliances furnished by manufacturer for maintenance and adjustment of manufacturer's electrical equipment.

G. Grout materials: In accordance with Section 03 63 30 – Epoxy Grout.

H. Use test equipment that has been calibrated within 365 days of its use with the calibration sticker clearly visible.

I. Deliver all spare parts required by these specifications to the Bureau of Reclamation only after completion of contract.

2.02 SOURCE QUALITY ASSURANCE

A. Government will inspect the outdoor switchgear and motor control equipment at supplier's manufacturing plant during fabrication and testing. However, final acceptance will not be made until the equipment has been installed and is operational.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, assemble, and adjust equipment in accordance with this subparagraph. These specifications requirements are based on the premise that no conflict exists between the specified design, the standards, and the codes. However, in the event a conflict is discovered by the Contractor, it will be the Contractor's responsibility to inform the CO of the conflict.

1. In the event of conflicting requirements, establish precedence by the following order:

    a. These specifications or as directed by the CO.

    b. The drawings included in these specifications.

    c. The latest edition of "National Electric Code" of the National Fire Protection Association for electrical wiring apparatus and the adopted electrical code of the State in which the construction is located. Cooperate with any agency designated by that State to inspect the electrical installation for conformance with the applicable State code.

B. Do not install electrical equipment until approval drawings and data for associated equipment have been approved by Government.

C. Electrical Installations, Assembly Operations, and Adjustments: Comply with NFPA 70, IEEE C2, and NECA 1.

D. Make electrical installations complete and ready for service.

E. Install electrical equipment in accordance with directions furnished by manufacturer's instruction books.

F. Make all electrical wire, cable, conduit and grounding connections and furnish all miscellaneous materials which are required for making these connections to equipment.

G. Install items of electrical equipment that are required to be in a lineup so appearance is uniform, including height, depth, color, and general construction.

H. Tighten nuts used in electrical equipment assembly with torque wrenches to torque values recommended by equipment manufacturers.

I. Drill holes in bolted steel structures and provide fastenings required for mounting or installing electrical equipment and materials.

J. Do not drill holes in tubular steel structures. Fasten to tubular steel structures by means of properly drilled and tapped pads or brackets welded to tubular members.

K. Installation of Electrical Equipment Includes:

1. Leveling and grouting channel bases.
2. Drilling holes, furnishing hardware, and assembling components to each other.
3. Furnishing materials for and making all connections correctly in accordance with final wiring diagrams.
4. Tagging wires and cables at each end.
5. Correcting any errors made by the Contractor in the installation at no expense to the Government.
6. Wiring and checkout of all equipment in accordance with Section 26 05 90 – Wiring Checkout and Tests.

L. Set electrical equipment installed on concrete foundations on channel bases and grout in place to provide full and even bearing.

3.02 REPAIR

A. Repair or replace damaged devices and repair damaged painted surfaces of equipment to match original finish.

B. Correct by repair or replacement, at the Contractor’s expense, all damage to or failure of any part of the items of material and equipment which in the opinion of the COR was caused by faulty installation, faulty mechanical assembly, or mishandling.

3.03 FIELD QUALITY ASSURANCE

A. Government will inspect the outdoor switchgear and motor control equipment during construction. Acceptance of equipment will be made after equipment is operational.

END OF SECTION

SECTION 26 05 10

CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Conductors and Cables:

1. Measurement: Length of installed conductor or cable.
2. Payment: Linear foot price offered in the schedule for applicable conductor or cable size.

B. Cost: Include cost of making electrical connections to equipment and devices in prices offered in the schedule for equipment and devices that require connections.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM B8-11	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

B. National Fire Protection Association (NFPA)

1.	NFPA 70-2011	National Electrical Code (NEC)

C. National Electrical Manufacturers Association (NEMA)

1.	NEMA WC 57-2004	Control Cables
2.	NEMA WC 70-2009	Nonshielded Power Cables Rated 2000V or Less for the Distribution of Electrical Energy

D. Underwriters Laboratories, Inc. (UL)

1.	UL 486B-2003	Wire Connectors

1.03 DESIGN REQUIREMENTS

A. Determine conductor sizes, except where shown or specified, in accordance with NFPA 70. In the event of conflict between design requirements and NFPA 70, the more stringent requirement applies.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 20 05 10-1, Approval Data:

1. Manufacturer's catalog data.

C. RSN 26 05 10-2, Field Test Reports.

1.05 DEFINITIONS

A. Cable: Cable, cables, wire, or wires of one or more insulated conductors.

B. Power Cable: For power loads including motors; alternating-current distribution circuits; heating, ventilating, and air-conditioning and lighting circuits; and cable that is used for controlling heating, ventilating, air-conditioning, and lighting equipment.

C. Building Premises Wire: For connection of separately-housed components such as wiring devices and luminaire circuits to branch circuit breakers and to one another.

D. Multi-conductor Control Cable: For control, metering, indication, annunciation, and relaying circuits; and circuits not identified as power circuits.

E. Instrumentation Cable: For RTD, transducer output circuits, and MODBUS RTU.

F. Life Safety Cable: For fire protection system devices providing detection, notification, and suppression.

PART 2 PRODUCTS

2.01 CABLE, GENERAL

A. Manufactured no more than 24 months prior to Notice to Proceed.

B. Round shape.

C. Conductors:

1. Copper in accordance with ASTM B8, class B or C.
2. Stranded conductors, except for solid conductor building premises wire.

D. AWG or kcmil designation.

2.02 POWER CABLE

A. Type:

1. Single-conductor or multi-conductor, non-shielded type.
2. Labeled type TC when installed in cable tray.

B. Size: No. 12 AWG, minimum.

C. 600-volt rated insulation unless specified otherwise.

D. Color Coding:

1. Power Cable Phase Conductors and Building Premises Wire:

a. 120/240, single-phase: Black, Red.

b. 120/208- or 240-volt 3-phase: Black, red, blue. Colored phase tape may be used in lieu of colored insulation.

c. 277/480-volt, 3-phase: Black with brown, orange, yellow phase tape.

2. Neutral (Grounded) Conductors:

a. 6 AWG and smaller: White insulation.

b. Larger than 6 AWG: White insulation or White tape at both ends and visible points including junction boxes.

3. Equipment Grounding Conductors:

a. 6 AWG and smaller: Green insulation or green with one or more yellow stripes.

b. Larger than 6 AWG: Green tape at both ends and visible points including junction boxes.

E. Suitable For:

1. Installation in raceways.

2. Installation in cable trays when required by specifications.

F. Insulation Type:

1. Single- or multi-conductor cable: THHN/THWN or XHHW.

G. Multi-conductor Overall Jacket:

1. Type: PVC (Polyvinyl chloride) or better, flame-retardant.

H. In accordance with NEMA WC 70. Cable UL listed and labeled.

I. Provide multi-conductor power cable with integral ground conductor. Size ground conductor in accordance with NFPA 70.

2.03 MULTICONDUCTOR CONTROL CABLE

A. Type:

1. Non-shielded type.

2. Labeled type TC when installed in cable tray.

B. Size: No. 16 AWG, minimum

C. 600-volt rated insulation unless specified otherwise.

D. Color Coding:

1. Colored insulation or jacket compound. Do not apply color coatings to insulation or jacket surface.

2. In accordance with NEMA WC 57, Table E-2.

E. Suitable For:

1. Installation in raceways.

2. Installation in cable trays when required by specifications.

F. Insulation Type:

1. XHHW.

G. Multi-conductor Overall Jacket:

1. Type: PVC (Polyvinyl chloride) or better, flame-retardant.

2. Jacket thickness:

a. 16 AWG conductors: 45 mils for 12 conductor or less. 60 mils for greater than 12 conductor.

b. 14 AWG conductors: 45 mils for 9 conductor or less. 60 mils for greater than 9 conductor.

H. In accordance with NEMA WC 57. Cable UL listed and labeled.

2.04 BUILDING PREMISES WIRE

A. Type: Single, solid conductor.

B. Size: 14 AWG for 15 ampere branch circuits, 12 AWG for 20 ampere branch circuits, or as shown.

C. 600-volt rated insulation unless specified otherwise.

D. Color Coding:

1. Phase Conductors:

a. 120/240, single-phase: Black, Red.

b. 120/208- or 240-volt 3-phase: Black, red, blue.

c. 277/480-volt, 3-phase: Brown, orange, yellow.

2. Neutral (Grounded) Conductors:

a. White insulation.

b. Larger than 6 AWG: White insulation, or White tape at both ends and visible points including junction boxes.

E. Suitable For: Installation in raceways.

F. Insulation Type:

1. 600-volt. THHN/THWN.

G. Conform to NEMA WC 70. UL listed and labeled.

2.05 INSTRUMENTATION CABLE

A. Type: Twisted, single-pair or twisted triad shielded or multiple individual twisted shielded pairs or twisted triads with overall shield.

B. Suitable for installation in raceways and cable tray.

C. Size: 16 AWG or as shown.

D. Insulation: 300-volt, 105 degrees Celsius, minimum.

E. Single-Pair or Triad Shield: Aluminum-mylar tape providing 100 percent coverage with a tinned, stranded copper drain wire.

F. Multiple Pair or Triad Shield:

1. Pair or triad shield: Aluminum-mylar tape providing 100 percent coverage with a tinned, stranded copper drain wire.
2. Cable shield: Aluminum-mylar tape providing 100 percent coverage with a tinned, stranded copper drain wire.
3. Each pair or triad sequentially numbered for identification.

G. Jacket: Black PVC with rip-cord.

2.06 LIFE SAFETY CABLE

A. Shielded, solid copper, polyvinylchloride (PVC) insulation and an overall flame retardant PVC jacket.

B. UL listed as Fire Power Limited Plenum (FPLP).

C. Shielded: 0.007-inch thick insulation and 0.015-inch jacket thickness minimal.

2.07 ACCESSORIES

A. Single Conductor Markers:

1. Type: Heat-shrink, machine printable sleeve.
2. Color: White with black text.
3. Text size: As large as practical but at least 7 point (0.06-inch).

4. Be 1-inch in length, minimum, and have diameter suitable for installation on the intended conductor.

B. Multi-conductor Cable Tags:

1. Type: Cross-laminated polyethylene film or Nomex®. Be resistant to water, oil, solvent, abrasion, and tearing.
2. Rectangular shape and have minimum dimensions of 2 by 0.5 inches.
3. Color: White with black text.
4. Text size: As large as practical but at least 16 point (0.16-inch).
5. Attach to cable with standard nylon self-locking tie wraps or cable ties.

C. Terminal Connectors for Control and Instrumentation Cable:

1. Heavy-duty, insulated, pressure-crimp-type with ring tongues. 600-volt, pressure-crimp pin type may be used where the use of ring tongue connectors is not practical.
2. Tin-plated copper.
3. Serrated inner barrel.
4. UL listed.
5. Compatible with conductor size and type of cable for which it is used.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with NFPA 70.

B. Do not splice single or multi-conductor cables.

C. When using cable ties, do not over tighten, to ensure tie does not cut conductor insulation or cable outer jacket. Do not use cable ties to support cables.

D. Use building premises wire for lighting circuits and 120-volt receptacles unless shown otherwise.

E. Cable Installed in Conduit:

1. Do not pull cable into conduit until they have been cleaned and are free from obstructions and sharp corners.
2. Draw a clean, dry, tight-fitting rag through conduit immediately before installing cable.
3. Install cable using gradual and uniform pulling stresses. Do not exceed allowable pulling tensions and sidewall pressures as recommended by cable manufacturer.

4. Install cable to prevent cuts or abrasions in insulation or protective covering and kinks in cable.

5. When a lubricant is needed as an aid to pulling, use only soapstone or other suitable lubricant that is not injurious to cable insulation.

6. When mechanical cable pulling equipment is used, use a tension meter release mechanism to ensure pulling tension remains below tensile strength of the cable.

7. Remove and replace with new cable that is damaged during installation.

8. Do not install wiring for the fire alarm system in conduits, junction boxes, or outlet boxes with conductors of other systems. Conduit shall be dedicated to the fire protection system.

F. Cable Installed in Vertical or Inclined Plane:

1. Install in locations shown. If not shown, install in accordance with NFPA 70.

2. Support with cable grips leaving slack spans between supports.

3. Clamp cable entering enclosures, junction boxes, or equipment with commercial cable clamps.

G. Grounding:

1. Provide one non-active conductor, grounded at both ends, in each multi-conductor control cable.

2. Ground shielding of instrumentation cable only to source equipment ground bus using pressure crimp type connectors with ring tongues on drain wire.

H. Wiring Methods:

1. Terminate control and instrumentation cable with terminal connectors.

2. At termination point of multi-conductor cables, form conductors into neat packs and tie with self-locking cable ties.

3. Do not combine current and potential transformer circuits in same multi-conductor cable with control circuits

4. Leave sufficient length cable ends to make connections conveniently to equipment, fixtures, and devices.

5. Provide 5-conductor cable for each three-phase current and each potential transformer circuit. Use No. 10 AWG conductors for current transformer circuits.

6. Retain sufficient length of conductors in a current transformer cable length to reach farthest terminal used to select current transformer ratios.

7. Retain spare single conductors at each end of a multi-conductor cable in a length equal to longest single conductor of multi-conductor cable.

8. Terminate spare conductors of multi-conductor cable at terminal blocks. Ground spare conductors by using wire jumpers between terminations and equipment ground bus.

3.02 CABLE AND CONDUCTOR IDENTIFICATION

A. Power Cable:

1. Identify power conductors that are service conductors, panelboard and switchboard feeders, motor control center feeders, and motor power conductors with colored insulation or colored phase tape in accordance with this section. An additional conductor marker is not required.
2. Provide a single-line marker on the load end of feeder and branch-circuit conductors that originate at panelboards, switchboards, and motor control centers. The marker to include designation of source equipment and circuit number.

B. Conductor Markers:

1. Text to be machine or computer generated. Hand written text is not acceptable.
2. Provide individual conductors of multi-conductor control cable and instrumentation cable, with conductor marker. Print conductor designation, as shown on approved schematic diagram, on first line. Print conductor destination and device terminal number on second line.
3. A single line conductor marker will be acceptable provided the conductor designation is enclosed in parenthesis followed by the conductor destination.
4. Do not heat shrink marker onto conductor. Allow marker to rotate about the conductor.
5. Provide markers for spare conductors of multi-conductor cables. The marker to include cable designation and the word “SPARE”. Numerically sequence the spare conductor markers e.g. (1CSA-CSB-SPARE1, 2CSA-CSB-SPARE2, etc.).

C. Multi-Conductor Cable Tags:

1. Tag multi-conductor cables at each end.
2. Text to be machine or computer generated. Hand written text is not acceptable.
3. Mark tags with cable designations as shown on approved wiring and interconnection diagrams. Cable designation to be a single-line of text that includes cable number, originating equipment designation, and destination equipment designation. Develop cable designations when not shown. Examples of cable designations are:
    a. 1MCA-DV1 – First cable from motor control center MCA to discharge valve No. 1).
    b. 3MCB-ACP – Third cable from motor control center MCB to auxiliary control panel ACP.
4. Attach tags to cable with self-locking tie wraps or cable ties.

3.03 CONTRACTOR FIELD QUALITY CONTROL

A. Notify COR, in writing, of date, time, and cables to be tested at least 5 working days before testing. Testing dates to be mutually agreeable between Contractor and COR.

B. Perform testing after installation, but before connection to equipment.

C. Test cables in large groups to minimize number of testing sessions.

D. Perform following tests.

1. Continuity test: Test continuity of each conductor prior to performing insulation resistance test.
2. Insulation resistance tests:
    a. Measure insulation resistance between each conductor and station ground with all other conductors in same cable or conduit grounded.
    b. Test voltage: 1,000 volts direct-current, minimum.
    c. Minimum acceptable insulation resistance: R in MΩ = (rated voltage in kV + 1) x 1000/length in feet.

E. Record following test data on test report for each conductor tested.

1. Date of test.
2. Name or names of Contractor's personnel who performed test.
3. Name of Government inspector who witnessed test.
4. Conductor identification.
5. Continuity.
6. Megohms between conductor and ground.
7. Total length of conductor.

F. If conductor fails continuity or insulation resistance testing, remove and replace cable and conductor.

END OF SECTION

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SECTION 26 05 13

MEDIUM-VOLTAGE POWER CABLE SYSTEM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Medium-Voltage Power Cable:

1. Measurement: Length of installed cable.
2. Payment: Linear foot price offered in the schedule.

B. Medium-Voltage Power Cable Accessories:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. Association of Edison Illuminating Companies (AEIC)

1.	AEIC CS8-07	Extruded Dielectric Shielded Power Cables Rated 5 Through 46 kV

B. ASTM International (ASTM)

1.	ASTM B8 - 04	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

C. Institute of Electrical and Electronics Engineers (IEEE)

1.	IEEE 48-2009	Alternating-Current Cable Terminations 2.5 kV Through 765 kV
2.	IEEE C2-2012	National Electrical Safety Code (NESC)

D. National Electrical Manufacturers Association (NEMA)

1.	ICEA S-93-639 NEMA WC 74-2007	5-46 KV Shielded Power cable for Use in the Transmission and Distribution of Electric Energy

E. National Fire Protection Association (NFPA)

1.	NFPA 70-2011	National Electrical Code (NEC)

F. Underwriter's Laboratory (UL)

1.	UL 486A-486B-2004	Wire Connectors

1.03 PERFORMANCE REQUIREMENTS

A. Furnish, install, and make operable 15-kV cable systems.

B. Determine actual cable length and cable termination configurations.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 05 13-1, Approval Drawings and Data:

1. Manufacturer's catalog data.

C. RSN 26 05 13-2, Field Test Reports.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver cable on reels which are sufficiently sturdy to withstand normal handling during shipping, hauling, and installation.

B. Seal ends of cable on reels from moisture with suitable heat-shrinkable caps and mastic compounds.

C. Do not drag cable across ground, fences, or other sharp projections during shipping or placement of cable reels at the jobsite.

PART 2 PRODUCTS

2.01 POWER CABLE

A. Type: MV-105 single-conductor shielded.

B. Ratings:

1. Rated Voltage: 15 kilovolts.
    a. Operating voltage: 13.8 kilovolts.
    b. Frequency: 60-hertz.
    c. Operating temperature: 90 degrees Celsius, maximum.
    d. Insulation level: 133 percent insulation.
    e. Circuit configuration: Delta.

C. Conductor:

1. Stranded bare annealed copper in accordance with ASTM B 8.
2. Size: As shown.

D. Insulation: Solid-dielectric EPR (ethylene-propylene rubber).

E. Screens:

1. Strand Screen: Extruded, semi-conducting EPR.
2. Insulation Screen: Extruded, semi-conducting EPR strand screen applied directly over the insulation.

F. Shield: 5 mil copper tape, coated, helically applied.

G. Jacket: PVC (polyvinyl chloride).

H. Suitable for conduit installation.

I. Date of Manufacture: No more than 24 months before Notice-to-Proceed.

J. Have AWG or circular mil designation.

K. Conform to ICEA S-93-639 NEMA WC 74 and AEIC CS8, where applicable.

2.02 CABLE TERMINATIONS

A. Type: Kit form, heat shrinkable, suitable for outdoor use and with the cable specified. Include stress tube, ground kit, and appropriate lug.

B. Conform to IEEE 48.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer's instructions and recommendations, and recognized industry practice.

B. Install cable terminations in accordance with manufacturer's instructions and recommendations.

C. Reel Procedures:

1. Remove cable from reel by turning mounted reel.
2. Do not end feed from reel.
3. Do not allow cable reel to rest upon reeled cable.
4. Inspect cable as removed from reel for visible defects.

D. Do not drag cable across ground, fences, or other sharp projections.

E. Installation in Raceways:

1. Do not exceed cable pulling tensions and bending radius recommended by manufacturer.
2. Use lubrication in accordance with manufacturer's recommendations.
3. Pull cable by hand, or use tensiometer or release mechanism on cable pulling equipment to ensure pulling tension remains below tensile strength of cable.
4. Pull all cable in each conduit run at the same time.

F. Terminate or seal cut ends of cable immediately after cutting operation. Seal ends of cable against moisture with waterproof end caps.

G. Do not splice cables.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Perform testing after cable terminations have been installed, but before connections have been made to bus or apparatus.

B. Notify COR, in writing, of date, time, and cables to be tested at least 14 working days before testing. Test dates shall be mutually agreeable between the Contractor and the COR.

C. Perform Following Tests:

1. Insulation resistance.
2. D.C. high potential.

D. Insulation Resistance Test:

1. Perform test prior to D.C. high potential test.
2. Measure cable insulation resistance with megohm meter.
3. Test voltage: 2,500 volts direct current for 1 minute.
4. Reject cable if resistance is less than 25 megohms.

E. D.C. High Potential:

1. Test voltage: 56 kilovolts.
2. Apply voltage between conductor and metallic shield with the shield and other metallic components of the cable grounded.
3. Initially applied DC voltage shall not exceed 3 times rated AC voltage of cable.
4. Test duration: 15 minutes or until current reading levels off and remains steady for at least three minutes.
5. Test failure is detected by excessive leakage current tripping the internal circuit breaker of the test equipment.

F. Record the following data on test report for each test performed and for each conductor tested:

1. Date of test.
2. Name or names of Contractor's personnel who performed test.
3. Name of Government inspector who witnessed test.
4. Conductor identification.
5. Test data for each conductor tested. Record the current magnitude at 2, 5, 10 and 15 minutes after the maximum test voltage has been reached.
6. Result of test: Pass or fail.

END OF SECTION

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SECTION 26 05 20
GROUNDING AND BONDING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Ground Cable:

1. Measurement: Length of ground cable installed.
2. Payment: Linear foot price offered in the schedule.
    a. Includes costs of associated accessories.

B. Ground Rods:

1. Measurement: Number of ground rods installed.
2. Payment: Ground rod price offered in the schedule.
    a. Includes costs of associated accessories.

C. Electrical Ground Resistance Test:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM B 3 - 12	Soft or Annealed Copper Wire
2.	ASTM B 8 - 11	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
3.	ASTM B 228 - 04	Concentric-Lay-Stranded Copper-Clad Steel Conductors

B. Institute of Electrical and Electronic Engineers (IEEE)

1.	IEEE 80-2000	Safety in AC Substation Grounding
2.	IEEE 81-1983	Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
3.	IEEE 142-2007	Grounding of Industrial and Commercial Power Systems
4.	IEEE 837-2002	Qualifying Permanent Connections Used in Substation Grounding
5.	IEEE C2-2012	National Electrical Safety Code (NESC)

C. National Fire Protection Association (NFPA)

1.	NFPA 70-2011	National Electrical Code (NEC)

D. Underwriters Laboratories (UL)

1. UL 467-2007 Grounding and Bonding Equipment

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals and 01 33 26 – Electrical Drawings and Data.

B. RSN 26 05 20-1, Approval Drawings and Data:

1. Manufacturer's catalog data.

C. RSN 26 05 20-2, As-built Drawings:

1. Specifications drawings indicating as-built changes made to grounding systems.

D. RSN 26 05 20-3, Test Reports.

PART 2 PRODUCTS

2.01 MATERIALS

A. Ground Cable:

1. Annealed bare-copper cable:
   a. ASTM B 8, class B.
   b. Solid wires used in forming the copper cable: ASTM B 3.
2. Copper-clad steel cable: ASTM B 228.
3. Concentric stranded.
4. Sizes:
   a. As indicated on drawings.
   b. Where not shown, minimum sizes:
      1) Ground risers and electrode conductors: 4/0 AWG.
      2) Equipment grounding conductors:
         a) Major equipment: Equal to size to electrode conductors.
         b) Minor equipment: No. 4 AWG.
      3) Electrode interconnecting conductors: Equal in size to electrode conductors.

B. Ground Rods:

1. Type: Solid, copper-clad steel.
   a. Bond 0.018 inch thick layer of copper inseparably to steel core.

2. Length: 10 feet.

3. Diameter: 3/4-inch, nominal.

4. In accordance with UL 467.

2.02 ACCESSORIES

A. Cable Connectors:

1. Welded, bolted solderless or compression type.

2. Current-carrying capacity: Equal to cable with which they are used.

3. Connectors for ground cables, including fittings, lugs, bolts, nuts, and washers: Copper alloy containing not more than 4 percent zinc.

4. Bolted solderless or compression type connectors: IEEE 837.

5. Ground connectors that will be direct buried or embedded in concrete: Listed for direct burial use in accordance with the requirements of UL 467.

B. Ground Plates:

1. High-strength, high-conductivity, cast-copper alloy.

2. Four-hole type, except where indicated on drawings.

3. Suitable for concrete construction.

C. Flexible Copper Braid:

1. Flat, extra flexible, tinned, pure copper braid.

2. Unplated, seamless, pure copper ferrules formed into a rectangular shape on each end.

3. Outdoor ampacity: 400 amperes, minimum.

4. Overall length: Suitable for the application.

2.03 WELDING PROCESS

A. Use Cadweld, Thermoweld, or equivalent exothermic process.

B. Molds and Weld Metal:

1. Use fresh stock from same manufacturer.

2. Weld metal and starting material: No significant quantities of hazardous ingredients.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with NFPA 70, IEEE C2, and this Section.

B. Make grounding connections in accordance with standard drawings 40-D-4334, 40-D-4335, and 40-D-4753; and as shown.

C. Use at least No. 4 AWG stranded bare copper as equipment grounding conductors.

D. Do not connect equipment grounding conductors directly to steel reinforcing bars.

E. Ground or Bond as applicable:

1. Electric motors.
2. Metal enclosures for electrical equipment.
3. Unit substations.
4. Elevated steel tanks.
5. Regulating tanks.
6. Air chambers.
7. Shielding and armor on insulated conductors.
8. Steel structural columns.
9. Pumping plant service yard fence.
10. Metal structures located within 200 feet of power or distribution line centerlines.

F. Grounding Electrodes at Pumping Plant:

1. Use steel reinforcing bar system within concrete floor at bottom of sump as grounding electrode.
    a. Steel reinforcing bars used for electrodes:
        1) Diameter, minimum: 1/2-inch.
        2) Length, minimum: 20 feet.
        3) Concrete encasement, minimum: 2 inches thick.
2. Ground risers:
    a. Connect grounding electrodes to ground bus.
    b. Install at least 6 ground risers for connection to grounding electrodes, unless shown otherwise.
3. Ground bus:
    a. Embed in floor of structure.

b. Connect equipment grounding conductors, grounding system risers, and building structural steel to ground bus.

4. Ground ring:

a. Attach to ground rods to serve as grounding electrode for water storage tanks.

b. Encircle each tank completely.

c. Bury in direct contact with the earth.

d. Depth: Not less than 2-1/2 feet.

e. Conductor: At least 20 feet of No. 4/0 AWG stranded bare copper.

G. Service Yard Fence:

1. Ground service yard fence, gate posts, and gate frames.

2. Ground fence fabric on each side of a corner post or location where the fabric is not continuous.

H. Ground Electrode Interconnections:

1. Install minimum of two physically separate grounding electrode tie conductors as interconnections between ground electrodes of the pumping plant ground system and the elevated steel tank as shown.

2. Installation depth: At least 2-1/2 feet.

3. Separation: At least 10 feet.

I. Ground Rods:

1. Drive ground rods vertically until tops of rods are within 2 inches above installation location of ground cables to which rods will be connected.

2. If solid rock is encountered within 3 feet of the subgrade, grout ground rod into 1-1/4-inch vertical hole such that top of rod is within 2 inches above installation location of ground cables to which rod will be connected.

3. If solid rock is encountered deeper than 3 feet below the subgrade, drive ground rod to refusal at approximately a 45 degree angle, then bend ground rod horizontally such that top of rod is within 2 inches above installation location of ground cables to which rod will be connected.

J. Connections:

1. Make all ground connections between equipment, miscellaneous metalwork, and ground plates whether or not such grounding connections are shown.

2. Number of grounding connections for equipment may be one, two, or more in some cases.

3. Remove paint, enamel, scale, oil, grease, or other foreign nonconductive material from point of contact on metal surfaces before making ground connections.

4. Repair damaged or removed paint or galvanizing material on metal finishes.

5. Make ground connections that are direct buried or embedded in concrete using an exothermic process and in accordance with manufacturer's instructions.

   a. In accordance with manufacturer's instructions.

   b. Inspect in accordance with pocket handbook A7D *Installers and Inspectors Guide for CADWELD® Electrical Connections* written by ERICO® Products, Inc., Cleveland, Ohio.

   c. Remove and replace rejected connections.

K. Excavate, place, and compact backfill in accordance with Section 31 23 11 – Earthwork for Structures, and Section 31 23 02 – Compacting Earth Materials, respectively.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Test Resistance of Grounding System:

1. Notify COR at least 3 working days in advance of time of test in order that test may be witnessed by COR.

2. Perform test no sooner than 30 days after completion of structural concrete work.

3. Measured resistance: Less than 5 ohm.

4. Use fall of potential method in accordance with section 8.2.1.5 of IEEE 81.

5. Testing device:

   a. Earth resistance tester.

      1) Heavy-duty, low-resistance type with direct-reading and direct-current ohmmeter as described in bulletin No. 25 and any one of bulletins Nos. 25J, 25J-2, and 25T, all by James G. Biddle Company; the 3 point electronic Vibroground® by Associated Research, Incorporated; or equal.

      2) Capable of measuring ground resistance to an accuracy of 0.5 ohms or better.

6. Test performance:

   a. Initial distance between remote current electrode (C) and grounding system under test (X): At least six times longest diagonal dimension of grounding system.

   b. Distance between electrode C and electrode X if grounding electrode system consists of one or two ground rods: At least 100 feet or as directed by COR.

   c. Beginning at electrode X, drive potential-reference electrode (P) into ground at a number of test points on a straight line between electrode X and electrode C.

d. Distance between test points: Approximately 5 percent of actual distance between electrodes X and C.

e. Continuously log apparent resistance readings for each test point and plot curve of resistance versus distance to ensure that the electrode C location is giving acceptable results as indicated in IEEE 81.

f. Measure and record test points until reaching electrode C or as directed by COR. If plot of resistance vs. distance curve indicates remote current electrode is in area of influence of grounding system, increase distance between electrode C and grounding system, and measure and record a new set of test data.

g. Allow 40 calendar days after receipt of the grounding system resistance test reports for the Government to determine the location and size of any additional grounding is required.

h. Retest the grounding system resistance in accordance with these paragraphs if additional grounding is added.

END OF SECTION

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SECTION 26 05 33
RACEWAYS AND BOXES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Electrical Conduit:

1. Measurement: Length of installed conduit.
2. Payment: Linear foot price offered in the schedule for applicable conduit size.
    a. Includes cost of work and materials for conduit.

B. Fabricated Sheet Steel Boxes, Wiring Troughs, and Precast Handholes:

1. Payment: Lump sum price shown in the schedule.
    a. Includes cost of drilling and punching holes.

C. Wireways:

1. Measurement: Length of installed wireway.
2. Payment: Linear foot price offered in the schedule.
    a. Includes cost of work and materials for wireway.

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1.	ANSI C 80.1-2005	Electric Rigid Steel Conduit (ERSC)
2.	ANSI/ SCTE 77-2007	Specification for Underground Enclosure Integrity

B. Institute of Electrical and Electronics Engineers (IEEE)

1.	IEEE C2-2012	National Electrical Safety Code (NESC)

C. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250-2008	Enclosures for Electrical Equipment (1000 Volts Maximum)
2.	NEMA FB 1-2007(2010)	Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
3.	NEMA TC 2-2003	Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
4.	NEMA TC 3-2004	Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing

D. National Fire Protection Association, Inc. (NFPA)

1. NFPA 70-2011 National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL)

1. UL 360-09 Liquid-tight Flexible Steel Conduit
2. UL 651-05 Schedule 40 and 80 Rigid PVC Conduit

1.03 DESIGN REQUIREMENTS

A. Determine size of junction and pull boxes, fabricated sheet steel boxes, and precast handholes in accordance with NPFA 70, unless shown otherwise.

B. Determine size of wireways and wiring trough in accordance with NFPA 70, unless shown otherwise.

C. Design wireway support system.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals and Section 01 33 26 – Electrical Drawings and Data.

B. RSN 26 05 33-1, Approval Drawings and Data:

1. Manufacturer's drawings and catalog data.
2. Wireway Plan.

C. RSN 26 05 33-2, As-built Drawings:

1. Marked prints of specifications drawings indicating "As-built" changes made to electrical raceways during construction.

PART 2 PRODUCTS

2.01 RACEWAYS

A. Rigid Metal Conduit (RMC):

1. ANSI C 80.1.
2. Factory painted red coating when required by specifications or shown.

B. Rigid Polyvinyl Chloride Conduit (PVC):

1. Product Description: Schedule 80 PVC conduit. Conduit and elbows furnished with integral bell end.
2. Length: Manufacturer's standard 10- or 20-foot lengths.

3. Temperature Rating: Equal to or greater than temperature rating of enclosed conductors.

4. Conduit conform to NEMA TC 2, NFPA 70, and UL 651. Fittings and conduit bodies conform to NEMA TC 3, NFPA 70, and be UL listed.

C. Liquidtight Flexible Metal Conduit (LFMC):

1. Interlocked steel construction with PVC jacket.

2. Ultra-violet resistant.

3. Color: Black.

4. Conform to NFPA 70 and UL 360.

5. Fittings conform to NEMA FB 1.

D. Wireways: Lay-In NEMA Type 12 Wireway, manufactured by Hoffman Engineering Company, Anoka, MN; or equal, with the following essential characteristics:

1. Material: Manufacturer's standard gauge steel.

2. Seems continuously welded and ground smooth.

3. Smooth, rounded edges on sections and fittings.

4. Hinged covers with quick-release latches and oil-resistant gasket.

5. Furnish without holes or knockouts. Punch holes onsite as required.

6. Wireway accessories: Bolt-on barrier kit for separation 0f 300-volt instrumentation cable and 600-volt power cable.

7. Finish: Manufacturer's standard grey coating.

E. Wiring Trough:

1. Material: 16 gauge or 14 gauge galvanized steel.

2. Enclosure:

a. NEMA Type 3R in accordance with NEMA 250.

b. Drip shield top and no knockouts.

3. Slip-on removable cover fastened with captive screws along bottom edge and provided with provisions for padlocking.

4. Embossed mounting holes on back of enclosure.

5. Finish: Manufacturer's standard grey coating inside and outside of enclosure.

2.02 OUTLET BODIES, DEVICE BOXES, JUNCTION AND PULL BOXES

A. Outlet Bodies and Fittings:

1. Material: Cast iron or malleable iron.

2. Covers: Cast or sheet metal.

B. Cast Devices Boxes: Type FD and GRF manufactured by Cooper Crouse-Hinds; or equal, having the following essential characteristics:

1. Rectangular or round, deep-wiring device outlet boxes with threaded hub connections for rigid steel conduit.
2. Material: Iron alloy.
3. Number of gangs: As required.
4. Provide plugs for unused openings.
5. Extension rings: Iron alloy with corrosion-resistant finish.

C. Boxes for Dry Wall Construction:

1. Standard galvanized sheet steel switch and outlet boxes.
2. Switch boxes:
   a. Depth: 2-1/8 inches, minimum.
   b. Number of gangs: As required.
   c. Furnish with raised device covers (plaster rings).

D. Fabricated Sheet Steel Boxes:

1. Used as junction and pull boxes.
2. Sheet steel thickness: No. 14 United States Standard gauge, minimum.
3. Boxes installed indoors to be NEMA type 12. Boxes installed outdoors to be NEMA type 4.
4. Hinged cover with oil-resistant gasket.
5. Finish: Manufacturer's standard grey coating.
6. Conform to NEMA 250.

E. Large, Fabricated Sheet Steel, Free Standing, Type 4 Enclosures:

1. Large free standing pull box, NEMA 250, Type 4.
2. Sheet steel: 12-gauge, minimum.
3. Seams: Continuously welded and ground smooth.
4. Coating: Polyester powder coating over phosphatized surface, inside and out, ANSI 61 gray.
5. Internal mounting channels welded horizontally to sides at top, bottom, and center.
6. Stainless steel door clamps and heavy gauge continuous hinge with stainless steel pin.
7. Includes lifting eyes, document pocket, and oil resistant door gasket.
8. Size in accordance with NFPA 70 or as indicated on drawings.

2.03 PRECAST HANDHOLE

A. Type: Precast polymer concrete with open bottom and Tier 15 rating.

B. Cover:

1. Bolt down type with gasket and stainless steel bolts.
2. Have embossed logo “ELECTRIC” on the surface.
3. Have Tier level rating embossed on the surface.

C. Provide embedded pulling eyes with ratings suitable for the installation. Locate pulling eyes on wall opposite each conduit entrance.

D. Conform to test provisions of ANSI/SCTE 77.

2.04 CONDUIT FITTINGS

A. Expansion-deflection Couplings:

1. Furnish for movement in any direction.
2. Watertight, raintight, concretetight.
3. Deflection and expansion: 3/4-inch, minimum.
4. Angular misalignment: 30 degrees, minimum.

B. Watertight Conduit Hubs:

1. Myers hub manufactured by Cooper Industries, Crouse-Hinds Division, Syracuse, NY, catalog series ST-, STA- and SSTG-; catalog series HUB- and HUBG- manufactured by Appleton, Rosemont, IL; catalog series CHM- manufactured by O-Z Gedney, Rosemont, IL; or equal with the following essential characteristics:
    a. Suitable for terminating rigid steel electrical conduit through the walls of enclosures.
    b. Recessed O-ring for raintight connection.
    c. In accordance with NEMA FB-1.
    d. Galvanized malleable iron.
    e. Insulated throat.

2.05 ACCESSORIES

A. Fittings required to complete electrical conduit systems. Includes, caps, connectors, couplings, unions, nipples, reducers, elbows, pipe plugs, bondnuts, and any other fittings .

B. Devices required to fasten, clamp, attach, and support conduit in place. Includes supports and clamps complete with bolts, washers, and nuts.

C. Locknuts and Bushings:

1. Locknuts: Steel. Die cast locknuts are not acceptable.

2. Bushings: Insulated and pressure cast or malleable iron. Grounding bushing to be lay-in saddle type.

D. Conduit Riser Grips:

1. Suitable to support vertical cable runs in rigid steel conduit:

2. Single weave, closed or split mesh type.

3. Mesh material: Tin-coated bronze strands.

E. Conduit Tags: Round brass or stainless steel.

F. Polyethylene Warning Tape:

1. Type: Heavy-duty polyethylene, detectable underground warning tape.

2. Width: 6 inches.

3. Color: Red.

4. Copy: Continuously imprinted with "CAUTION BURIED ELECTRIC LINE BELOW" or equivalent wording.

5. Suitable for direct burial.

G. Thread Lubricant: Lithium, graphite, or zinc based material designed to inhibit corrosion and to lubricate metal-to-metal joints.

H. Electrical duct seal for sealing ends of raceways.

I. Protective Sealant: Water repellant, and resistant to peeling and cracking.

J. PVC Solvent Cement: In accordance with NEMA TC 2 and conduit manufacturer's recommendations.

K. Corrosion Protection Tape:

1. ScotchrapTM 51 All-Weather Corrosion Protection Tape manufactured by 3M, St. Paul, MN, and Plymouth Plywrap 11 Vinyl Pipe Wrap manufactured by Plymouth Ruber Company, Canton, MA; or equal, having the following essential characteristics:

a. Thickness: 20 mils minimum.

b. Material: Polyvinyl chloride (PVC).

PART 3 EXECUTION

3.01 INSTALLATION

A. Conduit Type: As listed below unless shown otherwise.

1. PVC Conduit: For direct-buried conduit inside and outside the fenced pumping plant yard.
2. PVC Conduit: For conduit installed beneath concrete slab floors.
3. Rigid Metal Conduit: Exposed conduit, unless shown otherwise. Vertical risers through concrete slab floor.

B. Install as shown and in accordance with NFPA 70 and IEEE C2.

C. Determine routing of exposed, buried, and embedded conduit when not shown.

D. Determine exact location of embedded conduit stub-ups based on equipment being furnished.

E. Bends:

1. Make smooth, gradual bends to permit pulling insulated conductors without undue stress or damage to conductors or conduit.
2. Ensure bends are free from kinks, indentations, or flattened surfaces.
3. Make metal conduit bends onsite with radii in accordance with NFPA 70.
4. Bend conduit cold to prevent damage to protective coating.

F. Remove burrs and sharp corners at ends of metal conduit.

G. Coat male threads of rigid metal conduit joints with suitable graphite or zinc sealing material before making joints.

H. Tighten conduit joints securely to ensure electrical continuity and to prevent entrance of moisture or foreign material.

I. Install with necessary fittings and supports.

J. Make transitions from PVC conduit to RMC with suitable fittings designed for the application.

K. Tighten conduit to electrical equipment mounted on tubular metal structures securely and support rigidly in place by conduit clamps, hex head nuts, and threaded 3/8-inch stud fasteners driven by powder-actuated tools.

L. Install expansion couplings where exposed or embedded conduits cross expansion or contraction joints. Install expansion couplings and expansion-deflection couplings in accordance with manufacturer’s instructions.

M. Conduit for Fire Protection System:

1. Factory painted red conduit and accessories.
2. Conduit shall be dedicated to the fire protection system. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of other systems.
3. See Section 28 31 00 – Fire Detection and Alarm for additional information.

N. Exposed Conduit Runs:

1. Straight and parallel with each other and with centerlines of room or structure.
2. Support conduit rigidly in place and in accordance with NFPA 70. Do not weld conduit to conduit supports or structural steel.

O. Conduit Beneath Concrete Slab Floors:

1. Transition horizontal runs of PVC conduit to rigid metal conduit before making 90 degree bends using appropriate conduit fitting.
2. Make 90 degree bend with rigid metal conduit and extend vertically through concrete slab floor. Ensure conduit risers are vertically plumb.
3. Wrap rigid metal conduit with anti-corrosion tape from the transition coupling to at least 6 inches above the concrete slab floor.
4. Apply manufacturer's recommended pipe primer to rigid metal conduit before wrapping with corrosion tape.
5. Apply anti-corrosion tape in accordance with manufacturer's instructions and recommendations.
6. Make adequate provisions to protect the anti-corrosion tape wrap from physical damage during backfill operations.

P. Conduit Embedded in Concrete:

1. Conduit to be rigid steel (RMC) type.
2. Conduit not to displace more than 3 percent of the gross area of the cross-section of the slab. (Calculate cross sectional area as 12 inches times slab thickness)
3. Conduit outside diameter to be no larger than 1/3 of the overall thickness of the slab in which they are embedded.
4. Conduit to be spaced at least 3 diameters or widths on center.
5. Conduit to occupy the middle third of the cross sectional depth of the slab in which they are embedded, where possible.
6. Protect ends of conduit with coupling and plug to prevent entrance of concrete, sand, or other foreign material.
7. Tie conduit from reinforcing bars or otherwise support to prevent sagging while concrete is being placed.

8. Conduit stub-ups:
    a. Minimum length above finished floor: 4 inches, not including coupling.
    b. Terminate conduit with coupling and plug until ready to connect remaining conduit sections. Replace plug with bushing or Chase-type nipple before installing insulated conductors.
    c. Approximately 1-foot of the horizontal embedded conduit and entire vertical stub-up to be plastic-coated rigid steel conduit.
9. Seal conduit boxes with rubber gasketed blank cover. Clean concrete from inside of conduit boxes immediately after forms are removed
10. Swab conduit within 24 hours after removal of forms with clean dry rags until conduit is thoroughly cleaned and dried.
11. Terminate ends of conduit that do not terminate at boxes with couplings and pipe plugs or insulating bushings and caps.

Q. Direct-Buried Conduit:
1. Depth: 24 inches, minimum unless shown otherwise.
2. Install 2 inches of sand around conduit.
3. Install detectable warning tape 18 inches above buried conduit.
4. Backfill and compact trench in accordance with Section 31 23 22 – Pipe Trench Earthwork.

R. Liquid tight Flexible Metal Conduit:
1. Use flexible conduit for connections to equipment that is subject to vibration, where flexibility is required, or where shown.
2. Maximum length of a flexible conduit section is not to exceed 24 inches.

S. Wireways:
1. Support wireways from crane rails where shown.
2. In other locations support wireway from pumping plant building wall.
3. Provide barrier, as necessary, to separate 300-volt instrumentation cable from 600-volt power cable.

T. Hand Holes:
1. Install in locations shown and in accordance with manufacturer’s instructions and recommendations.
2. Place a minimum of 6 inches of pea gravel or crushed rock in bottom of excavation before installing hand hole.
3. Install such that top of hand hole is at finished grade level.

4. Install pumping plant hand holes at least 2 feet, but no more than 4 feet away from side of the pumping plant.

5. Backfill and compact around hand hole in accordance with Section 31 23 11 – Earthwork for Structures and as directed by COR.

U. Conduit Terminations:

1. Make conduit terminations to indoor boxes, cabinets, and panel boards in accordance with standard drawing 104-D-254.

2. Make conduit terminations to outdoor boxes with watertight conduit hubs. Use of locknuts, bushings, or bushed nipples at outdoor conduit terminations is not acceptable.

3. Install bushings or Chase-type nipples on ends of conduit to protect insulation of insulated conductors from abrasion.

4. Install locknuts and bond nuts to provide tight ground connections between conduit and boxes, panel boards, and cabinets.

5. Make terminations of conduit beneath substation switchgear, motor control equipment, motor control centers, and floor mounted cabinets with grounding bushings. Connect grounding bushing to equipment ground bus with a 4 AWG bare-copper conductor.

6. Seal ends of conduit terminations with electrical duct seal to prevent air circulation and entrance of vermin through conduits into boxes, panel boards, or cabinets. Install duct seal to a minimum depth of 1-inch.

V. Conduit Tags:

1. Provide metal conduit tags for conduit terminations.

2. Stamp or engrave tag with conduit number as shown on “As-Built” cable and conduit schedule.

3. Permanently attach tag to conduit with wire and metal crimp-type connector.

END OF SECTION

SECTION 26 05 90
WIRING CHECKOUT AND TESTS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for equipment and devices that require wiring checkout and tests.

1.02 REFERENCE STANDARDS

A. National Fire Protection Association (NFPA)

1. NFPA 70- 2011 National Electrical Code (NEC)

1.03 DEFINITIONS

A. Qualified Person: In accordance with Article 100 of NFPA 70.

1.04 PERFORMANCE REQUIREMNENTS

A. Tests:

1. Demonstrate proper interaction between equipment through cabling interconnections and verify these interconnections are accurately documented.
2. In addition to tests required by Section 26 05 10 – Conductors and Cables.

B. Furnish materials, including test instruments, required for checkout and testing.

C. Make wiring changes and drawing revisions to ensure there are no discrepancies between check prints, and internal equipment wiring and external cabling.

D. Replace defective equipment and make device setting adjustments as required for operation of electrical systems in accordance with specifications and manufacturer's instructions.

E. If required during testing, remove and replace wire connections.

F. Make wiring changes, wire tag revisions, and other repairs or revisions during the testing session the discrepancy is discovered.

G. Perform wiring checkout, and operational and functional tests in presence of the COR.

1.05 QUALIFICATIONS

A. Testing Personnel:

1. Competent and qualified person to perform wiring checkout, and operational and functional testing.
2. Have thorough knowledge of the electrical equipment, installation, and drawings.
3. Qualified to operate equipment being tested.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. Notify COR in writing 10 days in advance of each testing session.

B. Provide the following at time wiring checkouts and tests are performed.

1. Two complete sets of full-size (D-size) electrical schematic and wiring diagram check prints for equipment being tested.
    a. One set to be used and maintained by the COR.
    b. One set to be maintained by Contractor and used to produce final drawings.

C. Perform wiring checkout and tests in accordance with the following.

1. Wiring checkout:
    a. Use electrical schematic and wiring diagram check prints to perform internal wiring check of equipment.
    b. Use electrical schematic and wiring diagram check prints to perform wiring check of external cabling.
    c. Perform a complete wire-by-wire, contact-by-contact, terminal-by-terminal (point-to-point) check of circuit logic.
    d. Verify agreement with approved wiring diagrams. Revise to reflect circuit logic corrections made during checkout.
    e. Verify agreement with approved schematic diagrams. Revise to reflect circuit logic corrections made during checkout.
    f. Verify contact configuration and contact numbering.
    g. Verify continuity of wiring.

h. Verify proper wire tagging at ends of conductors and cables.

i. Check conductors for insulation damage. Perform additional insulation resistance test of damaged conductors.

2. Operational and functional testing:

a. Perform after completion of wiring checkout of equipment being tested.

b. If required, adjust and calibrate protective devices in accordance with specifications, and manufacturer's instructions and recommendations.

c. Check electrical systems and controls for proper sequence of operation, correct adjustments and settings, and agreement with schematic diagram.

END OF SECTION

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SECTION 26 12 19
PAD MOUNTED TRANSFORMER

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Pad Mounted Transformer:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1.	ANSI C12.20-2010	Electricity Meters 0.2 and 0.5 Accuracy Classes

B. Institute of Electrical and Electronics Engineers (IEEE)

1.	IEEE C2-2012	National Electric Safety Code
2.	IEEE C57.12.00-2010	Liquid-Immersed Distribution, Power, and Regulating Transformers
3.	IEEE C57.12.28-2005	Pad-Mounted Equipment Enclosure Integrity
4.	IEEE C57.12.90-2010	Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers

C. National Electrical Manufacturers Association (NEMA)

1.	NEMA TR1-1993 (2000)	Transformers, Regulators, and Reactors

D. National Fire Protection Association (NFPA)

1.	NFPA 70-2011	National Electrical Code (NEC)

1.03 QUALITY ASSURANCE

A. UL Listed.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Handle and store equipment in accordance with manufacturer’s instructions.

1. Include copy of these instructions with equipment at time of shipment.

1.05 DESIGN REQUIREMENTS

A. Design for close-coupling with medium voltage switchgear lineup as shown.

1.06 PROJECT CONDITIONS

A. Ambient Temperature Range: -35 to 40 degrees Celsius.

B. Altitude: 6,700 feet.

1.07 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals and Section 01 33 26 – Electrical Drawings and Data.

B. RSN 26 12 19-1, Approval Drawings and Data:

1. Manufacturer's technical data.
2. Equipment layout diagram.
3. Nameplate list.
4. Bill of materials.
5. Three-line diagram.
6. Schematic diagram.

C. RSN 26 12 19-2, Approval Drawings:

1. Wiring diagrams.

D. RSN 26 12 19-3, Factory Test Report.

E. RSN 26 12 19-4, Field Test Report.

F. RSN 26 12 19-5, Final Drawings.

G. RSN 26 12 19-6, Operation and Maintenance Instruction Book:

1. Provide for all equipment.

PART 2 PRODUCTS

2.01 TRANSFORMER

A. Three-Phase Pad-Mounted Compartmental Type Transformer:

1. Conform to IEEE C57.12.00, C57.12.28, and NEMA TR-1.
2. Type: Self-cooled, outdoor, liquid-filled, three-phase, pad mounted.
3. Dielectric coolant:
   a. Ester-based (soy).

b. Listed less-flammable fluid meeting the requirements of the National Electrical Code and the requirements of the National Electrical Safety Code (IEEE C2).

c. Non-toxic, non-bioaccumulating and be readily and completely biodegradable per EPA OPPTS 835.3100.

B. Ratings and Features:

1. Phase and frequency: 3-phase, 60-hertz.
2. Size: 500-kVA.
3. Primary BIL: 60-kV.
4. Primary rating: 4,160 volts.
5. Primary connection: Delta without neutral bushing.
6. Secondary voltage rating: 480 /277 Grd Y volts.
7. Secondary connection: Grounded Wye with neutral fully insulated with removable ground strap.
8. Secondary BIL: 30-kV.
9. Impedance in accordance with IEEE C57.12.00.

2.02 CONSTRUCTION

A. Construction:

1. Include transformer pad with base for installation on the ground with cables and conduit from below
2. Enclosure: Totally enclosed, dead front, with three-point latching security door with padlock.
   a. In accordance with IEEE C57.12.28
   b. Separate low-voltage compartment.
3. Core: Grain oriented silicon steel.
4. Windings: Copper.
5. Four lifting lugs.
6. Minimum two stainless steel NEMA 2-hole ground pads.
7. Primary well.
8. Secondary voltage bushings with 2-hole pattern NEMA spades.
9. Sealed tank construction of sufficient strength to withstand a pressure of 7 pounds per square inch gauge (psig) without permanent distortion, and 15 psig without rupturing.
10. Conduit and cable entry from full length bottom of termination chambers.

2.03 ACCESSORIES

A. Indicating and Protective Devices:

1. Liquid level gauge.
2. Dial type thermometer.
3. Automatic pressure relief device.
4. Pressure/Vacuum gauge.

B. One-inch drain valve with sampling device and 1-inch upper fill plug.

C. Nameplates:

1. Manufacturer's nameplate:
    a. Stainless steel laser engraved.
    b. Nameplate shall meet IEEE C57.12.00 for Nameplate B.
2. Engraved nameplates:
    a. Material and size as shown on standard drawing 40-D-6234.
    b. Provide equipment designation nameplate.
    c. Provide nameplates for devices mounted on outside of doors that are not furnished with a manufacturer's nameplate or escutcheon.
    d. Provide nameplate for devices mounted within low-voltage compartments.

D. 480-Volt Bolted Connectors:

1. Double lug, double bolted connections.
2. Suitable for connecting at least two parallel sets of conductors.

E. Pad: As provided by manufacturer.

2.04 FINISHES

A. Manufacturer's standard finish.

2.05 SOURCE QUALITY CONTROL

A. Transformer Factory Tests:

1. Manufacturer's standard factory tests which shall include as a minimum:
    a. Percent impedance (85 degrees Celsius) at rated current and tap extremes.
    b. Excitation Current (100 percent voltage) test.
    c. Winding Resistance measurement tests.
    d. Ratio Tests using all tap settings.

e. Polarity and Phase relation tests.

f. Applied and Induced potential tests.

2. Testing conducted in accordance with IEEE C57.12.90.

PART 3 EXECUTION

3.01 INSTALLATION

A. Locate as shown on drawings.

B. Install transformer on a galvanized steel channel base.

1. Make channel base continuous around perimeter of equipment in accordance with drawings.
2. Provide channel base with holes for grout and anchors in accordance with drawings.
3. Set and level channel base on floor. The use of shims to level the channel base is not acceptable.
4. Bolt and grout channel base in place in accordance with Section 03 63 00 – Epoxy Grout.
5. Bolt motor control equipment in place on channel base after grout has cured.
6. Furnish anchoring, supporting, and mounting materials required to install equipment.

C. Make the pad mounted transformer ready for energizing.

D. Make all ground connections to the ground system.

3.02 FIELD QUALITY CONTROL

A. Transformer Site Tests:

1. Power factor.
2. Excitation current.
3. Turns Ratio.
4. Insulation Resistance.

B. Adjusting:

1. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

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SECTION 26 17 20

METAL-CLAD SWITCHGEAR ASSEMBLY, UXA

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Metal-clad Switchgear Assembly, UXA:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1.	ANSI C37.46-2010	High Voltage (>1000V) Expulsion and Current-Limiting Power Class Fuses and Fuse Disconnecting Switches

B. Institute of Electrical and Electronic Engineers (IEEE)

1.	IEEE 693-2005	Recommended Practice for Seismic Design of Substations
2.	IEEE C2-2012	National Electric Safety Code
3.	IEEE C37.04-1999	Rating Structure for AC High Voltage Circuit Breakers
4.	IEEE C37.06-2009	AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities
5.	IEEE C37.09-1999	Test Procedure for AC High Voltage Circuit Breakers
6.	IEEE C37.20.2-1999(2005)	Metal-Clad Switchgear
7.	IEEE C57.13-2008	Instrument Transformers
8.	IEEE C62.11-2012	Metal-Oxide Surge Arresters for Alternating Current Power Circuits

C. National Equipment Manufacturers Association (NEMA)

1.	NEMA FU 1-2002(2007)	Low Voltage Cartridge Fuses
2.	NEMA LA 1-2009	Surge Arresters
3.	NEMA SG 4-2009	Alternating-Current High-Voltage Circuit Breakers

D. InterNational Electrical Testing Association, Inc. (NETA)

1. NETA ATS-2013 Acceptance Testing Specifications for Electrical Equipment and Systems

E. National Fire Protection Association (NFPA)

1. NFPA 70-2011 National Electrical Code (NEC)

1.03 PROJECT CONDITIONS

A. Completely assembled and installed switchgear assembly shall operate as specified without derating under following conditions:

1. Elevation: 6,700 feet.
2. Temperature range: -35 degrees Celsius to +40 degrees Celsius.
3. Seismic qualifications: Low Qualification level in accordance with IEEE 693.
4. Wind loading: Withstand wind up to 90 miles/hour.
5. Seismic and wind forces do not occur simultaneously.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals and Section 01 33 26 – Electrical Drawings and Data.

B. RSN 26 17 20-1, Approval Drawings and Data:

1. Manufacturer's technical catalog data marked with corresponding Bill of Materials (BOM) item number.
2. Layout drawings.
3. Equipment data:
   a. Total weight of switchgear assembly and additional impact load during opening operation of breaker.
   b. Weight of removable element of circuit breaker.
   c. Circuit breaker tripping and closing currents.
   d. Description of bus bar insulation system.
4. Equipment Nameplate list.
5. Device Nameplate list.
6. BOM.
7. Schematic diagrams.
8. Time-Current Characteristic Fuse Curves. Government will determine which fuse characteristic curve rating to be used based on curves submitted.

C. RSN 26 17 20-2, Wiring Diagrams:

D. RSN 26 17 20-3, Check Prints.

E. RSN 26 17 20-4, Factory Test Reports:

1. For design tests, certificates stating equipment has passed all applicable referenced design tests are acceptable in lieu of submitting actual test reports.

F. RSN 26 17 20-5, Field Test Reports.

G. RSN 26 17 20-6, Final Drawings.

H. RSN 26 17 20-7, Operation and Maintenance Instruction Book.

1.05 DELIVERY, STORAGE, AND HANDLING

A. In accordance with IEEE C37.20.2

1.06 EXTRA MATERIALS

A. Furnish special tools and accessories required for installation, normal operation, and maintenance.

B. Furnish Spare Parts:

1. Identical to and interchangeable with equipment being furnished with switchgear assembly.
2. Circuit breaker moving contact and stationary contact assembly, complete for one pole. Vacuum bottle assembly complete for one pole.
3. One spare blank terminal block marking strip for each terminal block furnished.
4. One fuse of each type and size used.
5. One indicating light assembly of each color, size, type used.

PART 2 PRODUCTS

2.01 SWITCHGEAR ASSEMBLY

A. Conform to IEEE C37.20.2.

B. Type: Outdoor, dead front, with energized parts behind grounded metal barriers.

C. Ratings:

1. Maximum voltage: 15-kV, rms.
2. Lightning impulse withstand: 95-kV, peak.
3. Continuous current: 1200 A, main bus.
4. Momentary current: Not less than close-and-latch capability of circuit breaker.

5. Short-time current: Not less than short-time withstand rating of circuit breaker.

6. Frequency: 60-hertz.

D. Construction Features:

1. Shield energized low-voltage terminals exposed by door opening with removable cover.

2. Equip high-voltage drawer or trunion-mounted devices with automatic grounding devices.

3. Determine number of switchgear sections from drawings, including required bus transition sections.

4. High-voltage cable entries: Conduits from below.

5. Low-voltage control and auxiliary power cable entry into switchgear assemblies: Conduits from below.

E. Bus: Copper.

F. Enclosures:

1. Outdoor, weatherproof, IEEE C37.20.2: Category A.

2. "Non-walk-in" type which provides front of each section with at least one inside door, or equivalent, and one outside weatherproof door.

3. Inside doors to provide access to equipment cavity and may be used for mounting control and metering devices.

4. Outside weatherproof doors:

a. Provide access and protection to front of section.

b. Do not mount electrical devices on outside door.

c. Equip with top and bottom strikes, and center latch. Strikes and latch shall pull door securely against gasket and enclosure. Mechanism used to pull door against gasket and enclosure shall be adjustable.

d. Door handle shall engage latch and strikes.

e. Door handles shall be pad lockable.

5. Slope top of outdoor equipment away from front of enclosures.

6. Seal weatherproof doors and outdoor enclosure walls with neoprene gaskets.

7. Equip ventilation openings with filters.

2.02 CIRCUIT BREAKERS

A. Conform to IEEE C37.04, C37.06, and NEMA SG4.

B. Type:

1. Vacuum with motor-compressed spring stored-energy mechanism.
2. Three-pole, single-throw, back-connected, latch-in, removable-element type.
3. Trip Free in all positions.

C. Ratings:

1. Maximum voltage: 15-kV, rms.
2. Nominal system voltage: 4.16-kV, rms.
3. Full wave withstand (BIL): 95-kV, peak.
4. Continuous current: 1200 A, rms.
5. Short-circuit/Short time current: 20,000 A, rms.
6. Interrupting time: 83 milliseconds (5 cycles).

D. Construction Features and Accessories:

1. Locate manual closer and opener on front panel of removable element.
2. Closing Speed of Contacts: Independent of control voltage and operator.
3. Visual indications:
   a. On front of breaker panel.
   b. Circuit breaker contact position.
   c. Spring charge condition.
   d. Operation counter.
4. Mechanical interlocks to prevent insertion or removal of circuit breaker removable elements while circuit breaker is in closed position.
5. Mechanical interlocks to prevent circuit breaker from closing unless primary disconnecting devices are in fully closed contact.
6. Internal wiring shall be NEC Type SIS, size 14 AWG min., and terminators shall be insulated ring-tongue type utilizing lock washers.
7. Self-coupling, separable, adjustable ground plate.
8. Mechanism Operated Contact (MOC) switch interface shall completely close and latch breaker contacts without stalling and with no harm to the MOC switch.

E. Control and Operational Features:

1. Closing and tripping power: 120 Vac.
2. Stored energy mechanism motor operator power: 120 Vac.
3. Capacitive trip device.
4. Breaker closing will normally be by operator pendant-connected control switch operation.

5. Manual close and trip for emergency operation, test, and withdrawn positions.
6. During closing operation, stored energy springs shall be automatically charged for tripping.
7. Provide manual charging of stored energy mechanism for use during power outages or testing.
8. Auxiliary switches with not less than 5 spare "a" contacts and 5 spare "b" contacts.
9. Local operation of circuit breaker from control circuit while breaker is in test position.
10. Initiate breaker tripping by operator control switch or protective relays.
11. Latch breaker closed so loss of station power or control power does not cause breaker tripping.
12. Removal of breaker element shall automatically trip breaker and release springs.
13. In installed breaker position, stored-energy mechanism shall automatically charge following a trip operation.

2.03 CURRENT TRANSFORMERS

A. Conform to IEEE C57.13, C37.04, and NEMA SG4.

B. Bushing or window type.

C. Multi-ratio. Ratios as indicated on drawings.

D. Accuracy Class: As indicated on drawings.

2.04 SURGE ARRESTERS

A. Conform to IEEE C62.11 and NEMA LA 1.

B. Type: Metal-oxide.

C. Construction: Polymer housing.

D. Station class.

E. Protective characteristics as specified in Table 26 17 20A - Surge Arrester Protective Characteristics.

Table 26 17 20A - Surge Arrester Protective Characteristics

TOV, 1 sec.	MCOV, kV rms; not less than:	Maximum Equivalent Front-of – Wave, kV crest	Maximum Discharge Voltage, kV crest Using 8/20 Current Wave @			Maximum Switching Surge, kV crest
			5kA	20kA	40kA	
5.2 kV	4.4 kV	23.9 kV	TBD	TBD	TBD	13.5 kV

2.05 POTENTIAL TRANFORMERS

A. In accordance with IEEE C57.13, C37.04, and NEMA SG4.

B. Ratings and Connection: As shown on drawings.

C. Drawout type.

D. Fuse:

1. In accordance with ANSI C37.46.
2. Current-limiting type.
3. Sized by PT manufacturer.
4. Interrupting rating: TBD (rms, symmetrical).

2.06 PROTECTIVE RELAYS

A. Provide on each feeder and utility source.

B. BE1-11f Feeder Protective Relay as manufactured by Basler Electric Company, Highland, IL; or equal, having following essential characteristics:

1. Multifunction, digital relay that monitors 3-phase, alternating-current and voltage.
2. Output relays: Trip relay, alarm relay. Output relays to be programmable.
3. Self diagnostics failure function: Continually monitor its own functions and trip or alarm in case of failure.
4. Protective functions:
   a. Phase instantaneous overcurrent (50).
   b. Phase inverse time overcurrent (51).
   c. Under/Overvoltage Protection (27/59).
   d. Modbus RTU.
   e. 120 Vac Control Input.
   f. 5-ampere current Input.

g. 120 Vac Voltage Input.

h. Programmable for Maintenance Switch use.

i. Furnish Maintenance Switch circuit for each feeder breaker overcurrent circuit.

2.07 ACCESSORY DEVICES

A. Compatible with associated electrical, mechanical, and thermal ratings of circuit breakers.

B. Provide device to permit removing and handling breaker element by one person.

C. UL listed, where applicable.

D. Suitable length of control cable, with plug and receptacle, to permit test of removable breaker element while in withdrawn position, from control circuit.

E. Control Switches:

1. Pistol-grip handle switches:
   a. 600 volts alternating current or direct current.
   b. 20 amperes continuous current.
2. Contacts: Silver plated and of self-wiping action type.

F. Hand Held Pendant Pushbutton Station:

1. OPEN and CLOSE pushbuttons.
2. Minimum 25-foot umbilical cord.

G. Remote Racking Device:

1. Allows for open/close operation and in/out racking at a safe distance.
2. Torque switch mechanism to stop racking motor.
3. Powered by plug connection to 120 Vac receptacle.
4. Hand held pendant racking control station.
   a. Minimum 25-foot umbilical cord
   b. Open, Close, In, Out pushbuttons. Enable pushbutton for two-hand operation.
   c. Permissive circuit provisions.

H. Engraved Nameplates and Warning Signs:

1. Signs, size, engraving, and material: As indicated on standard drawing 40-D-6234.

2. Provide nameplates and warning signs for following:
    a. Overall switchgear assembly: Manufacturer’s nameplate.
        1) Place manufacturer's name, trademark, or other descriptive marking on all electrical equipment.
        2) Provide other markings: Voltage, current, wattage, or other ratings as specified.
    b. Each section of switchgear assembly: Designations as indicated on drawings or as follows:
        1) Mount nameplates for each device on a door.
        2) Nameplates for each device mounted within switchgear enclosure. In lieu of furnishing nameplates, Contractor may fulfill this requirement by identifying each device with device name or standard NEMA designation by a typed or computer generated permanent marking on or adjacent to device.
        3) High-voltage compartment. - Warning sign mounted on access door or barrier to each high-voltage compartment. Sign shall carry notation "DANGER - High-voltage compartment."
3. No hand lettering.

I. Enclosure Wire:
1. NEC type SIS wire.
2. No. 14 AWG copper conductor minimum with the current transformer wiring No. 10 AWG minimum.
3. Class K stranded.
4. 600 volts.

J. Fuses and Fuseholders:
1. Voltage rating: 600 volts.
2. UL listed.
3. Fuses:
    a. In accordance with NEMA FU1.
    b. Current-limiting type.
    c. Current ratings determined by Contractor.
    d. Suitable for ‘finger-safe’ type fuse holders.
4. Fuseholders:
    a. Modular ‘finger-safe’ type.
    b. Current rating: Not less than fuse size.

c. Furnish with nameplate identifying protected circuit.

d. Mount in easily accessible location within control cabinet.

K. Space Heaters:

1. Provide as necessary to prevent condensation.
2. Suitable for 120 Vac service.
3. Thermostatically controlled and be adjustable.
4. Provide with protective covers.

L. Terminal Blocks:

1. Rated 600 volts, 30 amperes.
2. Molded-block type to accommodate ring lugs one half of an inch wide (outer diameter) at terminal screws.
3. Furnish with binding-head or washer-head screws having serrated or grooved contact surfaces or lockwashers.
4. Molded insulating barriers between terminals.
5. Shorting-type for current transformer wiring.
6. Removable covers and marking strips.
7. Provide 20 percent spare terminals on each terminal block for connections to external circuits.
8. Provide marking strips with conductor designations typed or computer generated. No hand lettering.

M. Terminal Connectors:

1. Pressure-crimp-type ring connectors:
   a. Tin-plated copper, serrated inner barrel.
2. Pressure-crimp-type pin connectors:
   a. Tin-platted copper.
   b. For use only on device terminals not suitable for ring connectors.
3. Insulation: 600 volts, nylon or vinyl.

N. Wire Markers:

1. Type: Self-laminating-vinyl or heat-shrink.
2. Color: White.
3. Lettering: Machine. Do not print wire markers by hand.

2.08 FABRICATION

A. General:

1. Completely wire switchgear. Tag cables going between switchgear sections.
2. Twist hinge wiring around axis of wire instead of bending laterally.
3. Firmly clamp wiring on hinged panels near hinged side of panels and terminate on adjacent blocks on stationary part of switchgear.
4. Equip switchgear with wiring to terminal blocks for connection to control and relaying circuits.
5. Coordinate location of openings for conduits from below.
6. Mount relays so vibration caused by door closing or breaker operation will not cause false operation.

B. Protective Relays:

1. Panel-mount on the internal door of the applicable switchgear section.
2. Wire to instrument transformers through relay test switches.

C. Ground Bus:

1. Install ground bus in accordance with IEEE C37.20.2. Electrically bond to enclosure.
2. Ground bus shall be accessible from front of cubicle.
3. Provide lugs or terminals on ground bus suitable for connection to ground system with No. 4 AWG bare copper conductors.

D. Terminal Blocks:

1. Arrange terminal blocks to allow external cabling to be supported and to allow easy connection of incoming and outgoing cables.
2. Mount terminal blocks at least 3 inches from panel edges and other devices. Mount adjacent rows of terminal blocks with 6 inches separation minimum. Access to front of terminal blocks shall be unobstructed.
3. Provide 1 spare 12-terminal block per breaker section.
4. Machine letter designations on terminal block marking strips. Do not use hand lettering.
5. Identify vertical columns of terminal blocks with a single letter such as “A”, “B”, “C”. Vertical columns may contain more than 12 termination points.
6. Terminate current transformer secondary wiring on short-circuiting type terminal blocks.

E. Wiring And Wiring Connections:

1. Make all connections at device terminals or terminal blocks. Maximum two wires at terminations. Wire splices are not acceptable.
2. Support and secure wire bundles with cable tie mounting bases. Secure cable tie mounting base with two No. 8 screws. Mounting cable tie bases with only adhesive will not be allowed.
3. Install ring tongue pressure-crimp-type connectors for terminations at terminal blocks and electrical devices.
4. Do not terminate wire without terminal connector.

F. Wire Markers:

1. Install wire markers on conductor end.
2. Print conductor designation on first line.
3. Print conductor destination and terminal number on second line.

G. Nameplates:

1. Attach nameplates with pan head self-tapping screws. Do not use adhesives to attach nameplates.

2.09 FINISH

A. Switchgear Assembly: In accordance with IEEE C37.20.2 and utilizing manufacturer's standard methods and materials for complying with IEEE, except as follows:

1. Interior: Manufacturer's standard 'white' finish.
2. Materials for paint system: Must be certified 'lead- and chromate-free', including painting systems and equipment.

B. Metal-clad Circuit Breaker: Manufacturer's standard finish.

2.10 CONTRACTOR SOURCE QUALITY TESTING

A. Inspection and Witnessing:

1. Government may, at its option inspect equipment and witness factory tests.
2. Notify COR, in writing, at least 14 days in advance of factory testing.

B. Circuit Breaker:

1. Factory Tests:
   a. Design tests in accordance with IEEE C37.09 on a circuit breaker of same type, style, and model furnished.
   b. Production tests in accordance with IEEE C37.09.

C. Switchgear Lineup(s):

1. Factory Tests:
    a. Production tests in accordance with IEEE C37.20.2.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with applicable requirements of IEEE C37.20.2, IEEE C2, NFPA 70, and these specifications.

B. As indicated on drawings.

C. Install Switchgear on a Galvanized Steel Channel Base:
    1. Make channel base continuous around perimeter of equipment in accordance with drawings.
    2. Provide channel base with holes for grout and anchors in accordance with drawings.
    3. Set and level channel base on floor. Do not use shims to level the channel base.
    4. Bolt and grout channel base in place in accordance with Section 03 63 00 – Epoxy Grout.
    5. Bolt motor control equipment in place on channel base after grout has cured.
    6. Furnish anchoring, supporting, and mounting materials required to install equipment.

D. Ground and bond switchgear to building ground system in accordance with Section 26 05 20 - Grounding and Bonding.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Wiring checkout in accordance with Section 26 05 90 - Wiring Checkout and Tests.

B. Field acceptance testing in accordance with NETA ATA and IEEE C37.20.2.

END OF SECTION

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SECTION 26 18 39

MEDIUM-VOLTAGE MOTOR CONTROLLERS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Medium-Voltage Motor Controllers:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

1.	IEEE 18-2012	Shunt Power Capacitors
2.	IEEE 1036-2010	Guide for Application of Shunt Power Capacitors
3.	IEEE C37.20.7-2007	Testing Metal-Enclosed Switchgear Rated Up to 38 kV for Internal Arcing Faults
4.	IEEE C57.13-1993	Standard Requirements for Instrument Transformers

B. National Electrical Manufacturers Association (NEMA)

1.	NEMA CP 1-2000(2008)	Shunt Capacitors
2.	NEMA ICS 1-2000(2008)	Industrial Control and Systems General Requirements
3.	NEMA ICS 3-2005(2010)	Industrial Control and Systems: Medium Voltage Controllers Rated 2001 to 7200 Volts AC
4.	NEMA ICS 3.1-2009	Industrial Control and Systems: Guide for the Application, Handling, Storage, Installation and Maintenance of Medium Voltage AC Contactors, Controllers and Control Centers
5.	NEMA ICS 5-2000(2010)	Industrial Control and Systems Control Circuit and Pilot Devices
6.	NEMA ICS 6-1993	Industrial Control and Systems Enclosures

C. National Fire Protection Association, Inc. (NFPA)

1.	NFPA 70-2011	National Electrical Code (NEC)

1.03 SYSTEM DESCRIPTION

A. Two separate assemblies of medium voltage reduced-voltage (soft) starters (motor controllers), isolation contactors, bypass contactors, power factor correction capacitors, and capacitor contactors, and power factor correction capacitor control system.

B. Design Requirements:

1. Design layout of medium-voltage motor controller sections.
2. Design medium-voltage motor controller sections and power factor correction capacitor sections to be grouped together in a continuous line-up and to be connected with a common horizontal bus.
3. Determine size and ratings of the following:
    a. Medium-voltage and low-voltage fuses.
    b. Control circuit transformers.
    c. Instrument transformers.
    d. Space heaters.
4. Determine current transformer ratios if not shown.
5. Design controls for automatic soft starting with application of bypass contactor and power factor correction capacitors upon reaching full speed operation.
6. Design protection circuits to open isolation contactor on protective action.
7. Designed, manufactured, assembled, and tested in accordance with IEEE, NEMA, ICS, and NEC standards.
8. Design control system for switching power factor correction capacitors. Control system to have following features:
    a. Control logic may be hard wired relays or soft logic with a PLC or similar device.
    b. Capacitors to be switched with a separate capacitor vacuum contactor.
    c. All capacitors within the lineup to be switched OFF while the solid-state starter ramps.
    d. After completion of the ramp cycle, capacitors for energized starters are sequenced back ON one at a time.
    e. Provide separate control power transformer for control system. Determine kVA rating.
    f. A maximum of two capacitors and its contactor may be stacked within a single enclosure.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals and Section 01 33 26 – Electrical Drawings and Data.

B. RSN 26 18 39-1, Approval Data:

1. Manufacturers' technical data.

C. RSN 26 18 39-2, Approval Drawings:

1. Layouts.
2. Nameplate list.
3. Bill of materials.

D. RSN 26 18 39-3, Approval Drawings:

1. Schematic diagrams.
    a. Include a separate schematic diagram drawing for each motor control circuit.

E. RSN 26 18 39-4, Time-Current Characteristic Curves.

F. RSN 26 18 39-5, Approval Drawings:

1. Wiring diagrams:
    a. Include separate wiring diagram for each motor control cubicle.

G. RSN 26 18 39-6, Check Prints:

1. Schematic diagrams.
2. Wiring diagrams.

H. RSN 26 18 39-7, Factory Test Report.

I. RSN 26 18 39-8, Field Test Report.

J. RSN 26 18 39-9, Final Drawings:

1. Layout drawings.
2. Schematic diagrams.
3. Wiring diagrams.

K. RSN 26 18 39-10, Operation and Maintenance Instruction Book:

1. Include the following:
    a. Title page/index.
    b. Manufacturer’s maintenance and operating instructions.
    c. Bill of materials.
    d. Copies of informational data.
    e. Half-size prints of As-built drawings.
    f. Time-current characteristic curves.
    g. Motor overload relay settings.

1.05 REGULATORY REQUIREMENTS

A. UL listed and labeled.

1.06 DELEVERY, STORAGE, AND HANDLING

A. Handle and store equipment in accordance with manufacturer's instructions and recommendations and in a manner to avoid damage to internal components, metal enclosure, and finish. Include copy of these instructions with equipment at time of shipment.

B. Store indoors in a clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect equipment from dirt, water, and construction debris.

1.07 PROJECT CONDITIONS

A. Ambient Temperature Range: 0 to 40 degrees Celsius.

B. Altitude: 6,700 feet.

1.08 EXTRA MATERIALS

A. Furnish one complete 600 HP reduced voltage starter; One complete set of power factor correction capacitors for 600 HP motor. These will be used to replace a 200 HP starter installed by these specifications. Include all other miscellaneous parts and devices to allow one 200 HP starter section to be field converted to a 600 HP section.

B. Also, furnish the following spare parts:

1. Three vacuum bottles for each size of contactor furnished.
2. One main operating coil for each size of contactor furnished.
3. Six medium-voltage power fuses for each different size furnished.
4. Six low-voltage fuses of each type and size furnished.

PART 2 PRODUCTS

2.01 RATINGS AND GENERAL REQUIREMENTS

A. Controller Type: Non-reversing, solid-state reduced voltage start for induction motor.

B. System Voltage: 4.16 kV, three-phase 3-wire, solidly grounded, 60-hertz.

C. Main Bus Ampacity: 1,000 amperes, continuous.

D. Medium Voltage Controllers: Integrated interrupting rating of 200 MVA with current limiting fuses.

E. Maximum Short-Circuit Current: 30 kA RMS symmetrical.

2.02 ENCLOSURE

A. NEMA 250: Type 12 enclosure for indoor application as shown.

B. Material: Manufacturer's standard gauge sheet steel.

C. Enclosures completely front accessible, allowing for freestanding, against a wall, or back-to-back mounting.

D. Vertical Sections:

1. Provide metal barrier between low-voltage and high-voltage compartments.
2. Provide each compartment with a separate door.
3. Do not combine controllers for more than motor in each section.

E. Provide separate metering section if required.

F. Incoming power is by cable. Provide sufficient space to accommodate number and size of incoming cables for bottom entry.

2.03 BUSES AND BUS CONNECTION

A. Horizontal And Vertical Buses:

1. Copper tin-plated, solid bar type.
2. Insulated to withstand system voltage.
3. Horizontal bus length: Length of motor starter cubicle.
4. Braced to withstand, without damage or deformation, maximum short-circuit current.

B. Ground Bus:

1. Copper bar.
2. Extend length of each motor starter section cubicle and each unit control section.

2.04 MOTOR CONTACTOR AND POWER FUSES

A. Motor Contactor and Fuses: Integral bolt-in assembly.

B. Motor Contactor:

1. Type: Class E2 motor controller, vacuum, 3-pole, 400 amperes.
2. Rated voltage: 7,200 volts.
3. Single-break high pressure type main contacts with weld-resistant alloy contact faces.

4. Operating coil:
    a. Suitable for operation from 120-volt, 60-hertz.
    b. Full voltage, energize and hold.
    c. Equip direct-current coil with integral rectifier.
    d. Provide transient protection if required by manufacturer.
5. Auxiliary switches with contacts to perform functions shown.
6. Provide built-in test circuit to permit checking starter control and pilot circuits, with high-voltage de-energized and isolated, and with contactor in its normal position or in the draw-out position. Control circuit to be capable of being energized through a polarized plug connector from an external 120-volt, 60-hertz source.
7. Coordinate and interlock with soft starter to bypass reduced-voltage starting components after motor full speed is achieved.

C. Load-Break Main Disconnect Switch:
1. Externally operated, two position, manual three-pole device.
2. Mechanical interlocks:
    a. Prevent opening of high-voltage access door with disconnect switch closed.
    b. Be directly attached to operating mechanism without relying on cables or long linkages.
3. Provide viewing port to enable visible verification of blade position.
4. Provide switch-operating handle with provisions for padlocking.

D. Power Fuses:
1. Type: Medium-voltage, current-limiting, R-rated with blown fuse indicator.
2. Incorporate time-current characteristics for motor service allowing proper coordination with contactor and overload relay for maximum protection.
3. Fuse holder designed to permit easy inspection and replacement of fuses without starter disassembly.
4. UL recognized.

E. Bypass and Power Factor Capacitor Contactor:
1. Type: Vacuum, 3-pole, 400 amperes.
2. Rated voltage: 7,200 volts.
3. Operating coil:
    a. Suitable for operation from 120-volt, 60-hertz.
    b. Full voltage, energize and hold.

c. Equip direct-current coil with integral rectifier.

d. Provide transient protection if required by manufacturer.

2.05 MOTOR PROTECTION RELAY (MPR)

A. SEL-749M Motor Relay and SEL-2600 RTD Module as manufactured by Schweitzer Engineering Laboratories, Pullman, Washington; GE Multilin 269 Plus Motor Protection System as manufactured by GE Multilin, 215 Anderson Avenue, Markham, Ontario Canada L6E 1B3; or equal, having the following essential characteristics:

1. Multifunction, digital relay that monitors 3-phase, alternating-current and makes separate trip and alarm decisions based on preprogrammed motor current and temperature conditions.
2. Control power input: 90-260 volts, 60-hertz.
3. Output relays: Trip relay, alarm relay, and two auxiliary output relays. Output relays to be programmable.
4. Self diagnostics failure function: Continually monitor its own functions and trip or alarm in case of failure.
5. Protective functions:
   a. Phase overload standard curves (device 51).
   b. Phase overload custom programmable curve (device 51).
   c. It modeling (device 49).
   d. Stator overtemperature/ bearing overtemperature with 10 independent RTD inputs (device 49).
   e. Negative sequence unbalance/ single-phase (device 46).
   f. Phase reversal (device 47).
   g. Starts per hour and time between starts (device 48).
   h. Short circuit (device 50).
   i. Ground fault (devices 50G/50N/51G/51N).
   j. Undercurrent (device 37).
   k. Mechanical jam/stall.
6. Management functions:
   a. Statistical data.
   b. Pre-trip-data.
   c. Ability to learn, display and integrate critical parameters to maximize motor protection.
   d. Communication with external devices using a RS485 port and ModBus RTU protocol.

e. A keypad and LCD display.

2.06 COMPONENTS

A. Control Power Transformer (CPT):

1. Encapsulated, dry-type with copper windings.
2. Voltage: 4,160-120-volts, 60-hertz.
3. Provide with primary and secondary fuse blocks and current limiting fuses.

B. Selector Switches:

1. Type: Heavy-duty, oiltight with 30.5 mm mounting hole.
2. Number of Positions: As shown.
3. Contact rating: A600 in accordance with NEMA ICS 5.
4. Black extended lever operator.
5. Nameplate: Equipment manufacturer's standard or custom nameplate suitable for mounting directly over device. Engraving as shown.

C. Pushbuttons:

1. Type: Momentary, heavy-duty, oiltight with flush head and 30.5 mm mounting hole.
2. STOP Pushbutton: Two position, push-pull type with red mushroom head.
3. Contact rating: A600 in accordance with NEMA ICS 5.
4. Nameplate: Equipment manufacturer's standard or custom nameplate suitable for mounting directly over device. Engraving as shown.

D. Indicating Light Assemblies:

1. Type: Heavy-duty, oiltight, push-to-test.
2. Voltage: 120 volts, 60-hertz.
3. Lamp: Full voltage, high-visibility LED with multiple LEDS install in lamp base. Single LED in lamp base is not acceptable.
4. Color: As shown.
5. Nameplate: Equipment manufacturer's standard or custom nameplate suitable for mounting directly over device. Engraving as shown.

E. Auxiliary Relays:

1. Self-resetting, heavy-duty, machine-tool type with convertible contacts. Latching type relays are mechanically latched and electrically reset. General purpose type relays are not acceptable.
2. Coil Voltage: 120 volts, 60-hertz.

3. Contact rating: A600 in accordance with NEMA ICS 5.

F. Timing Relays:

1. Bulletin 700 Type RTC solid-state timing relay as manufactured by Rockwell Automation; or equal, with following essential characteristics:
2. Type: Solid-state, with adjustable timing range as shown.
3. Voltage: 120 volts, 60-hertz.
4. Operating mode: On-Delay.
5. Contact configuration :
   a. Two timed contacts, one Normally Open (N.O.) and one Normally Closed (N.C.).
   b. Two instantaneous contacts one Normally Open (N.O.) and one Normally Closed (N.C.).
6. Contact rating: B600 in accordance with NEMA ICS 5.

G. Terminal Blocks:

1. Type: One piece, molded-block with molded-insulating barrier between terminals. Do not use sectional type of terminal blocks.
2. Rating: 600 volts, 25 amperes, minimum.
3. Terminals: Binding-head or washer-head screws with serrated or grooved contact surfaces suitable for use with ring-type terminal connectors.
4. Provide marking strips with conductor designations typed or computer generated.
5. Provide shorting type terminal blocks for current transformer circuits.

H. Terminals Connectors:

1. Heavy-duty, pressure-crimp type.
2. Connector: Tin-plated copper, serrated inner barrel.
3. Style: Ring or pin type.
4. Insulation: 600 volts, nylon or vinyl.
5. UL listed.
6. Compatible with conductor and terminal block for which it is used.

2.07 REDUCED VOLTAGE (SOFT) STARTER

A. Sized for applications shown on drawings.

B. Operator Interface:

1. Provided with programmable keypad with backlit LCD display.

2. Provided with status and alarm LEDs.
3. Provided with non-volatile memory.
4. Display and monitor functions:
    a. Motor current in each phase.
    b. RTD temperature.
    c. Most recent trip and alarm.

C. Motor and Starter Protection:
1. Type: Solid-state, microprocessor controlled, multifunction relay.
2. Motor and starter protective functions:
    a. Electronic overload based on inverse time-current curves as defined by NEMA trip curve classes. Provide programmable trip curve classes from between Class 5 and Class 30.
    b. Short circuit.
    c. Ground fault.
    d. Undervoltage and overvoltage.
    e. Shorted SCR.
    f. Coast down lockout.
    g. Starts per hour lockout.
    h. Time between starts.
    i. Separate trip and alarm set points for motor armature RTDs.
    j. Separate trip and alarm set points for bearing RTDs.

D. Soft Starter Module Programmable Functions:
1. Initial current.
2. Motor full-load current.
3. Dual ramp adjustments with two independent settings for the following:
    a. Initial voltage: 0 to 100 percent of nominal voltage.
    b. Current limit: 200 to 600 percent of motor full-load current.
    c. Acceleration time: 1 to 120 seconds.
4. Deceleration time: 1 to 60 seconds.

E. Communications: Modbus RTU via RS485/RS232 or RS422 with Windows interface.
1. Provide for remote start/stop and control interlocks.
2. Provide for data acquisition of starter and pump equipment status as shown.

2.08 POWER AND ENERGY METER

A. Eaton IQ 150 electronic power meter as manufactured by Eaton; or equal, having the following essential characteristics:

1. Microprocessor based and designed for multifunction electrical measurement on 3-phase power system.
2. User programmable for voltage range to any PT ratio. Accept a direct voltage input range of up to 416 volts line-to-neutral and 721 volts line-to-line.
3. User programmable for current to any CT ratio and accept current input up to 11 amperes continuous.
4. Provide true RMS measurements of phase-to-phase voltage and per phase current.
5. Accuracy: Plus or minus 0.25 percent for volts, and 0.5 percent for power and energy functions.
6. Provide Volts, Amps, VAR, VA, PF, Frequency, Watthours, VARh, and VAh.
7. Provide meter with three-line LED display. Meter display to include a percent of FULL SCALE having not less than 10 segments.
8. Be a traceable revenue meter, which contains a utility grade test pulse allowing power providers to verify and confirm the meter is performing to its rated accuracy.
9. Provide meter with Modbus TCP communication format.
10. Allow user to set up utility demand profile.
    a. Readings for kW, kVAR, kVA, and PF calculated using utility demand features.
    b. All other parameters have MAX and MIN capability over a user selectable averaging period.
    c. Provide voltage with instanaeous MAX and MIN reading displaying the highest surge and lowest sag seen by meter.
11. Meter capable of operating on a power supply of 90 to 265 volts, 60-hertz.
12. Meter to be of the same manufacturer and type as that provided for the Switchboards as specified in Section 26 24 13 – Switchboards.
13. UL listed.

2.09 INSTRUMENT TRANSFORMERS

A. Potential Transformers (PT):

1. Designed for service in medium-voltage switchgear and for use in metering and relaying circuits.
2. Designed to withstand Basic Impluse Level (BIL) of switchgear.

3. Drawout type mounted on steel carriage and installed in separate drawout compartment.
4. Provide for PT withdrawal from operating position via a racking device with PT compartment door closed.
5. Ensure fuses completely disconnected in withdrawn position and exposed parts are visibly grounded.
6. Design to allow for replacing fuses and general maintenance.
7. PT connection as shown.

B. PT Fuses:

1. Current-limiting type.
2. Provide in primary circuit.
3. E-rated and 5.5 kV.
4. UL listed.

C. Current Transformers (CT):

1. Type: Indoor, window type with shorting terminal block.
2. Five ampere secondary.
3. Insulation: 600-volt, 10 kV BIL.
4. Accuracy Class: Suitable for metering service shown.
5. Polarity identified with standard marking symbols.
6. Provide all required mounting devices.

D. Instrument transformers conform to IEEE C57.13.

2.10 POWER FACTOR CORRECTION CAPACITORS

A. Enclosure: Manufacturer's standard sheet steel suitable for mounting within a cabinet of the medium-voltage motor controller lineup.

B. Voltage: 4,160, 3-phase, 60-hertz.

C. Rating:

1. 200 horsepower motor: 50 kVAR.
2. 350 horsepower motor: 100 kVAR
3. 600 horsepower motor: 150 kVAR.

D. Dielectric Fluid: Non-PCB, nonflammable, and biodegradable.

E. Provide with fuses that have a visual means of detecting a blown fuse.

F. Provide discharge resistor in capacitor to bring voltage down to 50 volts in less than 5 minutes after isolation of capacitor.

G. Operate without shortened life with an average 24-hour ambient air temperature of 35 degrees Celsius.

H. Finish: Manufacturer's standard grey coating.

I. Conform to NEMA CP 1 and NFPA 70.

2.11 POWER FACTOR CORRECTION CAPACITOR CONTROL SYSTEM

A. Components: Suitable for the application and manufacturer's standard.

2.12 ENCLOSURE WIRE

A. 14 or 16 AWG type SIS stranded copper with 600 volt insulation.

B. Insulated conductors used to connect components external to medium-voltage motor controller lineup to be in accordance with Section 26 05 10 - Conductors and Cables.

C. UL listed.

2.13 NAMEPLATES AND WARNING SIGNS

A. Manufacturer's Nameplates:

1. Material and size: Manufacturer's standard durable, permanent nameplate.
2. Nameplate engraving with manufacturer's name, trademark, or other descriptive marking and with voltage, current, or other ratings as required by the standards..

B. Engraved Nameplates:

1. Material and size as shown on standard drawing 40-D-6234.
2. Provide nameplate for each starter section engraved with the equipment designation.
3. Provide nameplate for each door, which describes the purpose of the compartment.
4. Provide nameplate for devices mounted on outside of doors that are not furnished with a manufacturer's nameplate or escutcheon.
5. Provide nameplate for devices mounted within low-voltage compartments.

C. Warning Signs:

1. Provide warning sign for hinged access doors and accessible bolted plates of compartments where operating voltage exceeds 600 volts.

2. Be in accordance with Occupational Safety and Health Administration (OSHA) regulations.
3. Be colored red with white lettering.
4. Be 7 inches high by 10 inches wide.
5. Be fastened with round head stainless steel screw or bolt.
6. Engraving for hinged access doors: "DANGER – 4,160 VOLTS - KEEP OUT".
7. Engraving for accessible bolted plates: "DANGER – 4,160 VOLTS INSIDE".

2.14 FABRICATION

A. Deliver motor control equipment to site ready for installation.

B. Connect vertical sections together to form rigid lineups with flush front surfaces.

C. Mount selector switches, pushbuttons, and meters to be readily accessible and no higher than 78 inches above finished floor or deck.

D. Power factor correction capacitor controller may be integrated into a cabinet of the motor controller lineup or may be installed in separate enclosure, which is attached to the motor controller lineup.

E. Vertical Sections:
1. 90 inches high, excluding the channel base.
2. Mount low-voltage motor control equipment and terminal blocks within a separate control section.
3. Provide suitable backpanel for mounting devices in low-voltage control section.
4. Provide barriers in compartments to prevent contact with high voltage parts and to prevent tools from being dropped on high voltage parts.
5. Medium-voltage power cables shall enter bottom of section. Allow adequate room for installation of stress cones.
6. Cable entry from top of sections or bottom of sections.

F. Doors:
1. Provide single, hinged access doors on the front of all compartments.
2. Provide access doors with neoprene gaskets.
3. Use two screws, minimum, to latch door. Screw head shall be a large slotted, knurled knob. Provide keeper to prevent screw from falling out of door. Use of hex head screws will not be acceptable.

G. Bus Fabrication:
1. Support bus with molded glass-filled polyester insulating material.

2. Interconnect vertical section bus with horizontal bus, such that when they are bolted together, they become a continuous power bus.

3. Ground Bus:

   a. Material: Bare copper bar.

   b. Run continuously along entire length of motor controller cubicles.

   c. Accessible from front of cubicle.

   d. Electrically bonded to starter metal enclosures.

   e. Provide solderless, bolted type ground lug at each end of starter lineup.

H. Terminal Blocks:

1. Mount terminal blocks at least 3 inches from panel edges and other devices. Mount adjacent rows of terminal blocks with 6 inches separation minimum. Access to terminal blocks shall be unobstructed.

2. Identify vertical columns of terminal blocks with a single letter. Vertical columns may contain more than 12 termination points.

I. Starter Wiring and Wiring Connections:

1. Wire motor controller as shown.

2. Provide wiring duct system with removable covers for low-voltage wiring within the starter. The covers shall be accessible for removal and replacement.

3. Make all connections at device terminals or terminal blocks. Maximum two wires at terminations. Wire splices are not acceptable.

4. Provide ring tongue pressure-crimp type connectors for terminations at electrical devices and terminal blocks. Use pin-type terminal connectors where use of ring tongues is not practical, such as terminations at selector switches, pushbuttons, indicating lamps, and auxiliary relays.

5. Do not terminate wire without a terminal connector.

6. Terminate spare cable of multi-conductor control cable at terminal blocks.

J. Wire Markers:

1. Provide wire marker on conductor end.

2. Print conductor designation, as shown on approved schematic diagram, on first line. Print conductor destination and device terminal number on second line.

K. Nameplates: Attach nameplates with pan head self-tapping screws. Do not use adhesives to attach nameplates.

2.15 FINISHES

A. Manufacturer’s standard grey finish.

B. Interior of Low-Voltage Compartment: Painted white.

2.16 SOURCE QUALITY CONTROL

A. Factory Testing:

1. Manufacturer's standard factory tests.
2. Power frequency dielectric test.
3. Operational test of control circuits.
4. Point-to-point wiring checks.

B. Factor Inspection:

1. COR will inspect medium-voltage motor controllers prior to shipment to site.
2. Notify COR at least 14 days in advance of inspection date.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer's instructions and recommendations, and NEMA ICS 3.1.

B. Perform under onsite supervision of a qualified original equipment manufacturer's erecting engineer.

C. Tighten accessible bus connections and mechanical fasteners after placing motor controller.

D. Terminate medium-voltage cable with cable terminators.

E. Connect external wiring and cabling to fully integrate the equipment with other systems in the plant, and in accordance with approved drawings.

F. Ground and bond motor controller lineup in accordance with Section 26 05 20 - Grounding and Bonding and as shown.

G. Medium-voltage cable entry: From below motor control equipment via conduit.

H. Set motor protection relay in accordance with motor manufacturer's recommendations.

I. Set protective devices.

J. Installation on Concrete Floor:

1. Install motor control equipment on a galvanized steel channel base.

2. Make channel base continuous around perimeter of equipment in accordance with drawings.

3. Provide channel base with holes for grout and anchors in accordance with drawings.

4. Set and level channel base on floor. Do not use shims to level the channel base.

5. Bolt and grout channel base in place in accordance with Section 03 63 00 – Epoxy Grout.

6. Bolt motor control equipment in place, on channel base, after grout has cured.

7. Furnish anchoring, supporting, and mounting materials required to install equipment.

3.02 FIELD QUALITY CONTROL

A. Field Testing:

1. Perform field wiring checkout and test in accordance with Section 26 05 90 - Wiring Checkout and Tests.

2. Bus megger test.

3. Ground test.

4. Verification all mechanical interlocks are functioning properly.

5. Record settings of motor protection relay and other protective devices.

B. Field Inspection: Prior to initial energization, inspect motor control equipment in accordance with NEMA ICS 3.1.

3.03 ADJUSTING

A. Adjust motor protective relay in accordance with relay settings furnished by Government.

END OF SECTION

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SECTION 26 22 12

DRY-TYPE TRANSFORMERS, KCA & KCB

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Dry-Type Transformer:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250-2008	Enclosures for Electrical Equipment (1000 Volts Maximum)

B. National Fire Protection Association (NFPA)

1.	NFPA 70-2011	National Electrical Code (NEC)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 22 12-1, Approval Data:

1. Manufacturer’s technical data.
2. Equipment layout drawings.
3. Nameplate drawing.

C. RSN 26 22 12-2, Operation and Maintenance Instruction Book.

1.04 REGULATORY REQUIREMENTS

A. Be UL listed and beat the UL label.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handle and store equipment in accordance with manufacturer’s instructions. Include copy of these instructions with equipment at time of shipment.

PART 2 PRODUCTS

2.01 DRY-TYPE TRANSFORMER

A. Type: General purpose, self-cooled, dry-type.

B. Enclosure: Ventilated, NEMA Type 2 drip-proof. Fabricated of heavy gauge, sheet steel construction.

C. Completed coil and core bolted to enclosure base but isolated by means of rubber vibration-absorbing mounts.

D. Provide electrostatic shield for attenuation of voltage spikes, line noise, and transients.

E. Winding Conductors: Copper.

F. Insulation: A 220 degree C system.

G. Winding Temperature Rise: 150 degrees Celsius above a 40 degree Celsius ambient.

H. Primary Voltage: 480 volts, 3-phase, 60-hertz.

I. Secondary Voltage: 208Y/120 volts, 3-phase, 60-hertz.

J. kVA Rating: As shown.

K. Primary Taps: Four 2.50 percent full-capacity below rated voltage and two 2.50 percent full-capacity above rated voltage.

L. Mounting: Floor.

2.02 NAMEPLATES

A. Material: Type A as described on standard drawing 40-D-6234.

B. Provide nameplate for each transformer.

C. Engraving:

1. “Transformer KCA – Feed Panelboard DCB”.
2. “Transformer KCB – Feed Panelboard DDA”.

2.03 FINISHES

A. Manufacturer’s standard grey finish for intended installation location.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install Transformers on Galvanized Steel Channel **B**ases:

1. Make channel base continuous around perimeter of equipment in accordance with drawings.
2. Provide channel base with holes for grout and anchors in accordance with drawings.
3. Set and level channel base on floor. The use of shims to level the channel base is not acceptable.
4. Bolt and grout channel base in place in accordance with Section 03 63 00 – Epoxy Grout.
5. Bolt motor control equipment in place on channel base after grout has cured.
6. Furnish anchoring, supporting, and mounting materials required to install equipment.

B. Install in accordance with manufacturer's instructions and recommendations.

C. Minimum separation of at least 12 inches from any combustible materials,

D. Make conduit and wiring connections.

E. Transformer is a separately derived alternating-current system as defined in NFPA 70. Ground and bond transformers in accordance with NFPA 70 and as shown.

F. Provide require safety labels.

G. Provide engraved nameplate on transformer.

3.02 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

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SECTION 26 24 13

SWITCHBOARDS, DCA

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Switchboards:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1.	ANSI C12.20-2010	Electricity Meters 0.2 and 0.5 Accuracy Classes

B. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250-2008	Enclosures for Electrical Equipment (1000 Volts Maximum)
2.	NEMA FU 1-2002	Low-Voltage Cartridge Fuses
3.	NEMA PB 2-2011	Deadfront Distribution Switchboards
4.	NEMA PB 2.1-2007	General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less

C. National Fire Protection Association (NFPA)

1.	NFPA 70-2011	National Electrical Code (NEC)

D. Underwriters Laboratories, Inc. (UL)

1.	UL 50-07	Enclosures for Electrical Equipment
2.	UL 489-2013	Safety Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
3.	UL 891-2007	Switchboards

1.03 DESIGN REQUIREMENTS

A. Design free-standing, dead-front type, low-voltage distribution switchboard that utilizes group mounted circuit breakers.

B. Group mounted assemblies to consist of molded-case circuit breakers mounted on a panelboard type chassis.

C. Switchboard design shall be suitable for both top and bottom cable entry.

D. Switchboard design to include integrated automatic transfer switch that is fully compatible with the engine-generator set. Transfers between normal service power and engine-generator shall be fully automatic.

E. Provide shunt trips for 480-volt, 3-phase building space heater circuit breakers.

F. Design shunt trip control circuit such that shunt trips are energized upon transfer of the automatic transfer switch to the emergency position.

G. Provide source of voltage for shunt trip control circuit.

1.04 PROJECT CONDITIONS

A. Ambient Temperature Range: 0 to 40 degrees Celsius.

B. Altitude: 6,700 feet.

1.05 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals and Section 01 33 26 – Electrical Drawings and Data.

B. RSN 26 24 13-1, Approval Drawings and Data in Manufacturer's Format:

1. Manufacturer's technical data.
2. Equipment layout diagram.
3. Nameplate list.
4. Bill of materials.

C. RSN 26 24 13-2, Approval Drawings in Government Format:

1. Three-line Diagram.
2. Schematic Diagram (115 V circuits).
3. Wiring Diagrams.

D. RSN 26 24 13-3, Factory Test Report.

E. RSN 26 24 13-4, Check Prints:

1. Schematic and wiring diagrams.

F. RSN 26 24 13-5, Final Drawings.

G. RSN 26 24 13-6, Operation and Maintenance Instruction Book:

1. Provide for all equipment.

1.06 REGULATORY REQUIREMENTS

A. Be UL listed and labeled.

B. Conform to NEMA PB 2, UL 50, UL 891, and NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle and store equipment in accordance with manufacturer's instructions. Include copy of these instructions with equipment at time of shipment.

PART 2 PRODUCTS

2.01 RATINGS

A. Switchboard Short-Circuit Rating: 65,000 symmetrical RMS amperes.

B. Voltage Rating: 480/277 volts, 3-phase, 4-wire, 60-hertz.

C. Through Bus: 800 amperes, RMS, minimum.

2.02 CONSTRUCTION

A. Switchboard consists of the required number of vertical sections bolted together to form a rigid assembly. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.

B. Enclosure Type: Type 1 in accordance with NEMA 250.

C. All protective devices shall be group mounted as shown.

D. All bus and device connections shall be accessible from front.

E. Provide switchboard sections with adequate lifting means.

2.03 BUS

A. Bus Material: Manufacturer's standard plated copper.

B. Provide full capacity neutral bus.

C. Provide copper ground bus (minimum 1/4 x 2-inch).

D. Provide bus joints with conical spring-type washers.

2.04 MOLDED CASE CIRCUIT BREAKER

A. Thermal-magnetic type with inverse-time trip characteristics on overload and instantaneous trip on short circuit.

B. Voltage: 480/277 volts, as indicated.

C. Frequency: 60 Hertz (Hz).

D. Interrupting Rating: 25,000 symmetrical RMS amperes, minimum.

E. Arc quenchers.

F. Quick-make and quick-break toggle mechanisms.

G. Trip-free operating handle.

H. Single operating handle. Use of handle ties on multiple-pole circuit breakers is not acceptable.

I. Equip with padlock attachments for locking breakers in “OFF” position.

J. Shunt Trip: Intermittent rated solenoid with tripping plunger and cutoff switch assembled to a plug-in module.

K. Conform to UL 489.

2.05 AUTOMATIC TRANSFER SWITCH

A. Type: Automatic transfer, open transition.

B. Number of Poles: Three.

C. Current Rating: 400 amperes.

D. Voltage Rating: 480 volts, 60 Hz.

E. Enclosure: Mounted within a NEMA 1 switchboard section.

F. Switching panel shall consist of completely enclosed contact assemblies and a separate control or transformer panel. Control power for all transfer operations shall be derived from the line side of the source to which the load is being transferred.

G. Transfer switch shall be positively interlocked both mechanically and electrically to prevent simultaneous closing of both sources. Main contacts shall be mechanically locked in position in both normal and emergency positions. A neutral position shall not be possible under normal electrical operation.

2.06 TRANSFER SWITCH LOGIC CONTROLLER

A. Microprocessor-based. Controller shall be hardened against potential problems from transients and surges. Operation of the transfer switch and monitoring of both sources shall be managed by the controller.

B. Provide controller display with the following unit status:

1. Availability of NORMAL source.
2. Availability of EMERGENCY source.
3. Connection status of NORMAL source.
4. Connection status of EMERGENCY source.

C. Provide controller with pushbuttons for Engine Test, Engine Start, and System Test.

D. Provide controller with the following features:

1. Store set points in Non-Volatile memory. Use of an external battery source to maintain operation during “dead” periods is not acceptable.
2. Monitor voltage of each phase of the NORMAL source and EMERGENCY source and provide under-voltage dropout protection.
3. Monitor frequency of the NORMAL source and EMERGENCY source and provide under-frequency and over-frequency dropout protection.

E. Provide controller with the following time-delay features.

1. Selectable time delay on transfer to EMERGENCY source.
2. Fixed time delay to override a momentary power outage or voltage fluctuation.
3. Fixed time delay on retransfer from EMERGENCY source to NORMAL source.
4. Fixed time delay after retransfer that allows the engine-generator to run unloaded prior to shutdown.
5. A fixed time delay for engine failure to start.

F. Provide controller with one form A contact for closure of the engine-generator start circuit.

G. Capable of communicating to monitor all set points and operational characteristics using Modbus RTU.

H. Include the following Historical Data Storage:

1. Engine run time.
2. NORMAL source available time.
3. EMERGENCY source available time.

4. NORMAL source connected time.
5. EMERGENCY source connected time.
6. LOAD energized time.
7. Number of transfers.

2.07 POWER AND ENERGY METER

A. Eaton IQ 150 electronic power meter as manufactured by Eaton; or equal, having the following essential characteristics:

1. Microprocessor based and designed for multifunction electrical measurement on 3-phase power system.
2. User programmable for voltage range to any PT ratio. Accept a direct voltage input range of up to 416 volts line-to-neutral and 721 volts line-to-line.
3. User programmable for current to any CT ratio and accept current input up to 11 amperes continuous.
4. Provide true RMS measurements of voltage, phase-to-phase and phase-to-neutral; current, per phase and neutral.
5. Accuracy: Plus or minus 0.25 percent for volts, and 0.5 percent for power and energy functions.
6. Provide Volts, Amps, VAR, VA, PF, Frequency, Watthours, VARh, and VAh.
7. Provide meter with three-line LED display. Meter display to include a percent of FULL SCALE having not less than 10 segments.
8. Be a traceable revenue meter, which contains a utility grade test pulse allowing power providers to verify and confirm the meter is performing to its rated accuracy.
9. Provide meter with Modbus TCP communication format.
10. Allow user to set up utility demand profile.
    a. Readings for kW, kVAR, kVA, and PF calculated using utility demand features.
    b. All other parameters have MAX and MIN capability over a user selectable averaging period.
    c. Provide voltage with instanaeous MAX and MIN reading displaying the highest surge and lowest sag seen by meter.
11. Meter capable of operating on a power supply of 90 to 265 volts, 60 Hz.
12. Meter to be of the same manufacturer and type as those provided for in Section 26 18 39 – Medium-Voltage Motor Controllers.
13. UL listed.

2.08 INSTRUMENT TRANSFORMERS

A. Current Transformers:

1. Three single-phase; 60-hertz; single-ratio; single-secondary; indoor.
2. Voltage rating: 600-volts.
3. Basic impulse insulation level (BIL): 10-kilovolts.
4. Quantity and Ratio: As shown on the drawings.
5. Class: C200.
6. Thermal Rating: 1 at 55 degrees Celsius.
7. Short-time thermal-current rating: 40,000 amperes, minimum, (for 1 second).
8. Provide complete with necessary mounting devices, primary and secondary terminal studs, and secondary short-circuiting devices.
9. Provide shorting blocks for CT wiring that are U.L. recognized to 105 degrees Celsius, and are made up of a thermoplastic body material.

B. Potential Transformers:

1. Rated primary voltage: 480 volts.
2. Basic impulse insulation level: 10 kilovolts.
3. Quantity/Ratio: As shown. Rating: 200 VA, minimum.
4. ANSI metering accuracy classification and thermal burden ratings: Suitable for this application.
5. Provide complete with necessary mounting devices and primary and secondary terminal studs.
6. Fuses:
    a. Current-limiting fuses in primary.
    b. As indicated on drawings in potential transformer ungrounded secondary leads. Withstand maximum energizing current.
    c. Locate in accessible areas.
    d. Potential transformer primary circuit fuses and fuse holder ratings: 600 volts, current limiting with 3-pole block.
    e. Potential transformer secondary circuit fuses and fuse holder ratings: 6 amperes, 250 volts, with 3-pole block.
    f. UL listed.
    g. Fuseholders: Block type with side barriers.
    h. Conform to NEMA FU1.

2.09 SHUNT TRIP CONTROL CIRCUIT

A. All required components to be switchboard manufacturer's standard devices.

2.10 WIRING/TERMINATIONS

A. Provide control wiring, necessary fuse blocks, pushbuttons, switches, auxiliary relays, potential transformers, and terminal blocks within the switchboard as required. Provide 15 percent spare terminals on each terminal block.

B. Provide mechanical-type terminals for line and load terminations suitable for copper cable rated for 75 degrees Celsius of the size shown.

C. Provide lugs in the incoming line section for connection of the main grounding conductor. Provide additional lugs for connection of other grounding conductors as required.

D. Control wire shall be type SIS, bundled and secured with nylon ties.

2.11 NAMEPLATES

A. Nameplate:

1. As indicated on standard drawing 40-D-6234.
2. Provide nameplates for following:
    a. Overall switchboard assembly: Manufacturer's nameplate.
        1) Place manufacturer's name, trademark, or other descriptive marking on all electrical equipment.
        2) Provide other markings: Voltage, current, wattage, or other ratings as specified.
    b. Each section of switchgear assembly: Designations as indicated on drawings or as follows:
        1) Provide equipment designation nameplate for each section of the switchboard.
        2) Mount nameplates for each device on a door.
        3) Nameplates for each device mounted within switchgear enclosure. In lieu of furnishing nameplates, Contractor may fulfill this requirement by identifying each device with device name or standard NEMA designation by a typed or computer generated permanent marking on or adjacent to device.

2.12 FINISH

A. Manufacturer's standard grey finish for intended installation location.

2.13 FABRICATION

A. Form the 480-volt station service switchboard into an integral assembly complete with channel base.

B. Where welding is required, weld enclosures and sections along entire length of joint. Do not use skip welding.

C. Extend copper ground bus entire length of switchboard.

1. Mechanically and electrically bond each vertical section.
2. Equip with a No. 4/0 AWG terminal for connection to building ground system.
3. Drill and tap at 1-inch intervals for 8/32-inch screws.

D. Provide spare circuit breakers as shown.

E. Cover blank spaces with removable covers.

F. All covers secured with captive screws.

G. Internal Wiring:

1. Wire control circuits in accordance with approved drawings and as necessary for equipment to function as required.
2. Terminate all circuits that are required to be wired to external equipment on terminal blocks.
3. Make wire terminations with ring tongues terminal connectors. Use pin type connectors where the use of ring tongues is not practical such as terminations at selector switches, pushbuttons, indicating lamps, and auxiliary relays. Bare wire connections are not acceptable.
4. Current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device.
5. Form wiring into compact groups bound together and firmly supported. Run wiring straight, horizontally, or vertically with short-radius, right-angle bends. Twist hinge wiring around longitudinal axis of hinge, wherever practicable, instead of bending laterally.
6. Attach nameplates with pan head self-tapping screws. Do not use adhesives to attach nameplates.
7. Install grommets at holes in enclosure for wires and cables.
8. Do not splice wiring within the switchboard.

PART 3 EXECUTION

3.01 CONTRACTOR SOURCE QUALITY CONTROL

A. Factory Testing:

1. Production (routine) tests on the actual switchboard sections provided in accordance with NEMA PB 2.
2. Test circuits before shipment to demonstrate correctness of completed wiring connections and proper functioning of devices.
3. Job Hazard Analysis (JHA):
    a. Provide when the Government will be performing factory inspection.
    b. Prepare JHA in accordance with 29 CFR 1910, Subpart I.
    c. As a minimum include the following in JHA:
        1) Factory address and name of site visit contact person.
        2) Date of JHA.
        3) Purpose of JHA, for example “Visitor Safety Procedures.”
        4) Hazards:
            a) Types of hazards at factory.
            b) Safety procedures in or around high-voltage test labs.
            c) Safety procedures on factory floor.
        5) Personal protective equipment:
            a) List of equipment required.
            b) List of equipment provided by factory.
        6) Emergency response:
            a) Name and phone number of Factory Safety Officer.
            b) Employees trained in emergency conditions (CPR, First Aid).
            c) Factory fire protection/evacuation procedures.
            d) Nearest hospital or emergency room.
        7) Name, title and signature of factory official approving JHA.

3.02 SOURCE QUALITY ASSURANCE

A. Government reserves the right to inspect equipment at supplier’s manufacturing plant during fabrication and testing.

3.03 INSTALLATION

A. Install switchboard on a galvanized steel channel base:

1. Make channel base continuous around perimeter of equipment in accordance with drawings.
2. Provide channel base with holes for grout and anchors in accordance with drawings.
3. Set and level channel base on floor. The use of shims to level the channel base is not acceptable.
4. Bolt and grout channel base in place in accordance with Section 03 63 00 – Epoxy Grout.
5. Bolt motor control equipment in place on channel base after grout has cured.
6. Furnish anchoring, supporting, and mounting materials required to install equipment.

B. Install in accordance with manufacturer's instructions and recommendations.

C. Ground and bond distribution board to existing grounding system in accordance with Section 26 05 20 - Grounding and Bonding.

D. Make conduit and wiring connections.

3.04 CONTRACTOR FIELD QUALITY CONTROL

A. Automatic Transfer Switch:

1. Coordinate testing with testing of the engine-generator in Section 26 32 10 – Engine-Generator Set.
    a. Sense failure of the normal power source.
    b. Send a start command to the engine-generator set and have the engine-generator set respond properly.
    c. After a time delay, switch should sense proper voltage and frequency from the generator then transfer the load to the generator.
    d. Sense the return of proper voltage of the normal power source.
    e. After a time delay, transfer the load back to the normal power source.
    f. After the stop time delay (cool down cycle), shut down the engine-generator.
    g. Control and run the exercise cycle for the engine-generator set.

END OF SECTION

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SECTION 26 24 20
CONTROL BOARDS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Control Boards:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. National Electrical Manufacturer=s Association (NEMA)

1.	NEMA 250-2008	Enclosures for Electrical Equipment (1000 Volts Maximum)
2.	NEMA ICS 5-2000	Industrial Control and Systems: Control Circuit and Pilot Devices
3.	NEMA WC 70-1999	Nonshielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy

B. National Fire Protection Association, Inc. (NFPA)

1.	NFPA 70-2011	National Electrical Code (NEC)

C. Underwriters Laboratories, Inc. (UL)®

1.	UL 1077– 2005	Standard for Supplementary Protectors for Use in Electrical Equipment

1.03 DESIGN REQUIREMENTS

A. Design layout of air chamber control board.

B. Design electrical equipment supports using combination channels specified in Section 05 50 00 – Metal Fabrications.

C. Provide one control board for the two air chambers at pumping plant 12B.

D. Provide one control board for the two air chambers at pumping plant 12.1.

E. Determine size of supplementary overcurrent protective devices.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 24 20-1, Approval Data:

1. Manufacturer's Technical Data.

C. RSN 26 24 20-2, Approval Drawings:

1. Control board layout.
2. Bill of materials.
3. Nameplate list.
4. Schematic diagrams.

D. RSN 26 24 20-3, Final Drawings:

1. Schematic and wiring diagram drawings.

E. RSN 26 24 20-4, Operation and Maintenance Instruction Book.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handle and store equipment in accordance with manufacturer's instructions and recommendations and in a manner to avoid damage to internal components, metal enclosure, and finish.

B. Store indoors in a clean, dry space. Maintain factory wrapping or provide additional material to protect equipment from dirt, water, and construction debris.

PART 2 PRODUCTS

2.01 ENCLOSURE

A. Type 12 in accordance with NEMA 250.

B. Constructed from sheet steel no lighter than 14 MSG (Manufacturer's Standard Gage).

C. Seams continuously welded and ground smooth.

D. External mounting brackets.

E. Formed external return flanges around all sides of enclosure opening.

F. Screw-down door clamps.

G. Heavy-gauge continuous hinge pin.

H. Hasp and staple for padlocking.

I. Collar studs for mounting back panel.

J. Oil-resistant gasket attached with oil-resistant adhesive.

2.02 PUSHBUTTONS

A. Type: Heavy-duty, watertight/oiltight with 30.5 mm mounting hole. Momentary contacts.

B. Contact rating: NEMA A600.

C. Operator: Black, flush button.

D. Nameplate: Equipment manufacturer's standard or custom engraved nameplate suitable for mounting directly over device. Engraving as shown.

E. Conform to NEMA ICS 5.

2.03 SELECTOR SWITCHES

A. Type: Heavy-duty, watertight/oiltight with 30.5 mm mounting hole.

B. Contact rating: NEMA A600.

C. Contact arrangement as shown.

D. Nameplate: Equipment manufacturer's standard or custom engraved nameplate suitable for mounting directly over device. Engraving as shown.

E. Conform to NEMA ICS 5.

2.04 INDICATING LIGHTS

A. Type: Heavy-duty, watertight/oiltight, push-to-test with 30.5 mm mounting hole. Full voltage for operation on 120 volt, 60 Hz.

B. Color: As shown.

C. Lamp:

1. High visibility, LED type, 120 volts, 60 Hz.
2. Minimum of 5 LEDs in a cluster. Lamps with one LED are not acceptable.

D. Conform to NEMA ICS 5.

2.05 AUXILIARY RELAYS

A. Type: Heavy-duty, self-resetting, machine tool relay with convertible contacts.

B. Latching type auxiliary relay to be electrically reset.

C. Contact rating: A600 in accordance with NEMA ICS 5.

D. Coil voltage: 120 volts, 60-hertz.

2.06 TIME DELAY RELAYS

A. Type: Solid-state.

B. Timing function and timing ranges as shown.

C. Provide knob or dial for adjusting timing range.

D. Coil voltage: 120 volts, 60-hertz.

E. Configuration: DPDT.

F. Base: Octal pin type.

G. Provide retainer clip or spring to secure relay in base.

2.07 SUPPLEMENTARY OVERCURRENT PROTECTIVE DEVICE

A. Voltage: 120-volt, 60-hertz.

B. Single pole.

C. Mounting: DIN rail.

D. Trip-free design such that device handle cannot be defeated by holding the handle in the ON position.

E. Color-coded position indicator. Green for protective device OPEN and red for protective device CLOSED.

F. UL recognized and conform to UL 1077.

2.08 REMOTE I/O

A. The remote I/O components are Government-Furnished Products in accordance with Section 01 64 40 – Government-Furnished Products.

B. The following components are required for each control board remote I/O:

1. One rack.
2. One power supply.
3. One communication module.
4. One digital input module.
5. Necessary cables.

2.09 WIRING ACCESSORIES

A. Enclosure Wire (Insulated Conductors Between Components):

1. NEC type SIS or MTW
2. 14 or 16 AWG Class K stranded copper in accordance with NEMA WC 70.
3. VW-1 rated.
4. 600-volt insulation.

B. Ground Bus:

1. Material: Copper.
2. Size and Length: Sufficient for attaching ground conductors.

C. Terminal Blocks:

1. Type: Molded-block with molded-insulating barrier between terminals.
2. Rating: 600 volts, 25 amperes, minimum.
3. Terminals: Binding-head or washer-head screws with serrated or grooved contact surfaces suitable for use with ring-type terminal connectors.
4. Full-size marking strips.

D. Terminal Connectors:

1. Type: Heavy-duty, preinsulated, pressure-crimp type with serrated inner barrel.
2. Style: Ring-tongue or pin type.
3. Compatible with conductor and termination point for which it is used.
4. UL listed.

E. Wire Markers:

1. Type: Self-laminating-vinyl or heat-shrink.
2. Color: White.
3. Print wire markers using machine lettering. Do not print wire markers by hand.

2.10 NAMEPLATES AND LABELS

A. Provide engraved nameplates of appropriate size and that conform to standard drawing 40-D-6234 using type A material. Nameplate engraving to be as listed below:

1. Nameplate for each air chamber control panel door:
   a. “AIR CHAMBER 12.1 CONTROL PANEL”.
   b. “AIR CHAMBER 12B CONTROL PANEL”.
2. Nameplate for each door mounted device: Engraving as shown except for selector switches and pushbuttons.

B. Provide labels for equipment mounted on back panels and wiring side of control board doors. Labels to be white, adhesive type, and machine lettered with the device name as shown on approved schematic diagram.

C. Provide labels for terminal blocks. Labels to be white, adhesive type, and machine lettered with the terminal block designation as shown on wiring diagrams.

2.11 FABRICATION

A. Take delivery of Government-Furnished I/O components in accordance with Section 01 64 40 – Government-Furnished Products.

B. Install Government-Furnished I/O components in control boards and connect as shown.

C. Mount ground bus at bottom of enclosure. Electrically bond to enclosure.

D. Wiring and Wiring Connections:

1. Make connections at device terminals or terminal blocks. Maximum two wires at terminations.
2. Form wiring into compact groups bound together and firmly supported. Run wiring groups straight, horizontally, or vertically with short-radius, right-angle bends.
3. Support and secure wire bundles with cable tie mounting bases. Secure cable tie mounting base with two No. 8 screws. Mounting cable tie bases with only adhesive will not be allowed.
4. Group wires at terminal blocks to minimize number of external cables.
5. Install ring tongue pressure-crimp-type connectors for terminations at terminal blocks and electrical devices.
6. Install pin pressure-crimp-type connectors for terminations where the use of ring tongue is not practical such as terminations at selector switches, pushbuttons, indicating lamps, or auxiliary relays.
7. Termination of wire without terminal connector is not acceptable.

E. Wire Markers:

1. Install wire markers on conductor end.
2. Print conductor designation on first line.
3. Print conductor destination and terminal number on second line.

F. Nameplates: Attach nameplate to control board enclosure with machine screws. Use of adhesives for attaching nameplates is not acceptable.

2.12 FINISHES

A. Provide manufacturer’s standard white interior and grey exterior coating.

2.13 SOURCE QUALITY CONTROL

A. Perform production tests in accordance with manufacturer's standard shop and quality control procedures.

B. Test for correct operation and mechanical adjustment.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer's instructions and recommendations.

B. Install air chamber control boards on electrical equipment supports in locations shown and as approved by COR.

C. Ground and bond control panels in accordance with NFPA 70.

D. Make conduit and cable connections.

3.02 FIELD QUALITY CONTROL

A. Perform field wiring checkout and test in accordance with Section 26 05 90 – Wiring Checkout and Tests.

END OF SECTION

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SECTION 26 24 41

DISTRIBUTION PANELBOARDS

PART 1 GENERAL

1.01 MEASUREMENT AN D PAYMENT

A. Distribution Panelboards:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250-2008	Enclosures for Electrical Equipment (1000 Volts Maximum)
2.	NEMA PB 1-2011	Panelboards

B. National Fire Protection Association (NFPA)

1.	NFPA 70-2011	National Electrical Code (NEC)

C. Underwriters Laboratories, Inc. (UL)

1.	UL 67-09	Panelboards
2.	UL 489-13	Safety Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 24 41-1, Approval Data:

1. Manufacturer’s Technical Data.

C. RSN 26 24 41-2, Approval Layouts:

1. Equipment Layout Drawing.

D. RSN 26 24 41-3, Test Data.

1.04 REGULATORY REQUIREMENTS

A. UL listed and labeled.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handle and store equipment in accordance with manufacturer's instructions. Include copy of these instructions with equipment at time of shipment.

PART 2 PRODUCTS

2.01 DISTRIBUTION PANELBOARDS

A. Voltage and System: 208/120 volts, 3-phase, 4-wire, 60-hertz.

B. Input Type:

1. Panelboard DCB-1:
    a. Main Circuit Breaker (MCB): 225 amperes.
    b. Feed thru-lugs for connection to panelboard DCB-2.
2. Panelboard DCB-2:
    a. Main Lug Only (MLO)
3. Panelboard DDA:
    a. MCB: 225 amperes.

C. Main Bus Rating: 225 amperes, minimum.

D. Enclosure Type: in accordance with NEMA 250 with hinged door.

1. Panelboard DCB-1 and DCB-2: Type 12.
2. Panelboard DDA: Type 3R.

E. Solid neutral bus.

F. Bus Material: copper.

G. Mounting: Surface-mounted.

H. Accessories:

1. Ground bus:
    a. Copper.
    b. Sufficient length for attaching equipment ground conductors.
2. Circuit directory:
    a. Show breaker number and connected load as shown on drawings.
    b. Provide panelboard schedule on drawings unless as-built conditions require directory to be revised.

c. Use computer generated lettering in capital letter for directory entries.

d. Directory to provide the following information:

1) Panel name.

2) AIC Rating.

3) Feeding circuit number and panel name.

4) Volts, Amps, Phase, Wire, Date printed.

I. Nameplate:

1. As indicated on standard drawing 40-D-6234.

2. Provide nameplate for each Panelboard.

3. Engraving:

a. “Panelboard DCB-1”.

b. “Panelboard DCB-2”.

c. “Panelboard DDA”.

J. Conform to NEMA PB-1, UL 67, and NFPA 70.

K. Finish: Manufacturer’s standard grey finish for intended installation location.

2.02 MOLDED CASE CIRCUIT BREAKER

A. Thermal-magnetic type with inverse-time trip characteristics on overload and instantaneous trip on short circuit.

B. Voltage: 208/120 volts, as required.

C. Single or multi-pole as indicated on panelboard schedules.

D. Frequency: 60-hertz..

E. Interrupting Rating: 14,000 symmetrical RMS amperes, minimum.

F. Arc quenchers.

G. Quick-make and quick-break toggle mechanisms.

H. Trip-free operating handle.

I. Circuit breakers shall be lockable where required by other systems such as the Fire Protection System. See Section 28 31 00 – Fire Detection and Alarm. A lockable breaker is accomplished by using a circuit breaker lock that is listed for use with the circuit breaker and that allows the breaker to trip, but does not allow tampering with the breaker.

J. Single operating handle. Use of handle ties on multiple-pole circuit breakers is not acceptable.

K. Equip with padlock attachments for locking breakers in "OFF" position.

L. Conform to UL 489.

2.03 FABRICATION

A. Mount ground bus at bottom of panelboard enclosure. Bond bus to enclosure.

B. Mount circuit directory on inside of door.

C. Provide spare circuit breakers as shown.

D. Cover blank spaces with removable covers.

E. Circuit Directory:

1. Use computer generated lettering for directory entries. Hand written directory entries are not acceptable.
2. Show breaker number and connected load as indicated in their relative physical location.
3. Provide panelboard schedule on drawings unless as-built conditions require directory to be revised.
4. Mount directory in transparent plastic front on inside surface of access doors for each board.
5. Fabricate circuit directory frame such that directory need not be folded when placed in frame, and such that all information on directory is clearly visible and legible.
6. Directory to provide the following information:
    a. Panel name.
    b. AIC Rating.
    c. Supply circuit number and panel name.
    d. Volts, Amps, Phase, Wire, Date printed.

2.04 LIGHTING CONTROL PANEL

A. LP8 Peanut Lighting Control Panel by WattStopper, Website: www.wattstopper.com, Catalog #: LP8S-8-G-115; or equal, having the following essential characteristics:

1. Relay panel capable of controlling 8 channels of lighting circuits.
2. Operating Voltages: Separate low and high voltage sections for user protection.
    a. Low: 24VDC.

b. High: 277VAC, 60-hertz.

3. Relay:
   a. Mechanically latching.
   b. Relays shall be individually replaceable.
   c. Integral manual override through control panel.
   d. Ratings: 30 ampere ballast at 277VAC.
   e. Accessory power: 800 mA at 24VDC.
4. Eight universal switch inputs; compatible with 3-wire momentary or maintained, 2-wire momentary or maintained, or 24VDC input.
5. Eight universal group switch inputs that allow pushbutton grouping of relays.
6. Automatic daylight savings adjustments.
7. Scheduling times retained during power outage.
8. Light Emitting Diode (LED) for visual indication of relay status.
9. NEMA 1 enclosure.
10. Nameplate:
    a. As indicated on standard drawing 40-D-6234.
    b. Provide nameplate for each Panelboard.
    c. Engraving: "Lighting Control Panel (LCP)".
11. Operating Temperature Range: 0-degrees Celsius to 60-degrees Celsius.
12. Warranty: 1-year minimum.
13. UL listed.

B. EM Photocell by Wattstopper, Website: www.wattstopper.com, Catalog #: EM-24D2; or equal, having the following essential characteristics:
1. Low voltage photocell.
2. Compatible with lighting control panel listed above.
3. Raintight enclosure.
4. Mounts to building roof.
5. Adjustable aperture window:
   a. 1-15 footcandle range.
6. Isolated relay contacts rated for 1 ampere at 30VAC/VDC. Relay set is normally open.
   a. Photocell provides 'on' signal to panel when light drops below the 'dark' point.

b. Photocell provides 'off' signal to panel when light rises above preset 'light' point.

7. Time delay for signaling: 8 seconds.

8. Warranty: 1-year minimum.

PART 3 EXECUTION

3.01 INSTALLATION

A. Provide anchoring, supporting, and mounting materials for a complete installation.

B. Install in accordance with manufacturer's instructions and recommendations.

C. Panelboard shall be mounted so that no operating handle is less than 24 inches or more than 72 inches above finished floor.

D. Set panelboard plumb and level.

E. Make conduit and wiring connections.

F. Provide require safety labels.

G. Provide engraved nameplate on panelboard.

H. See Section 26 56 00 – Exterior Lighting for lighting control scheduling.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Panelboard enclosure key shall be shown to operate in the presence of government representative.

B. Provide test equipment, labor, and personnel as required to perform the following tests. Panelboards shall be given continuity and insulation tests after the installation has been completed and before the panelboard is energized.

1. Continuity tests using a dc device with buzzer.

2. Insulation test using a 500-volt minimum insulation-resistance test set.

a. Record readings after 1 minute and until the reading are constant for 15 seconds. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

3. Record test data and include the identification of panelboard and megohms readings verses time.

END OF SECTION

SECTION 26 27 16

ELECTRICAL CABINETS AND ENCLOSURES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Electrical Enclosures:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250-2008	Enclosures for Electrical Equipment (1000 Volts Maximum)

B. National Fire Protection Association (NFPA)

1.	NFPA 70-2011	National Electrical Code (NEC)

C. Underwriters Laboratories, Inc. (UL)

1.	UL 50-07	Enclosures for Electrical Equipment, Non-Environmental Considerations
2.	UL 50E-07	Enclosures for Electrical Equipment, Environmental Considerations
3.	UL 94-13	Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 27 16-1, Approval Data and Drawings:

1. Data:
   a. Manufacturer’s data.
2. Drawings:
   a. Provide internal layout drawing of enclosure showing mounting locations for all devices and the associated clearance requirements.
      1) Fire alarm control panel (FACP2).
      2) Fire alarm control panel battery box.
      3) Programmable controller.

4) Chlorine gas detection system device.

5) Chlorine gas detection system battery box.

6) Quad receptacle.

7) Electric heater.

b. Layout drawing to show location for routing of conductors.

1.04 SYSTEM DESCRIPTION

A. The electrical enclosure listed below will be used to mount three separate systems: fire alarm control panel (FACP2), chlorine gas detection system, and programmable controller. See the following Specification sections for reference:

1. Section 25 00 02 – Programmable Controller.
2. Section 28 31 00 – Fire Detection and Alarm.
3. Section 46 31 11 – Chlorine Feed Equipment.

B. This enclosure will provide protection from the surrounding environment to the systems listed above.

C. The enclosure shall provide thermal control for the enclosure to meet the most stringent temperature and humidity ranges from all systems listed above. The minimum standing temperature the enclosure shall reach is 15 degrees Celsius before turning on the heater.

D. The enclosure shall contain two (2) dedicated power circuits from panelboard DDA. One circuit will be dedicated to the fire alarm control panel (FACP2) and associated battery box, and one (1) circuit will supply power to one quad receptacle for equipment supply points. See drawings for panelboard schedules and locations.

PART 2 PRODUCTS

2.01 MULTIPURPOSE ENCLOSURE

A. WeatherFlo enclosure manufactured by Hoffman, Website: www.hoffmanonline.com, Catalog #: WF75LP; or equal, having the following essential characteristics:

1. Enclosure Type: Type 3R ventilated in accordance with NEMA 250 with hinged door.
2. Lockable hinged door with gasket.
3. External mounting brackets. Wall mounted per drawings.
4. Dimensions: 56-inch Height, 36-inch Width, 16-inch Depth, minimum size.
   a. Enclosure size could increase depending on specific systems being installed.
   b. Enclosure size to account for all devices and clearance requirements.

5. Forced air ventilation system included. Ventilation system voltage: 120VAC.
6. Ventilation to include 10-inch fan and metal washable filter.
7. Adjustable thermostat for heating. Thermostat range: 22 degrees Celsius to 60 degrees Celsius.
8. Grounding connections available on door and body of enclosure.
9. Finish: white polyester powder finish.
10. Material: 14 gauge galvanized steel.
11. UL listed.

B. Electric Heater with Fan manufactured by Hoffman, Website: www.hoffmanonline.com, Catalog #: DAH4001A; or equal, having the following essential characteristics:

1. Wattage: 400.
2. Voltage: 120VAC.
3. Thermostat range: -18 degrees Celsius to 38 degrees Celsius.
4. Aluminum housing.
5. Ball bearing fan.

C. Accessories:

1. Mounting Panel: Heavy Duty panel for mounting all large equipment.
   a. Panel supports to be provide to increase mounting weight.
2. DIN Rail for mounting equipment inside of the enclosure.
   a. Material: Steel.
   b. Type: 35mm.

PART 3 EXECUTION

3.01 GENERAL

A. Install all electrical equipment and wiring in accordance with NFPA 70.

B. Install enclosure as indicated.

C. Install all devices located in the electrical equipment area at a minimum height of 30 inches and a maximum height of 72 inches.

D. Install one quad receptacle with ground pole on top to enclosure.

E. Electric heater to be installed near the bottom of the enclosure and meet all manufacturers' clearance requirements.

F. All knockouts created for conduit connections to have gasket interfaces to maintain Type 3R integrity.

G. Install listed devices in Article 1.04A per manufacturer's installation instructions.

H. Internal wire routing to be neat and combined in conductor channels where possible.

I. Provide an exterior mounted nameplate. Nameplate shall state: "Enclosure for Life Safety Systems".

1. Material: Stainless steel
2. Mounting:
    a. On ventilated area.
    b. Attach nameplate with machine screws. Use of adhesives for attaching nameplates is not acceptable.

END OF SECTION

SECTION 26 27 40
WIRING DEVICES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Wiring Devices.

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. National Electrical Manufacturers Association (NEMA)

1.	NEMA WD 1-1999 (2010)	General Color Requirements for Wiring Devices
2.	NEMA WD 6-2002 (2008)	Wiring Devices - Dimensional Requirementss

B. Underwriters Laboratories Inc. (UL)

1.	UL 20-2010	General Use Snap Switches
2.	UL 94-2013	Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.03 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 27 40-1, Approval Data:

1. Manufacturer’s data.

PART 2 PRODUCTS

2.01 OCCUPANCY SENSOR LIGHT SWITCH

A. Manual-On Occupancy Sensor manufactured by Leviton, Website: www.leviton.com, Catalog #: OSSMT-MDW; or equal, having the following essential characteristics:

1. Switch shall be capable of manual-on and automatic-off operation via passive infrared (PIR) and ultrasonic (U/S) detection technology to monitor occupancy space.
2. If this unit does not detect movement after a preset period of time, it will respond by switching its assigned load off.
3. The device shall switch at the zero crossing point of the AC power curve to ensure maximum relay contact life and compatibility with electronic ballasts.

4. The manual-on occupancy sensor shall be equipped with a push-button to provide manual on/off switching.
5. The device shall feature adjustable delayed-off time as well as provide sensitivity adjustment and integral sliding blinders to customize the horizontal field of view.
6. Field of view shall be 180 degrees with maximum coverage of 2,400 square feet.
7. Sensing distance shall be a minimum of 40 feet in front and 30 feet to the sides.
8. Four optional manual adjustments for delayed-off time setting: 30 seconds, 10 minutes, 20 minutes, and 30 minutes.
9. All adjustment options are made after removing the control panel cover.
10. The device shall be capable of providing optional manual-on/automatic-off operation. If motion is detected within 40 seconds after the load has been turned off due to the absence of motion, the lights will turn back on. If the 40 seconds expires, the lights (load) must be turned on manually.
11. The device shall be capable of controlling the load in single pole applications as indicated.
12. Frequency: 60-hertz.
13. Voltage: 277 VAC.
14. Load rating: 2700 volt-amps (VA) at 277 voltage for fluorescent loads.
15. Color: White.
16. Conform to NEMA WD 1 and be UL listed.

2.02 TOGGLE LIGHT SWITCH

A. AC Switches manufactured by Leviton, Website: www.leviton.com, Catalog #: 1221-SW, 1223-SW, and 1224-SW; or equal, having the following essential characteristics:

1. Industrial grade.
2. Toggle switch.
3. Current: 20 amperes.
4. Single pole, 3-way, or 4-way operation as indicated.
5. Contacts: silver-cadmium 0.031 thick.
6. Operating temperature: -40 degrees Celsius to 65 degrees Celsius.
7. Flame resistance to V-0 rating per UL 94.
8. Frequency: 60-hertz.
9. Voltage: 120/277 VAC.
10. Color: White.
11. Terminals: Capable of #10 wiring.
12. Conform to NEMA WD 1 and WD 6.

13. UL listed, meeting the requirements of UL 20.

2.03 RECEPTACLES

A. 120-volt Type:

1. Specification grade, heavy duty, duplex plug.
2. NEMA Configuration: 5-20R.
3. Frequency: 60-hertz.
4. Current: 20 amperes.
5. Device Body: Impact resistant plastic.
6. Terminals: Screw type for line wiring and grounding.

B. Conform to NEMA WD 1, NEMA WD 6, and be UL listed.

2.04 GFCI RECEPTACLES

A. Specification grade, heavy duty, duplex plug with integral ground fault circuit interrupter.

B. NEMA Configuration: 5-20R.

C. Voltage and frequency: 120 volts, 60-hertz.

D. Current: 20 amperes.

E. Body: Impact resistant plastic.

F. Terminals: Screw type for line wiring and grounding.

G. Pushbuttons: Test and reset.

H. Conform to NEMA WD 1 and NEMA WD 6.

2.05 POWER RECEPTACLES

A. Interlocked Receptacle manufactured by Copper Crouse-Hinds, Website: www.crouse-hinds.com, Catalog #: CSR63542; or equal, having the following essential characteristics:

1. Type: Heavy duty, NEMA 4X, corrosion/impact resistant enclosure.
2. Configuration: 3-wire, 4-pole, Non-Fused, with mechanical interlock and disconnect switch.
3. Rated Voltage: 600 volts.
4. Rated Current: 60 amperes.
5. Provided with threaded cap with chain.
6. UL listed.

2.06 COVER PLATES

A. Standard Switch and Receptacle:

1. Type: Impact resistant plastic with white cover plate or 302 stainless steel as indicated.
2. Material Thickness: 0.032 inches.
3. Switch cover plates shall have number of gangs as indicated.

B. Weatherproof Switch Coverplates:

1. Type: Die cast with heavy rubber gasket.
2. Material: Copper free aluminum.
3. Suitable for mounting on type FS cast box.
4. Manufacturers: Crouse Hinds, Syracuse NY, catalog No. DS 185; or equal.

C. Weatherproof Receptacle Coverplates:

1. Type: Die cast with heavy rubber gasket.
2. Material: Copper free aluminum.
3. Suitable for mounting on type FS cast box.
4. Cover shall be 'in-use' type cover meeting requirements of NFPA 70.

2.07 FINISHES

A. Manufacturer's standard finishes except as follows:

1. Light Switches and all Receptacles: White.
2. Standard Cover Plates: White.

PART 3 EXECUTION

3.01 INSTALLATION

A. Bond wiring devices to equipment grounding conductor.

B. Provide wiring devices as indicated.

C. Install switches with OFF position down.

D. Install duplex receptacles in single gang back boxes. Install quad receptacles as 2 duplex receptacles in 1 double gang back box with 1 quad receptacle faceplate.

E. Install receptacles with grounding pole on top.

F. Set occupancy sensor switches to a 10 minute time delay for shut off.

G. Install fork pressure-crimp-type connectors for terminations. Do not place bare stranded conductors directly under screws. Do not use push-in terminals for wiring connections.

END OF SECTION

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SECTION 26 32 10

ENGINE-GENERATOR SET

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Engine-Generator Set:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME BPVC, VIII-2010	ASME Boiler and Pressure Vessel Code Section VIII – Rules for Construction of Pressure Vessels, Division I

B. Commercial Item Description (CID)

1.	CID A-A-1923A	Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)

C. National Electrical Manufacturer's Association (NEMA)

1.	NEMA 250-2008	Enclosures for Electrical Equipment (1000 Volts Maximum)

D. National Fire Protection Association (NFPA)

1.	NFPA 30-2012	Flammable and Combustible Liquids Code
2.	NFPA 37-2010	Installation and Use of Stationary Combustion Engines and Gas Turbines
3.	NFPA 54-2012	National Fuel Gas Code
4.	NFPA 58-2011	Liquefied Petroleum Gas Code
5.	NFPA 70-2011	National Electrical Code
6.	NFPA 110-2013	Emergency and Standby Power Systems

E. Underwriters Laboratories, Inc. (UL)

1.	UL 142-06	Steel Above Ground Tanks For Flammable and Combustible Liquids

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals, and 01 33 26 – Electrical Drawings and Data.

B. RSN 26 32 10-1, Approval Drawings and Data for Engine-Generator Set:

1. Commercial product data for components furnished.
2. Detailed shop drawings for components furnished.
3. Electrical control diagrams, interconnection wiring diagrams, and schematics showing wire connections and conduit layout. Provide electrical control schematic diagrams in ladder-logic format.

C. RSN 26 32 10-2, Approval Drawings and Data for Propane Fuel System:

1. Commercial product data for components furnished.
2. Detailed shop drawings for components furnished.

D. RSN 26 32 10-3, Check Prints:

1. Schematic and Wiring Diagrams.

E. RSN 26 32 10-4, Final Drawings and Data:

1. Service manuals for components furnished:
   a. Operating and maintenance instructions.
   b. Half-size prints (11 inches x 17 inches) of installation and detailed assembly drawings.
   c. Electrical schematics and wiring diagrams.
   d. Lubrication schedule.
   e. List of special tools.
   f. Parts catalog for components provided under this section.
2. Electronic copies of drawings and diagrams submitted in the service manual in AutoCAD format.
3. Site test procedures for on-site testing and provide NFPA 110 requirements.

F. RSN 26 32 10-5, Site Test Report and Photographs:

1. Certified copies of mechanical and electrical site tests.
2. Photographs: Include one side view and one end view of installed engine-generator set, and one view showing the fuel tank system after installation.

1.04 EXTRA MATERIALS

A. Furnish the following spare parts in a metal box:

1. Four engine oil filters.
2. Four air filter elements.
3. One complete set of engine V-belts.
4. Six spare fuses of each type of fuse.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect equipment from corrosion, deformation, and other types of damage.

PART 2 PRODUCTS

2.01 ENGINE-GENERATOR

A. Outdoor, stationary unit complete with weather-protective housing, and rated for standby service.

B. The engine and main generator both mounted to a rigid frame with vibration isolators sized for continuous full-load operation.

C. Fully operational system with associated control and electrical equipment installed complete.

D. Nameplate Rating:

1. Rating, minimum after derating: 100 kW (125 kVA).
2. Ambient air temperature range: -10 degrees Fahrenheit to plus 102 degrees Fahrenheit.
3. Elevation: 6,700 feet above sea level.

E. Engine:

1. 4-Cycle.
2. Fuel: LPG (Liquefied Petroleum Gas).
3. Speed: 1,800 rpm.
4. Starting system: 12-volt DC.
5. Governor: Electronic, isochronous.
6. Cooling system: Closed recovery, liquid coolant, with a unit-mounted radiator, belt-driven pusher fan, thermostatic temperature control, and engine-mounted circulating pump.

F. Power factor: 0.8 power factor.

G. Voltage: 277/480 volts.

H. Phase: 3-phase.

I. Frequency: 60-hertz.

J. Alternator:

1. At full rated load without exceeding 125 degrees Celsius (257 degrees Fahrenheit) temperature rise as defined by NEMA Standard MG1 for ambient temperatures above 40 degrees Celsius (104 degrees Fahrenheit).

2. Winding insulation: NEMA MG1, Class H.

K. Voltage Regulator: Torque-matched with under-frequency and over-voltage protection and 3-phase voltage sensing.

L. Excitation System:

1. Brushless.

2. Shaft mounted.

M. Frequency: Isochronous for all applied loads from no load to full-rated load.

N. Random Frequency: Plus or minus 0.5 percent of its mean value for constant loads, from no load to full-rated load.

O. Transient Voltage Dip: Not to exceed 20 percent of the rated voltage.

P. Steady-state Frequency: Voltage output shall be constant.

Q. Voltage Regulation: Plus or minus 1 percent between no load and full-rated load.

2.02 ASSOCIATED COMPONENTS

A. Circuit Breaker:

1. Type: Molded-case, thermal-magnetic.

2. Manual reset circuit.

B. Battery:

1. Voltage: 12-volt DC.

2. Type: Lead-acid.

3. Cranking Current: 550 amps (minimum) at ambient temperature of 32 degrees Fahrenheit.

4. Life expectancy: 4 years on float charge.
5. Insulation: Size and type recommended by battery manufacturer.
6. Rack mounted in engine-generator weather-protective housing.

C. Battery Charger:

1. Voltage: 12 volts DC.
2. Current: 75 amperes (minimum) and tapering to 0 ampere.
3. Service power: 120 volts, single phase, 60 hertz.
4. Meters: Direct-current voltmeter and ammeter, accuracy within 2 percent of full scale with an independently adjustable float and equalize charge.
5. Protect the input and output circuits of the battery charger with a circuit breaker (or fuses).
6. Enclosure: NEMA 250, Type 3R.
7. Rack mounted with battery in engine-generator weather-protective housing and isolated from engine-generator set.
8. DC voltage regulation: plus or minus 1 percent, from no load to full load.
9. Integrated with battery heater suitable for ambient conditions.

D. Heaters for Coolant and Battery:

1. Service power: 120 volts, single phase, 60-hertz.
2. Size: Manufacturer's standard.
3. Thermostatically controlled, as recommended by manufacturer.

E. Digital Electronic Control Panel:

1. Circuitry: Solid-state.
2. Mounting: Provide vibrational isolators.
3. Schematic wiring diagrams:
    a. Attach to inside of control panel cabinet door
    b. Show relationship and location of the controls and alarm contacts.
4. Selector switch and pushbuttons (or equivalent electronic controls):
    a. Three position selector switch (labeled OFF-MANUAL-AUTOMATIC):
        1) MANUAL position: manual startup or shutdown of the engine-generator set in response to START-STOP pushbuttons.
        2) OFF position: prevents manual or automatic operation of the engine-generator set and provides a lockout safety for periodic maintenance and resetting of the engine-generator.

3) AUTOMATIC position: starting and operating the engine-generator in response to the automatic engine-starting system controls.

b. START-STOP pushbuttons.

c. Emergency stop pushbutton or switch:

1) Cause engine-generator to immediately shut down and be locked out from automatic restarting.

2) Include a lockout provision for use in safely disabling the engine-generator set for necessary service.

d. Fault reset switch: clears a fault and allows restarting of the engine-generator set after shut down for any fault condition.

5. Indicators:

a. Running time meter (hours) to log actual engine operation.

b. Oil pressure.

c. Oil temperature.

d. Engine coolant temperature.

e. 3-phase AC current.

f. Line-to-line and line-to-neutral AC volts.

g. Frequency.

h. Total and individual phase kW and kVA.

i. Fuel-level indication meter.

F. Alarm Contacts and Illuminated Annunciation Lamps.

1. Alarm contacts wired to terminal blocks in the engine-generator control panel, to close and indicate the following conditions:

a. Engine-generator fail to crank shutdown.

b. Engine-generator fail to start (overcrank) shutdown.

c. Engine-generator overspeed shutdown.

d. Engine-generator high coolant temperature shutdown.

e. Engine-generator low coolant temperature alarm.

f. Engine-generator low oil pressure shutdown.

g. High, low, and weak battery voltage alarm.

h. High and low AC voltage shutdown.

i. Under frequency shutdown.

j. Short circuit shutdown.

k. Ground fault alarm.

l. Over load alarm.

m. Low fuel level in the fuel sub-base tank.

G. Cranking Controls:

1. Cranking limiter: Prevent simultaneous engine cranking and engine operation.

2. Oil-pressure bypass switch: Bypass the engine oil-pressure protective switch for the duration of the cranking interval to permit engine-generator startup.

H. Shutdown Controls:

1. High engine coolant temperature.

2. Low coolant level.

3. Low oil-pressure.

4. Overspeed.

5. Failure to start after the stipulated number of cranking attempts.

6. Failure to crank.

7. High and low AC voltage shutdown.

8. Under frequency shutdown.

9. Short circuit shutdown.

I. Exhaust System:

1. Directs all engine exhaust to outside the weather-protective housing for the engine-generator set.

2. Flexible exhaust connector:

a. Spiral or bellows type.

b. Locate between discharge of engine exhaust and exhaust system to isolate vibration.

3. Exhaust piping: Carbon steel with sweeping long-radius elbows.

4. Rain cap: Install on discharge end of exhaust pipe.

5. Condensation trap and drain valve: Install between flexible exhaust connector and muffler.

6. Muffler: Rated for critical noise applications. Weight of muffler shall be supported by the weather-protective housing.

7. Heat shield: Provide around exhaust piping to prevent accidental burns.

J. Weather-Protective Housing:

1. Commercial unit, specifically designed for the engine-generator set supplied.
2. Fabricated steel framework and panels, with properly sized vents for dissipating engine heat.
3. Removable panels or hinged doors on both sides of the housing to provide access to the engine-generator set, batteries, battery charger, and control panel. All service points to be accessible.
4. Anchor to concrete foundation with expansion anchors on a rigid steel base, independent of the enclosed engine-generator set. See drawing 1695-D-187 for concrete foundation.
5. Louvers: Sized to meet engine-generator set manufacturer's requirements.

2.03 FUEL SYSTEM

A. General: Fuel system shall comply with applicable rules and regulations of NFPA 30, NFPA 54 and NFPA 58, and shall meet all prevailing Federal, State, and Local Codes governing this type of installation.

B. Fuel Pipe:

1. Black iron pipe suitable for LPG gas.
2. Provide both vapor-withdrawal pipe line and liquid-withdrawal pipe line between fuel tank and vaporizer.
3. Provide single vapor pipe line between vaporizer and engine-generator set.
4. Size fuel piping in accordance with manufacturer's recommendations based on kilowatt rating and supplied pipe routing requirements of engine-generator set.
5. Provide flexible fuel line section between fuel line and engine-generator set.
6. Provide pipe unions to provide access to pipelines buried beneath fuel pipe. See drawing 1695-D-273 for layout of piping. Pipe unions to be rated for LPG service.
7. Provide pipe sleeves in concrete foundations necessary for the installation of the fuel piping.

C. Propane/LPG Storage Tank:

1. Tank size (minimum): 1,000 gallons.
2. Fabricate steel tank in accordance with UL 142 and requirements of ASME BPVC, VIII. Stamp the tank with official ASME code symbol.
3. Provide tank with saddle supports or support feet with earthquake restraints.
4. Provide hinged dome cover with padlock.

5. Anchor to concrete foundation with expansion anchors on a rigid steel base, independent of the enclosed engine-generator set. See drawing 1695-D-185 for concrete foundation.

D. Direct Fired Gas Burner Vaporizer:

1. Sized to supply maximum rated capacities of engine-generator set.
2. Supplies either generated gas, or gas from fuel tank, or both in response to demand.
3. Prevents liquid from flowing from vaporizer into service line to engine-generator set.
4. Furnish and install weather-protective walk-in housing.
    a. Angle iron base, drilled for mounting anchor bolts in concrete foundation and sealed to concrete foundation.
    b. Galvanized steel paneling of not less than 22-gauge thickness.
    c. All paneling and roof sections reinforced with angle supports.
    d. All exposed edges hemmed.
    e. Single door of dimensions shown on drawing.
        1) Rustproof door hinges and reinforced with backup plates.
        2) Equipped with handle or hasp providing padlocked access.
    f. Screened louvers as shown on drawing.
    g. Vaporizer stack:
        1) Cutouts in housing for extension of vaporizer stack.
        2) Pass through a weather-proof roof seal that is compatible with fire codes.
5. Adequately vent discharge of relief valve to outside air.
6. Provide electric pilot re-igniter to protect pilot outage due to unusually turbulent winds.
    a. Service power: 120 volts, single phase, 60-hertz.
7. Anchor to concrete foundation with expansion anchors on a rigid steel base, independent of the enclosed engine-generator set. See drawing 1695-D-185 for concrete foundation.

E. Accessories:

1. Pressure relief valve:
    a. Installed on fuel storage tank.
    b. Suitable for LPG fuel.

c. Set pressure not to exceed maximum allowable working pressure of tank.

2. Manual shut-off valves:

   a. Manually isolates fuel lines as shown on drawing.

   b. Located at fuel tank and before secondary regulator.

   c. Materials: Carbon steel or ductile iron. Brass valves will not be acceptable.

   d. Suitable for LPG fuel.

3. Solenoid shut-off valve:

   a. Energized by engine battery.

   b. Operates in conjunction with fuel supply controls for engine-generator set, and is capable of manual (nonelectric) activation when solenoid malfunctions.

   c. Seals off fuel to engine-generator when ignition switch is turned off.

   d. Located downstream of secondary regulator next to engine-generator set but upstream of flexible fuel line.

   e. Suitable for LPG fuel.

4. Primary regulator:

   a. Mounted within weather-protective housing for vaporizer.

   b. Adequately vent discharge of relief valve to outside air.

   c. Size regulator to provide maximum fuel consumption required by engine-generator set after pressure losses due to length of transmission pipes and losses through all fittings are taken into account.

   d. Suitable for LPG fuel.

5. Secondary regulator:

   a. Size regulator to provide maximum fuel consumption over full range of engine-generator set after pressure losses due to length of transmission pipes and losses through fittings are taken into account.

   b. Suitable for LPG fuel.

6. Protective housing for secondary regulator:

   a. Mount secondary regulator, pressure gauge, and manual shut-off valve within a protective housing.

   b. Fabricated from not less than No. 14 gauge sheet metal. Galvanize metalwork after fabrication.

   c. Rigidly reinforced with a hinged, lockable cover.

   d. Provide tabs and mount with anchor bolts to concrete slab.

7. Pressure gauges, fixed liquid level gauge, filler valve, liquid evacuation valve, other:
    a. Suitable for LPG fuel.
8. Fuel level indicator:
    a. Located on propane/LPG storage tank.
    b. Suitable for operation in LPG fuel.
    c. Provide direct (localized) readout of fuel level at storage tank and a low fuel level alarm relay.
    d. On-site readout in percentage of full.
    e. System components:
        1) Float gauge mechanism.
        2) Fuel level indication meter.
        3) Audible and visual alarm located next to automatic transfer switch indicating low fuel level.
        4) All additional accessories to make a complete system.
9. Isolation fittings:
    a. Specifically designed for use with LPG piping.
    b. Able to withstand forces on piping due to expansion and/or settlement, without leakage, throughout ambient temperatures range.
    c. Installed to electrically isolate the following:
        1) Fuel tank from the buried fuel lines.
        2) Vaporizer from the buried fuel lines.
        3) Engine-generator set from the buried fuel line.
10. Provide other necessary connections and components to make a complete fuel system.

2.04 EXPANSION ANCHORS

A. Expansion Anchors:
    1. CID A-A-1923, Type 4, galvanized steel.
    2. Bolt length: As shown on drawings. If not shown, provide bolt length with 3-1/2-inch minimum embedment.

2.05 CORROSION PROTECTION

A. Ribbon Zinc Anodes:
    1. Wire core diameter: At least 0.10-inch.

2. Nominal weight: 1.2 pounds per foot (minimum).

2.06 ELECTRICAL EQUIPMENT

A. Electrical service for operation of devices below will be 120 volts, AC, 60-hertz. Provide service power for the following components:

1. Engine-generator heater.
2. Fuel level indicator.
3. Battery charger.
4. Battery heater.
5. Vaporizer pilot reignitor.

2.07 COATINGS

A. Coat in accordance with Section 09 96 20 – Coatings.

2.08 NAMEPLATE

A. Location: Attached to control panel.

B. Inscribe the following:

1. Ratings: Kilowatt and kVA, rpm, phase, 60 hertz, Voltage, full load current.
2. Engine: Fuel type, number of cylinders.
3. Name and address of manufacturer.

2.09 CONTRACTOR SOURCE QUALITY TESTING

A. Perform mechanical, electrical, and operational tests to confirm that equipment meets specification requirements and applicable codes, standards, and regulations.

B. Furnish test equipment and factory test technician.

C. Perform testing in presence of the COR.

D. Notify COR at least 14 days in advance when tests are to be performed.

E. Documentation:

1. Date and sign.
2. Identify specific feature being tested.
3. Include test results and items such as: rated loads, power factor, ambient temperature, altitude, and fuel grade under which the test is performed.
4. Submit as part of final data.

F. Factory tests of the engine-generator set to include the following:

1. Full load test: Conducted and documentation provided per NFPA 110.
2. Cycle crank test: Conducted and documentation provided per NFPA 110.
3. Vibration:
    a. Loads: 50, 75, and 100 percent of nameplate rating.
    b. At each of the loads, conduct a vibration test and document engine-generator set vibration in mils (peak to peak).
    c. Acceptable level of vibration: Vibration tolerance not greater than 5 mils (peak to peak), at full-rated operating speed, as measured in any direction (horizontal, vertical or axial) on the main frame, engine, generator, and associated components.
    d. If vibration exceeds this tolerance, properly balance and/or provide vibration isolators to reduce vibrations to an acceptable level prior to shipping.

G. Test generator in accordance with NEMA MG-1. Demonstrate and document that electrical properties of generator excitation system, voltage regulation system, engine governor system, illuminated annunciators, and controls are acceptable for intended purpose and are in accordance with specification requirements.

H. Make adjustments as required and retest until unit functions properly.

I. Fuel tank factory test: Tested and repaired for leakage in accordance with the requirements of UL 142.

J. Correct defects demonstrated by the above tests by and at the expense of the Contractor to make the equipment fully operational to the satisfaction of the COR.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install engine-generator set, fuel system, and weather-protective housings:

1. In accordance with the manufacturer’s instructions and recommendations.
2. As shown on drawings 1695-D-273 and 1695-D-274.

B. Install grout as shown on drawing 1695-D-274, and in accordance with Section 03 63 00 – Epoxy Grout.

C. Lubricate and winterize equipment in accordance with the manufacturer's recommendations.

1. Use 25 percent or more re-refined oil base stock for engine lubricating oils, hydraulic fluids and gear oil.
2. Engine coolant to contain only one base chemical (typically ethylene glycol or propylene glycol) to prevent commingling of incompatible types of engine coolant.

D. Install electrical equipment in accordance with NFPA 70.

E. See Section 26 24 13 – Switchboards, DCA to coordinate transfer switch installation with engine-generator set.

F. After equipment is installed, testing completed, and adjustments made, repair any damage to the coatings in accordance with Section 09 96 20-Coatings.

G. Expansion Anchors:

1. Drill holes in concrete for installation of expansion anchors.
    a. Drill holes straight and true to diameter and embedment depth as recommended by anchor manufacturer and in accordance with requirements of respective equipment manufacturers.
    b. If embedded steel or reinforcement is encountered during drilling, use core drilling in accordance with expansion anchor manufacturer's recommendations.
2. If drilling water is used, clean exposed concrete surfaces immediately after drilling to prevent discoloration.

3.02 CORROSION PROTECTION

A. Ribbon Zinc Anodes:

1. Install for the following:
    a. Buried fuel line between the vaporizer and engine-generator set.
2. Lay continuous length anode of zinc ribbon in fuel line trench:
    a. Install parallel to line.
    b. Install approximately 3 inches from the line.
    c. For length of each buried pipe.
    d. Exothermically weld (Cadweld) to fuel lines at both ends of zinc ribbon to create galvanic circuit.

3.03 CONTRACTOR FIELD QUALITY TESTING

A. General:

1. Perform mechanical, electrical, and operational tests to confirm that equipment meets specification requirements and applicable codes, standards, and regulations.
2. Furnish test equipment and commissioning personnel.
3. Perform testing in presence of the COR.
4. Notify COR at least 14 days in advance when tests are to be performed. Coordinate testing with testing of the automatic transfer switch in Section 26 24 13 – Switchboards, DCA.
5. Conduct on-site testing of engine-generator unit after complete installation of equipment.
6. Documentation:
    a. Sign and date.
    b. Identify specific feature being tested.
    c. Include test results and items such as rated loads, power factor, ambient temperature, altitude, and fuel grade under which the test is performed.

B. Engine-Generator Set:

1. Conduct on-site test and document per NFPA 110 (Installation Acceptance section).
2. Test: Approved by the COR.
3. Correct defects disclosed by the tests, or vibration which is detrimental to the equipment, to the satisfaction of the COR.

C. Fuel System:

1. Test to occur after installation of equipment but prior to backfilling pipe trench.
2. Test fuel system for leaks by pressurizing system with air and then using soap-film method on fuel lines and fuel components.
3. Demonstrate that fuel system components operate in accordance with these specifications.
4. Correct any leakage or defects, and make necessary corrections and adjustments to the satisfaction of the COR.

3.04 TRAINING

A. Provide training at project site to instruct Government personnel in systems and operations of engine-generator set and fuel tank equipment.

B. Use equipment service manuals for training.

END OF SECTION

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SECTION 26 42 10

BURIED IMPRESSED CURRENT CATHODIC PROTECTION AND CORROSION MONITORING SYSTEMS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Impressed Current Cathodic Protection and Corrosion Monitoring Systems:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCES STANDARDS

A. ASTM International (ASTM)

1.	ASTM B 3-01(2007)	Soft or Annealed Copper Wire
2.	ASTM C 33/C33 M-11	Concrete Aggregates
3.	ASTM F 512-06	Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduits and Fittings for Underground Installation

B. Bureau of Reclamation (USBR)

1.	USBR M-47	Standard Specification for Repair of Concrete, August 1996

C. National Association of Corrosion Engineers (NACE)

1.	NACE SP0169-2007	Control of External Corrosion on Underground or Submerged Metallic Piping Systems.
2.	NACE TM0497-2012	Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems.

3. Peabody A.W., (2001), Peabody's Control of Pipeline Corrosion, 2nd Edition.

D. National Electrical Manufacturer's Association (NEMA)

1.	NEMA 250-2008	Enclosures for Electrical Equipment (1000 Volts Maximum)

E. Underwriters Laboratories (UL)

1.	UL 651-05	Schedule 40 and 80 Rigid PVC Conduit

1.03 DEFINITIONS

A. Bonded Dielectric Coating: A protective barrier coating system with high electrical resistivity bonded directly to the underlying structure and acting to physically and electrically isolate the metal from the electrolyte.

B. Impressed Current Protection: Reduction of corrosion of a metal in an electrolyte by supplying a DC current through an external power source and employing an impressed current anode.

C. Electrolyte: An electrically conductive solution, such as soil or water. The terms for these specific conductive solutions may be substituted for the word "electrolyte" in these definitions.

D. Portable Voltmeter: Portable instrument for measuring voltage drops across electrical components or potential (voltage) differences between a structure and a stable reference electrode:

1. Minimum input impedance: 10 megohm.
2. DC voltages measurment range: ±0.1 volts to ±100 volts.
3. Connect the positive terminal of the voltmeter to the structure and the common (negative) terminal to the reference electrode. Read the magnitude and polarity of the voltage as shown on the instrument display.
4. When measuring structure potentials using an analog instrument with a needle that swings in one direction, reverse connections and interpret of the polarity..

E. Reference Electrode: An electrode with constant open circuit potential under similar conditions of measurement; used for measuring the relative potentials of other electrodes (e.g. protected structures). Sometimes referred to as a reference half-cell. A copper/copper sulfate reference electrode (CSE) is often used.

F. Stray Current Interference: Corrosion resulting from current through paths other than the intended circuit - e.g., corrosion occurring on a structure caused by the cathodic protection system on a foreign structure, or some other source of current. Can be either AC or DC.

G. Structure: Metallic pipes and fittings or other metalwork being protected and monitored.

H. Structure-to-Electrolyte Potential:

1. Also referred to as structure-to-soil, pipe-to-soil, and structure-to-water potentials.
2. The potential of the structure in the electrolyte as compared to the potential of a reference electrode making contact with the same electrolyte.
3. Static structure-to-electrolyte potential: The structure-to-electrolyte potential determined without any external current (e.g. prior to energizing a cathodic protection system, and with no galvanic couple, pH cell, interference currents, or

the like present), or after such a current source has been disconnected for an extended time. Also referred to as native structure-to-electrolyte potential.

4. Uncorrected structure-to-electrolyte potential: The structure-to-electrolyte potential determined with the cathodic protection system energized and cathodic protection current flowing. This potential is sometimes called the protective potential and may contain significant IR drop error.

5. Polarized structure-to-electrolyte potential: The structure-to-electrolyte potential determined after the cathodic protection system has been energized, but immediately after the cathodic protection current is interrupted. Also referred to as "instant off" structure-to-electrolyte potential.

6. Polarization: The change from the static or native potential as a result of current flow across the electrode/electrolyte interface. Also considered the difference between polarized and native potentials.

I. Test Station: A location for conducting tests on a protected structure, normally having an enclosure containing terminals of cables from one or more structures.

1.04 QUALIFICATIONS

A. Installation and testing shall be directed or performed by a Cathodic Protection Specialist certified by NACE International. Manufacturer's Standards: Comply with manufacturer's recommendations and standards unless otherwise specified

B. NACE SP-0169 and NACE TM0497 shall apply to issues not specifically addressed by this specification.

1.05 SYSTEM DESCRIPTION

A. Provide cathodic protection systems for the buried portions of the following features and pipe choices on the Tohlakai Pumping Plant Project:

1. Metallic Twin Lakes Storage Tank and Metallic Tohlakai Pumping Plant Yard Pipe: Impressed current cathodic protection for tank bottom, pipe, fittings, and other associated metalwork, which is electrically continuous.

2. Metallic Pipe for Twin Lakes Turnout, Reach 12B, and Reach 12.1: Impressed current cathodic protection for pipe, fittings, and other associated metalwork, which is electrically continuous. Galvanic anode cathodic protection systems for metal casings on Twin Lakes Turnout and Reach 12.1 (See Specification 26 42 12).

3. PVC Pipe for Twin Lakes Turnout and Reach 12B: Galvanic anode cathodic protection systems for metal fittings, casings, and associated metalwork (See Specification 26 42 12).

B. Provide corrosion-engineering services to furnish, install, and test the cathodic protection and corrosion monitoring system components.

1. Include electrical isolation, electrical continuity bonds, rectifiers, junction boxes, test stations, anodes, and accessory equipment and features as directed in this specification or as otherwise indicated.
2. Include testing and adjustment of all impressed current systems.
3. All materials, installation and testing shall be consistent with sound corrosion engineering principles and practice in accordance with NACE SP0169, NACE TM0497, and Peabody.

C. Cathodic protection systems:

1. Provide a minimum service life of 20 years (system and components).
2. Maintain on all locations of protected structure(s), with reference to a copper/copper sulfate electrode placed close to the structure:
   a. A polarized structure-to-electrolyte potential of at least -0.850 volts on the structure having a high quality bonded dielectric coating.
   b. Alternately, at the discretion of COR, -0.100 volts of polarization if the -0.850 volt criterion cannot be obtained due to extenuating circumstances (e.g. on bare or poorly coated structures or localized locations with high soil resistivity).
   c. A polarized potential at any point on a dielectrically coated structure not exceeding -1.100 volts in all instances.

D. Placement and current output of anode shall provide adequate distribution of cathodic protection current, as indicated by potential readings.

E. Electrical Continuity Bonds:

1. Shall be metallurgical bonds and shall be provided as necessary to assure electrical continuity of all metalwork to be monitored.
2. Bond cable designed such that their resistance does not detrimentally affect the performance of the cathodic protection system.

1.06 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 26 42 10-1, Certification and Data;

1. Copy of the Cathodic Protection Specialists' NACE International certification for personnel performing or directing the installation and testing of the corrosion monitoring system
2. Preconstruction drawings:
   a. Intended location of test stations
   b. Intended wiring details for any test stations

3. Manufacturer's data including catalog data sheets when available, including:
    a. Impressed current anodes.
    b. Cables.
    c. Metallurgical bonding system.
    d. Dielectric coating system for bonds.
    e. Junction box.
    f. Test stations.
    g. Shunts.
    h. Variable resistors.
    i. Rectifier.
    j. Isolation joint flange kit
    k. Carbonaceous backfill material.
    l. Vent pipe.
    m. $Cu/CuSO_4$ permanent reference electrode(s).
    n. PVC conduit

C. RSN 26 42 10-2, Final Data:
1. As-built information and drawings, including:
    a. Locations of test stations, junction boxes, rectifier, anodes, electrical continuity bonds, and cable runs.
        1) Locations shall be given using unique identifier and GPS coordinates and type of test station.
    b. List of anode cable identifications in test station and anode junction box.
2. Test Results:
    a. Including:
        1) Test equipment and methods utilized.
        2) Placement location of reference electrode during each test.

PART 2 PRODUCTS

2.01 CABLES

A. Single-conductor: stranded, plain, annealed copper cable.

B. Cable insulation:
1. Rated for 600 volts and direct immersion or burial.

2. High molecular weight polyethylene (HMWPE) outer jacket with minimum thickness of 0.100 inch.

3. Dual insulation construction, inner layer of Halar or Kynar and outer layer of HMWPE for impressed current anode cables.

C. Unspliced lengths to permit installation from terminus to terminus (e.g. structure to test station or anode to junction box) free of splices and without stress.

D. Gauge:

1. No. 2 AWG or larger for electrical continuity joint (jumper) bonds (black insulation).

2. No. 6 AWG or larger for structure cables and structure to rectifier cables (black insulation).

3. No. 12 AWG or larger test cables for determining structure-to-electrolyte potentials (black insulation).

4. No. 10 AWG or larger for deep well impressed current anodes (red insulation if available).

5. No. 14 AWG or larger for permanent reference electrodes (yellow insulation).

2.02 ELECTRICAL CONTINUITY JOINT BONDS

A. Insulated copper cable in accordance with cable requirements above.

2.03 EXOTHERMIC METALLURGICAL BONDS

A. Specifically designed for cathodic protection systems.

B. Specifically designed for metallic substrate materials.

C. The exothermic reaction produces molten copper, which produces a permanent, high conductivity connection.

D. Uses a special alloy to provide minimum heat effect on the substrate material.

E. Current carrying capacity equal or better than that of the conductor.

2.04 JUNCTION BOX

A. Specifically constructed for cathodic protection system installations.

B. Enclosed within a NEMA 250, Type 3-R, lockable cabinet constructed of No. 16-gauge or thicker galvanized steel that is weatherproof, lockable, and vented for heat dissipation.

1. Screened against the entry of bees, hornets, or wasps.

C. Equip with 0.01 ohm calibrated shunt for each anode.

D. Equip with variable resistors of adequate electrical rating for each anode such that the current flow of each anode can be adjusted as required within 125 percent of one another, without overheating the variable resistor.

E. Engraved 1/4-inch minimum NEMA grade C phenolic panel.

F. Solderless, pressure-type terminals.

G. Identified terminals.

H. Equip with combination bracket for pole or wall mounting.

2.05 RECTIFIER

A. Constant voltage type.

B. Air cooled.

C. Capable of continuous operation at 120 percent of rated output in ambient temperature of 50 degrees C.

D. Fitted with a heavy-duty transformer.

E. Silicon diode type.

F. Fitted with individual meters for determining output voltage and current, and which are:

1. Accurate within 2 percent of full scale.
2. Marked with red lines designating rated capacities.

G. Output voltage is adjustable in 20 or more equal increments or continuously from 0 to 100 percent rated output.

H. Energized by 120-volts, single phase AC.

I. AC and DC lightning arrestors and protective fuses or relays.

J. Solderless, pressure-type terminals for anode and cathode cables.

K. NEMA 250 type 3-R, weatherproof, lockable, vented for heat dissipation cabinet constructed of No. 16-gauge or thicker galvanized steel.

L. A single slide out rack for easy access to internal components during maintenance. The rack shall slide out the front of the cabinet.

M. An accessible shunt on the front panel for determining current output. The shunt shall be stamped with the amperage per millivolt rating.

N. 115-volts AC convenience outlet.

O. Fitted with a combination bracket for wall or pole mounting.

P. Screened against the entry of bees, hornets, or wasps.

2.06 IMPRESSED CURRENT ANODES

A. Center connected graphite anodes as supplied by Farwest Corrosion Control Co., 480 Artesia Blvd., Gardena CA, 90248, or equal, with the following essential characteristics:

1. Number of anodes:
    a. Specified in table 26 42 10-C - Impressed Current.
2. Anode size:
    a. 4 inch diameter
    b. 80 inch length
3. Minimum weight:
    a. 64 pound
4. Wax or resin treated graphite anode material specifically designed for cathodic protection systems and the intended environment.
5. Low resistance center cable connection having a waterproof seal on both sides of the anode-to-cable connection.

B. Anode cable in accordance with cable requirements of this section. In addition, provide cable with dual insulation construction, inner layer of Halar or Kynar and outer layer of high molecular weight polyethylene.

C. Factory anode-to-anode cable connection:

1. Internal moisture seal.
2. Epoxy encapsulation and an external anode cap.

2.07 TEST STATIONS

A. Big Fink, manufactured by Cott Manufacturing Company, 1944 Gardena Avenue, Glendale, CA 91204; or equal, having the following essential characteristics:

1. Above-ground, orange-capped, post-mounted type.
2. Specifically constructed for cathodic protection system installations.
3. Protected as required for permanency.
4. Sufficient number of terminals (5 terminals minimum) with associated hardware for the number and size of cables and any other accessories required by the design.

2.08 DIELECTRIC COATING FOR METALLURGICAL BONDS

A. Royston Handy Cap, manufactured by Royston Laboratories, Inc., 128 First St., Pittsburgh, PA, 15238; or equal, having the following essential characteristics:

1. Specifically designed for cathodic protection systems.
2. Applied with primer coat, as needed.
3. Approved dielectric coating material.
4. Suitable for the intended environment.

2.09 SAND BACKFILL

A. Sand backfill: ASTM C 33, fine aggregate.

2.10 WARNING TAPE

A. Polyethylene warning tape:

1. Minimum 3 inches wide.
2. Red or yellow with black lettering.
3. Suitable for direct burial.
4. "Caution –Cathodic Protection Cable Buried Below" printed on tape for its full length.

2.11 ELECTRICAL CONDUIT

A. Minimum 1.5 inch diameter PVC conduit and fittings for deep well anode cables.

2.12 IMPRESSED CURRENT ANODE BACKFILL

A. Coke Backfill: Use SC3 calcined fluid petroleum coke as manufactured by Loresco Inc., 421 J.M. Tatum Industrial Park drive, Hattiesburg, MS, 39401; or equal, having the following essential characteristics listed in Table 26 42 10A – Typical Chemical Analysis.:

Table 26 42 10A - Typical Chemical Analysis

Component	Percent Composition
Carbon (fixed)	99.00 Minimum
Ash	0.6 Maximum
Volatiles	0 (950 degrees C)
Moisture	.05

1. Particle Analysis: Dust free with a maximum particle size of 1 mm.

2.13 PEA GRAVEL

A. 1/8th inch to 3/8th inch smooth (no rough edges) pea gravel.

2.14 PERMANENT REFERENCE ELECTRODE

A. Copper/Copper Sulfate permanent reference electrode: Permacell Plus, manufactured by CorrPro Canada, 103, 221 - 18th Street SE, Calgary, AB, T2E UJ5; or equal, having the following essential characteristics:

1. Double membrane, ceramic cell in a geomembrane package.
2. No. 14 AWG stranded copper cable with yellow HMWPE insulation of suitable length to extend from the pipeline to the test station without splicing.

2.15 DEEP WELL VENT PIPE

A. Deep Anode Venting System Pipe: AllVent, manufactured by Loresco® International, 421 J.M. Tatum Industrial Park drive, Hattiesburg, MS, 39401; or equal, having the following essential characteristics:

1. Nominal 1 inch inside diameter.
2. Slotted pipe within coke backfill and non-slotted outside the limits of the coke backfill column. Provide one of the following slot types while maintaining maximum pipe strength.
    a. Vertical slits 1.5 inches in length with a width of 0.006 inches parallel to the longitudinal centerline of the pipe. Center-to-center spacing of 6 inches placed 1 inch in circumferential distance from the preceding slot, allowing for a 360 degrees venting ability.
    b. 1/8-inch holes drilled on 6-inch centers in the area of the anodes for the plastic vent pipe. Do not drill holes in the vent pipe above the anodes.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

A. Installation and testing shall be performed or directed by a Cathodic Protection Specialist certified by NACE International.

B. Installation details indicated on Drawings 1695-D-92 to 1695-D-95.

C. Tank, pipe, and fittings shall be electrically isolated from all other metal (e.g. rebar in concrete).

D. Dielectric materials that might cause shielding of possible future cathodic protection current (e.g. plastic debris) shall not be left in the excavation with the structure.

E. Cable:

1. Inspect for insulation defects prior to backfilling.
    a. Replace cables if insulation is damaged.

2. Install without kinks, stresses, and/or splices.

3. Buried applications:

   a. Conform to Drawings 1695-D-92 ,1695-D-94, and Section 31 23 02 Compacting Earth materials for horizontal cable segments:

   b. Run cable through rigid galvanized conduit, test station pipe, or similar approved protection once cable emerges from ground.

      1) Run above ground segments of impressed current anode cables and structure cable to rectifier through rigid galvanized conduit only.

4. Connect to test station, rectifier, and junction box terminals with crimped, ring-tongue connectors.

5. Identify origin of cables terminating in an enclosure:

   a. Cable identification as to the distinct originating structure or anode in accordance with Drawing 1695-D-95.

   b. Printed letters on a shrinkable label attached to the cables clearly visible within the enclosure.

   c. Encase printed labels in clear heat shrink tubing.

F. Electrical continuity joint bonds:

1. Provide metallurgical bonds at all mechanical type joints (e.g., non-welded joints) between ferrous parts to be included in the cathodic protection or corrosion monitoring systems as indicated in this specification section or as necessary to ensure electrical continuity and as shown in Drawing 1695-D-95.

2. Minimum cables per bond joint:

   a. Minimum 4 cables per joint for pipe greater than or equal to 30 inches in diameter.

   b. Minimum 2 cables per joint for pipe less than 30 inches in diameter and all pumping plant yard pipe.

3. Bond cable installed with sufficient slack to prevent stress.

   a. Allow for at least ½-inch of joint movement.

4. Jumper bond locations:

   a. Between non-welded ferrous pipe sections and ferrous pipe and fittings.

G. Structure connections:

1. One test cable and one bond cable, separated by approximately 1 foot, per structure at each test station.

2. For connection from the junction box at the anode bed to Reach 12.1, two #6 AWG structure cables shall be run in conduit along the trench alignment for the Twin Lakes Turnout.

3. One #6 AWG structure cable shall be run from the yard fence to the junction box at the anode bed for the purpose of interference testing.

4. Connect cables and jumper bonds to structures by exothermic metallurgical bond as shown in Drawing 1695-D-95.

   a. Make exothermic metallurgical bond in accordance with the bonding supply manufacturer's instructions.

   b. Bonds shall not damage the linings inside pipes or fittings.

   c. Test metallurgical bond integrity by striking side of weld nugget with a 16-ounce hammer, in presence of the COR.

   d. Coat bare copper, weld nugget, and ferrous materials at metallurgical bonds with an approved dielectric metallurgical bond coating.

5. Allow dielectric material to cure before repair of the damaged structure coating or lining.

   a. Repair dielectric coatings/linings in accordance with Section 09 96 20 – Coatings

   b. Repair mortar/concrete coating and lining in accordance with USBR M-47.

3.02 IMPRESSED CURRENT CATHODIC PROTECTION SYSTEMS

A. Installation details indicated on n Drawings 1695-D-92 to 1695-D-95, and 1695-D-99.

B. Specifications for system are shown in table 26 42 10A – Impressed Current.

Table 26 42 10A - Impressed Current

# Anodes /Bed	# Beds*	Anode Spacing (ft)	Length of Bed (ft)	Diameter of Bed (in)	Depth to Top of Bed (ft)	Approximate Rectifier Station Location(s)	Rectifier Size V/A
6	3	1.67	100	10	150	North wall in North-West corner of pumping plant	19/39

*Anode beds are spaced 15 feet apart as shown in Drawing 1695-D-92.

C. Rectifier:

1. Rectifier shall be wall or bracket mounted and located as indicated in Table 26 42 10A- Impressed Current.

2. The rectifier shall meet governing electrical codes to include sufficient grounding.

3. Ground rectifier on A.C. side in accordance with local electrical codes.

4. For details of cabling from the junction box to the rectifier and power to the rectifier refer to Drawings 1695-D-248 and 1695-D-252.

5. Do not attach main anode cable or structure cable to the rectifier or energize the rectifier. Energize the system only at time of testing.

D. Junction Box:

1. Locations:

a. Junction box for the anode bed shall be located inside the west yard fence along the fence near the impressed current anode bed.

b. Junction boxes for the casings on Reaches 12.1 and 12B shall each be located in proximity to their respective casing structures.

c. Locate the junction boxes to make them readily accessible.

d. Locate where junction boxes will not likely be damaged or interfere with personnel and/or equipment (e.g., adjacent to above ground structures). Exact location is subject to approval of COR.

e. Locate as close to each current carrying structure connection as possible and convenient.

2. Junction boxes shall be mounted on a pole embedded in concrete footing.

3. Terminate cables through junction box.

a. Connect individual anodes through individual calibrated shunts within the junction box for current measurements.

b. Connect individual anodes to the structure through variable resistors within the junction box to allow for equalizing current output from individual anodes.

4. Single cable from anode bus bar and single cable from structures shall be installed for connection from junction box to rectifier terminals (see Drawing 1695-D-92).

5. Identify originating anodes and structures connected to terminals on both the cables and on the panel.

6. All junction boxes located outside of the Tohlakai Pumping Plant yard fence are to be protected by barriers as shown on Drawing 1695-D-109.

E. Test Station:

1. Locations:

a. End of Reach 12B section and Twin Lakes Turnout.

b. Test station at isolation joints:

1) Between end of Reach 12A and beginning of Tohlakai Pumping Plant pipe.

2) Pumping plant exterior wall and steel tee on Reaches 12.1 and 12B as shown on Drawings 1695-D-209, 1695-D-210, 1695-D-211, 1695-D-214.

c. Locate the test stations to make them readily accessible.

d. Locate where test stations will not likely be damaged or interfere with personnel and/or equipment (e.g., adjacent to above ground structures). Exact location is subject to approval of COR.

e. Locate as close to each current carrying structure connection as possible and convenient.

2. Permanently, uniquely, and clearly identify each test station.

3. Terminate all cables for a given location within the same test station enclosure. Identify all cables as to the distinct originating structure.

4. Contain two cables, at a minimum:

a. #6 AWG bond cable from the protected structure.

b. #12 AWG test cable from the protected structure for determining structure-to-soil potentials.

5. Details for each type of test station are shown in Drawings 1695-D-93 and 1695-D-94.

6. All test stations located outside of the Tohlakai Pumping Plant yard fence are to be protected by barriers as shown on Drawing 1695-D-109 and specified in Section 05 50 00- Metal Fabrications.

F. Deep Well Anode Ground Bed:

1. Locate on west side of pumping plant yard as indicated on Drawing 1695-D-99.

2. Locate and space anode beds as indicated on Drawing 1695-D-92.

3. A smaller pilot hole may be drilled to confirm suitability of the deep well anode bed site. The hole may be then widened as needed.

a. Log soil resistivity every 25 feet to ensure suitability for the deep well anode bed site.

4. Install graphite anodes vertically in 12 inch diameter bed as indicated on Drawing 1695-D-92.

5. Number of anodes, anode spacing, number of anode beds, length of beds, and depth of beds shown in table 26 42 10-A - Impressed Current and on Drawing 1695-D-92.

6. Each anode cable shall be continuous (without splices) from the anode to the anode junction box and shall be permanently identified as to the location of the originating anode.

7. Anodes shall be fitted with centralizers to maintain orientation of the anode in the center of the drill hole.
    a. At no time shall the anodes be supported by their cables.
    b. Anodes shall be lowered into the drill hole using rope.
8. Anode cables shall be installed in a PVC conduit from the sand backfill to the junction box.
    a. Install buried segments of anode cables in a PVC conduit (ASTM F512, Type DB-60).
    b. Above grade segments of anode cables shall be installed in rigid galvanized conduit only.
    c. Horizontal segments of conduit must meet the following requirements in accordance with Drawing 1695-D-92:
        1) Minimum burial depth: 30 inches.
        2) Surround cable and conduit with minimum 6 inches of sand backfill.
        3) Place warning tape approximately 12 inches above conduit for the entire length of segments.
    d. Do not pull cable into conduit until conduit runs have been cleaned and are free from obstructions and sharp corners.
    e. Draw a clean, dry, tight-fitting rag through conduit immediately before installing cable.
    f. Install cable to prevent cuts or abrasions in insulation or protective covering, or kinks in cable.
    g. Lubricant:
        1) Use only as aid to pulling.
        2) Soapstone or other suitable material not injurious to cable sheath.
9. A nonmetallic vent pipe shall be installed from the bottom of the deep anode bed to the rectifier installation.
    a. The vent pipe is buried except at the rectifier installation where it shall be terminated above ground, protected, goose necked, and fitted with a perforated cap.
    b. The goose necked portion of the pipe shall be installed such that it can be removed for manually introducing water into the deep anode ground bed with a 3/4-inch garden hose.
    c. The vent pipe shall be slotted within the coke backfill column and non-slotted outside the limits of the coke backfill column.
    d. Terminate the vent pipe close to but not directly beneath the rectifier.

e. Install the vent pipe in the hole with the first anode. Cap the bottom of the vent pipe. Cap the top of the vent pipe throughout the anode and coke backfill installation procedure to prevent intrusion of foreign material.

f. Do not allow drilling mud to enter in the vent pipe.

10. The top 45 feet of the anode bed shall have a PVC casing.

11. Introduce coke backfill material, into the bottom of the drill hole and by pumping action fill the drill hole in such a manner as to prevent bridging and to completely encase the anodes.

a. Anode bed filled with carbonaceous backfill with a 150 foot minimum distance between the top of coke backfill column and surface grade.

1) The coke backfill column, as a minimum, shall extend 5 feet below the lower most anode and 45 feet above the uppermost anode (Drawing 1695-D-92).

b. Pump the coke from the bottom of the hole up using a pipe that is the length of the anode hole. Do not use the vent pipe to pump the coke. Raise the pipe as the anode column is filled with coke

c. Settle as recommended by the coke backfill manufacturer. After the settlement period, measure the level of the coke and add additional coke backfill if required.

12. Place five feet (minimum) of sand on top of the coke. Fill the remainder of the drill hole with pea gravel. Do not damage anode cables and bridging while placing materials.

3.03 FIELD QUALITY TESTING

A. Testing shall include energizing, adjusting, and testing the cathodic protection systems.

B. Testing shall be performed in the presence of COR.

C. COR shall be informed of the date, time, and tests to be performed at least five working days prior to testing.

D. Testing equipment:

1. Portable Voltmeter: Minimum input impedance of 10 megohms and capable of measuring DC voltages between plus or minus 0.1 millivolt to plus or minus 100 volts.

2. Portable $Cu/CuSO_4$ reference electrode

E. Verify that each test station is properly labeled.

F. Troubleshoot and correct any problems determined by the COR.

G. Testing shall be conducted in least two testing cycles:

1. Record and report all readings with final test data submittal.

2. Check isolation flange before and after backfilling to ensure adequate electrical isolation using appropriate equipment.

3. Anode-to-structure resistance utilizing a four-pin resistance method.

a. Do not perform over cables or anodes.

b. Shall be determined for each individual anode immediately after coke backfill placement, and after the coke backfill settlement period for the impressed current system.

a) First testing cycle:

c. Prior to energizing the system.

1) Test structure electrical continuity.

2) Test station integrity.

a) Determine the voltage difference between all cables within each test station enclosure.

3) Static anode-to-soil potentials:

a) At anode beds.

b) Place a portable reference electrode on saturated ground surface directly over anode being tested.

c) Ground shall be saturated with water to reduce reference cell contact resistance.

4) Measure static structure-to-soil potentials of the buried metalwork.

a) At each individual test station location.

b) The portable reference electrode placed as close to the buried metalwork as possible for structure-to-soil potential measurements.

c) Ground shall be saturated with water to reduce reference cell contact resistance.

d. After energizing the system.

1) Determination of protective (uncorrected) and polarized structure-to-soil potentials in accordance with the capacity requirements of this Section.

a) At each individual test station location.

b) The portable reference electrode placed as close to the buried metalwork as possible for structure-to-soil potential measurements.

c) Ground shall be saturated with water to reduce reference cell contact resistance.

2) Determination of current output of each individual anode in junction boxes.

3) Adjustment of variable resistor setting for each anode to obtain the required balance of current output.

4) Determine rectifier outputs in volts and amperes and associated tap settings.

5) Test for cathodic interference with yard fence and mitigate if necessary.

4. Second and subsequent testing cycles:

a. Time between testing cycles shall be 30 to 60 days.

b. Cathodic protection system shall not be adjusted between testing cycles.

c. Repeat all testing required after energizing the system during the first testing cycle.

d. If testing cycle data indicates that the cathodic protection system requires adjustment to meet specifications requirements, adjust the cathodic protection system and conduct subsequent testing cycles within a 30 to 60 day window.

H. Submit final data after the last testing cycle when performance criteria have been met and no further adjustments are needed.

I. After reviewing the submittal, the Government may require additional testing cycles, adjustments, and re-submittal to determine if the cathodic protection system conforms to the specification requirements.

END OF SECTION

SECTION 26 42 11

SUBMERGED GALVANIC ANODE CATHODIC PROTECTION SYSTEM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Submerged Galvanic Anode Cathodic Protection System:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM B843-07	Magnesium Alloy Anodes for Cathodic Protection

B. NACE International (NACE)

1.	NACE SP0169-2007	Control of External Corrosion on Underground or Submerged Metallic Piping Systems
2.	NACE TM0497-2002	Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems

3. Peabody A.W., (2001), Peabody's Control of Pipeline Corrosion, 2nd Edition, NACE.

1.03 DEFINITIONS

A. Bonded Dielectric Coating: A protective barrier coating system with high electrical resistivity bonded directly to the underlying structure and acting to physically and electrically isolate the metal from the electrolyte.

B. Sacrificial Protection: Reduction of corrosion of a metal in an electrolyte by electrically coupling it to a more anodic metal. This form of cathodic protection is also called galvanic anode cathodic protection.

C. Electrolyte: An electrically conductive solution, such as soil or water. The terms for these specific conductive solutions may be substituted for the word "electrolyte" in these definitions.

D. Portable Voltmeter: Portable instrument for measuring voltage drops across electrical components or potential (voltage) differences between a structure and a stable reference electrode:

1. Minimum input impedance: 10 megohm.

2. DC voltages measurement range: ±0.1 volts to ±100 volts.

3. Connect the positive terminal of the voltmeter to the structure and the common (negative) terminal to the reference electrode. Read the magnitude and polarity of the voltage as shown on the instrument display.

4. When measuring structure potentials using an analog instrument with a needle that swings in one direction, reverse connections and interpret of the polarity.

E. Reference Electrode: An electrode with constant open circuit potential under similar conditions of measurement; used for measuring the relative potentials of other electrodes (e.g. protected structures). Sometimes referred to as a reference half-cell. A copper/copper sulfate reference electrode (CSE) is often used.

F. Structure: The submerged surface of a steel tank or other metalwork being protected and monitored.

G. Structure-to-Electrolyte Potential:

1. Also referred to as structure-to-soil, pipe-to-soil, and structure-to-water potentials.

2. The potential of the structure in the electrolyte as compared to the potential of a reference electrode making contact with the same electrolyte.

3. Static structure-to-electrolyte potential: The structure-to-electrolyte potential determined without any external current (e.g. prior to energizing a cathodic protection system, and with no galvanic couple, pH cell, interference currents, or the like present), or after such a current source has been disconnected for an extended time. Also referred to as native structure-to-electrolyte potential.

4. Uncorrected structure-to-electrolyte potential: The structure-to-electrolyte potential determined with the cathodic protection system energized and cathodic protection current flowing. This potential is sometimes called the protective potential and may contain significant IR drop error.

5. Polarized structure-to-electrolyte potential: The structure-to-electrolyte potential determined after the cathodic protection system has been energized, but immediately after the cathodic protection current is interrupted. Also referred to as “instant off” structure-to-electrolyte potential.

6. Polarization: The change from the static or native potential as a result of current flow across the electrode/electrolyte interface. Also considered the difference between polarized and native potentials.

1.04 QUALIFICATIONS

A. Installation and testing shall be directed or performed by a Cathodic Protection Specialist certified by NACE International. Manufacturer’s Standards: Comply with manufacturer’s recommendations and standards unless otherwise specified

B. NACE SP-0169 and NACE TM0497 shall apply to any issues not specifically addressed by this specification.

1.05 SYSTEM DESCRIPTION

A. Cathodic protection and corrosion monitoring systems shall be provided for the following features:

1. Above-ground steel tank (Qty.: 1)
2. Air chambers (Qty.: 4)

B. Provide corrosion-engineering services to furnish and install the galvanic anode cathodic protection system.

1. Include electrical continuity bonds, anodes, and accessory equipment and features as directed in this specification or as otherwise indicated.
2. Designs, materials, installation and testing in accordance with NACE SP0169, NACE TM0497, and Peabody.

C. Cathodic protection systems: Provide a minimum service life of 20 years (system and all components).

1. Maintain on all locations of protected structure(s), with reference to a copper/copper sulfate electrode placed close to the structure:
   a. A polarized structure-to-electrolyte potential of at least -0.850 volts on the structure having a high quality bonded dielectric coating.
   b. Alternately, at the discretion of Reclamation, -0.100 volts of polarization if the -0.850 volt criterion cannot be obtained.
   c. A polarized potential at any point on a dielectrically coated structure not exceeding -1.100 volts in all instances.

D. Placement and current output of anodes:

1. Provide adequate distribution of cathodic protection current.
2. Submerged and restrained in such a way as to:
   a. Maintain sufficient anode material below the minimum normal operating water level.
   b. Not place stress on the anode cables, which will be suitable for direct immersion.

1.06 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 26 42 11-1, Certification and Data:

1. Copy of the Cathodic Protection Specialists' NACE International certification for personnel performing or directing the installation and testing of the corrosion monitoring system

2. Preconstruction drawings detailing intended restraint of anodes.
3. Manufacturer's data including catalog data sheets when available, including:
    a. Galvanic anodes
    b. Cables
    c. Metallurgical bonding system
    d. Dielectric coating system for bonds
    e. Dielectric anode covering at anode hold points

C. RSN 26 42 11-2, Final Data:
1. As-built information and drawings, including locations of anodes and restraints.

PART 2 PRODUCTS

2.01 GENERAL

A. Installation details indicated on Drawings 1695-D-90, 1695-D-91,1695-D-94, and 1695-D-95.

2.02 CABLES

A. Single-conductor: stranded, plain, annealed copper cable.

B. Cable insulation:
1. Rated for 600volts and direct immersion.
2. Black, with a high molecular weight polyethylene (HMWPE) outer jacket with minimum thickness of 0.100 inch.

C. Unspliced lengths to permit installation from terminus to terminus (e.g. anode to test station) free of splices and without stress.

D. Gauge:
1. No. 12 AWG or larger for galvanic anodes.

2.03 EXOTHERMIC METALLURGICAL BONDS

A. Specifically designed for cathodic protection systems.

B. Specifically designed for metallic substrate materials.

C. The exothermic reaction produces molten copper, which produces a permanent, high conductivity connection.

D. Uses a special alloy to provide minimum heat effect on the substrate material.

E. Current carrying capacity equal or better than that of the conductor.

2.04 GALVANIC ANODES

A. Standard potential magnesium extruded rod anode with the following essential characteristics:

1.

2. Standard potential magnesium anode material specifically designed for cathodic protection systems and the intended environment.

3. Magnesium rod anode material length and diameter specified in individual tank sections.

4. Anode material meeting or exceeding the requirements of ASTM B 843 and having a minimum potential of -1.5 volts referenced to a copper/copper sulfate reference electrode (CSE).

5. Contain a mild steel core that extends essentially the entire length of anode. The mild steel core shall be centered within the anode material and exposed on one end of the anode for the factory made anode-to-cable connection.

B. The factory anode-to-cable connection, exposed mild steel core, and exposed copper cable potted in epoxy.

C. Silver-solder connection between the anode cable and mild steel core.

D. Anode cable in accordance with cable requirements of this section.

2.05 DIELECTRIC COATING FOR METALLURGICAL BONDS

A. Coat exposed weld nugget, exposed cable, or structure metal using Bitumastic 50 (Carboline) or equal.

B. Refer to Section 09 96 20 – Coatings.

PART 3 EXECUTION

3.01 INSTALLATION OF GALVANIC ANODE CATHODIC PROTECTION SYSTEMS

A. Installation and testing shall be performed or directed by a Cathodic Protection Specialist certified by NACE International.

B. Cable:

1. Inspect for insulation defects prior to backfilling.

   a. Repair defects using approved methods or replace the cable.

   b. COR will approve and inspect repairs prior to installation.

2. Install without kinks, stresses, and/or splices.

C. Anode cable connections:

1. Connect cables directly to tank walls by exothermic metallurgical bond as shown on Drawing 1695-D-95.

a. Make exothermic metallurgical bond in accordance with the bonding supply manufacturer's instructions.

b. Bonds shall not damage the external coatings on the tanks; otherwise, repairs shall be required.

c. Test metallurgical bond integrity by striking side of weld nugget with a 16-ounce hammer, in presence of the COR.

d. Coat bare copper, weld nugget, and ferrous materials at metallurgical bonds with an approved dielectric metallurgical bond coating.

2. Allow dielectric material to cure before repair of the damaged structure coating or lining.

a. Repair dielectric coatings/linings in accordance with Section 09 96 20 – Coatings

3. Cable connects to tank wall shall be made below NWS (Normal Water Surface) if possible.

4. Where support ropes hold the anodes, the anodes shall be wrapped with a double thickness of dielectric barrier material to a width of 3 to 4 inches.

5. Ropes attached to tank sidewalls using welded brackets shown on Drawing1695-D-94.

D. Above-Ground Storage Tank:

1. Installed vertically in tank as described in Drawing1695-D-90.

2. Install 9foot long and 2inch diameter anodes.

a. 14 anodes in a circle approximately 7.8 feet from the vertical wall and 7.8 feet from the floor of the tank.

b. With the anodes evenly spaced approximately 15.6 feet from each other.

3. Install the 2 foot long, 2 inch diameter stub array anodes:

a. 14 anodes in a circle approximately 11.5 feet from the center of the tank and 7.7 feet from the floor of the tank.

b. With anodes evenly spaced approximately 5.2 feet from each other.

4. Do not support main array anodes by their cables. Use non-conductive ropes as described in the drawings. Support stub array by their cables.

a. Connect main array of anodes to the tank at each end of the center core.

b. The stub anode array shall be connected to the tank at one end of the center core.

E. Air Chamber for Reach 12.1 and 12B:

1. Install vertically in the tank as shown on Drawing1695-D-91.
2. Install 6-foot long, 3-inch diameter anodes.
   a. 4 anodes in a square approximately 2.9 feet from the vertical wall and 2.7 feet from the bottom of the tank.
3. Do not support anodes by their cables. Use non-conductive ropes as described in the drawings.
4. Anode cables shall be connected to the tank wall from each end of the anode.

END OF SECTION

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SECTION 26 42 12

BURIED GALVANIC CATHODIC PROTECTION AND CORROSION MONITORING SYSTEMS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Galvanic Anode Cathodic Protection and Corrosion Monitoring Systems:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. NACE International (NACE)

1. NACE SP0169-2007 Control of External Corrosion on Underground or Submerged Metallic Piping Systems
2. NACE TM0497-2002 Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems
3. Peabody A.W., (2001), Peabody's Control of Pipeline Corrosion, 2nd Edition, NACE.

B. ASTM International (ASTM)

1. ASTM B843 - 07 Magnesium Alloy Anodes for Cathodic Protection

C. National Electrical Manufacturer's Association (NEMA)

1. NEMA 250-2008 Enclosures for Electrical Equipment (1000 Volts Maximum)

1.03 DEFINITIONS

A. Bonded Dielectric Coating: A protective barrier coating system with high electrical resistivity bonded directly to the underlying structure and acting to physically and electrically isolate the metal from the electrolyte.

B. Cable: Metallic conductors other than the protected structures and the anodes.

C. Cathodic Protection:

1. Sacrificial Protection: Reduction of corrosion of a metal in an electrolyte by electrically coupling it to a more anodic metal. This form of cathodic protection is also called galvanic anode cathodic protection.

D. Electrolyte: An electrically conductive solution, such as soil or water. The terms for these specific conductive solutions may be substituted for the word "electrolyte" in these definitions.

E. Portable Voltmeter: Any portable instrument for measuring voltage drops across electrical components or potential (voltage) differences between a structure and a stable reference electrode:

1. M input impedance of 10 megohm.
2. Capable of measuring DC voltages between ±0.1 volts and ±100 volts.
3. When measuring structure potentials using a digital instrument, connect the positive terminal of the voltmeter to the structure and the common (negative) terminal to the reference electrode. Read the magnitude and polarity of the voltage directly as shown on the instrument display.
4. When measuring structure potentials using an analog instrument with a needle that swings only in one direction, reverse connections and interpretation of the polarity by the user is required.

F. Reference Electrode: An electrode whose open circuit potential is constant under similar conditions of measurement; used for measuring the relative potentials of other electrodes (e.g. protected structures). Sometimes referred to as a reference half-cell. A copper/copper sulfate reference electrode (CSE) is often used.

G. Structure: The metallic pipes and fittings or other metalwork being protected and monitored.

H. Structure-to-Electrolyte Potential:

1. Also referred to as structure-to-soil, pipe-to-soil, and structure-to-water potentials.
2. The potential of the structure in the electrolyte as compared to the potential of a reference electrode making contact with the same electrolyte.
3. Static structure-to-electrolyte potential: The structure-to-electrolyte potential determined without any external current (e.g. prior to energizing a cathodic protection system, and with no galvanic couple, pH cell, interference currents, or the like present), or after such a current source has been disconnected for an extended time. Also referred to as native structure-to-electrolyte potential.
4. Uncorrected structure-to-electrolyte potential: The structure-to-electrolyte potential determined with the cathodic protection system energized and cathodic protection current flowing. This potential is sometimes called the protective potential and may contain significant IR drop error.
5. Polarized structure-to-electrolyte potential: The structure-to-electrolyte potential determined after the cathodic protection system has been energized, but immediately after the cathodic protection current is interrupted. Also referred to as "instant off" structure-to-electrolyte potential.

6. Polarization: The change from the static or native potential as a result of current flow across the electrode/electrolyte interface. Also considered the difference between polarized and native potentials.

I. Test Station: A location for conducting tests on a protected structure, normally having an enclosure containing terminals of cables from one or more structures.

1.04 QUALIFICATIONS

A. Installation and testing shall be directed or performed by a Cathodic Protection Specialist certified by NACE International. Other qualified individuals may assist testing personnel.

B. Manufacturer's Standards: Comply with manufacturer's recommendations and standards unless otherwise specified.

C. NACE SP-0169 and NACE TM0497 shall apply to any issues not specifically addressed by this specification.

1.05 SYSTEM DESCRIPTION

A. Cathodic protection and corrosion monitoring systems shall be provided for the following features on the Tohlakai Pumping Plant Project:

1. Twin Lakes Turnout – PVC Pipe Option: Galvanic cathodic protection systems for metal fittings and other associated metalwork.
2. Reach 12B – PVC Pipe Option: Galvanic cathodic protection systems for metal fittings and other associated metalwork.
3. Reach 12.1and Twin Lakes Turnout: Galvanic cathodic protection systems for metal casings.

B. Provide corrosion-engineering services shall be provided to furnish, install, and test the corrosion monitoring system components.

1. Include electrical continuity bonds, test stations, anodes, and accessory equipment and features as directed in this specification or as otherwise indicated.
2. All designs, materials, installation and testing shall be consistent with sound corrosion engineering principles and practice in accordance with NACE SP0169, NACE TM0497, and Peabody.

C. Cathodic protection systems will have capacity to:

1. Provide a minimum service life of 20 years (system and all components).
2. Maintain on all locations of protected structure(s), with reference to a copper/copper sulfate electrode placed close to the structure:
   a. A polarized structure-to-electrolyte potential of at least -0.850 volts on the structure having a high quality bonded dielectric coating.

b. Alternately, at the discretion of Reclamation, -0.100 volts of polarization if the -0.850 volt criterion cannot be obtained due to extenuating circumstances (e.g. on bare or poorly coated structures or localized locations with high soil resistivity).

c. A polarized potential at any point on a dielectrically coated structure not exceeding -1.100 volts in all instances.

D. Placement and current output of anodes:

1. Shall be placed to provide adequate distribution of cathodic protection current, as indicated by potential readings.

1.06 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 26 42 12-1, Certification and Data:

1. Copy of the Cathodic Protection Specialists' NACE International certification for personnel performing or directing the installation and testing of the corrosion monitoring system

2. Preconstruction drawings:

a. Intended location of test stations

3. Manufacturer’s data including catalog data sheets when available, including (see Checklist at end of section):

a. Galvanic anodes

b. Cables.

c. Metallurgical bonding system.

d. Dielectric coating system for bonds.

e. Test stations.

f. Anode junction box.

g. Shunts.

h. Variable resistors.

C. RSN 26 42 12-2, Final Data:

1. As-built information and drawings, including:

a. Locations of test stations, anodes, electrical continuity bonds, and cable runs.

1) Locations shall be given using unique identifier and GPS coordinates

2) Location shall include type of test station (Specification Drawings 1695-D-93 and 1695-D-94).

b. List of anode cable identifications in test stations.

2. Testing data:

a. Test equipment and methods utilized.

b. Placement of reference electrode during each test.

c. Results of tests conducted.

PART 2 PRODUCTS

2.01 GENERAL

A. Installation details indicated on Drawings 1695-D-93 to 1695-D-95.

B. Materials shall provide a minimum service life of 20 years (system and all components).

2.02 CABLES

A. Single-conductor: stranded, plain, annealed copper cable.

B. Cable insulation:

1. Rated for 600 volts and direct immersion or burial.

2. High molecular weight polyethylene (HMWPE) outer jacket with minimum thickness of 0.100 inch.

C. Unspliced lengths to permit installation from terminus to terminus (e.g. structure to test station or anode to junction box) free of splices and without stress.

D. Gauge:

1. No. 6 AWG or larger for structure (bond) cables (black insulation).

2. No. 12 AWG or larger test cables for determining structure-to-electrolyte potentials (black insulation).

3. No. 12 AWG or larger for galvanic anodes (red insulation if available).

4. No. 6 AWG or larger for casing structure cables (blue or white insulation if available).

5. No. 12 AWG or larger for casing test cables for determining structure-to-electrolyte potentials (blue or white insulation if available).

2.03 EXOTHERMIC METALLURGICAL BONDS

A. Exothermic metallurgical bond system by ThermOweld, 4102 South 74th East Ave., Tulsa, OK 74145; or equal, having the following essential characteristics:

1. Specifically designed for cathodic protection systems.
2. Specifically designed for metallic substrate materials.
3. The exothermic reaction produces molten copper, which produces a permanent, high conductivity connection.
4. Uses a special alloy to provide minimum heat effect on the substrate material.
5. Current carrying capacity equal or better than that of the conductor.

2.04 GALVANIC ANODES

A. Galvanic anodes: UltraMag High Potential Magnesium Anode with the following essential characteristics:

1. Minimum of 20 pounds of magnesium anode material per anode.
2. High potential magnesium anode material specifically designed for cathodic protection systems and the intended environment.
3. Anode material meeting or exceeding the requirements of ASTM B 843 and having a minimum potential of -1.700 volts referenced to a copper/copper sulfate reference electrode (CSE).
4. Contain a mild steel core that extends essentially the entire length of anode. The mild steel core shall be centered within the anode material and exposed on one end of the anode for the factory made anode-to-cable connection.

B. The factory anode-to-cable connection, exposed mild steel core, and exposed copper cable potted in epoxy.

C. Silver-solder connection between the anode cable and mild steel core.

D. Anode cable in accordance with cable requirements of this section.

E. Anode pre-packaged in a chemical backfill specifically intended for the type of buried anode used.

1. Chemical backfill: Approximately 75 percent ground hydrated gypsum, 20 percent powdered bentonite, and 5 percent anhydrous sodium sulfate.

F. Anode packaged in a plastic or heavy paper bag of sufficient thickness to protect electrode, backfill, and cloth bag during normal shipping and handling.

G. Store prepackaged anodes off the ground and protect against weather, condensation, and mechanical damage.

2.05 TEST STATIONS

A. Test stations: Big Fink, manufactured by Cott Manufacturing Company, 1944 Gardena Avenue, Glendale, CA 91204; or equal, having the following essential characteristics:

1. Above-ground, orange-capped, post-mounted type.

2. Specifically constructed for cathodic protection system installations.
3. Protected as required for permanency.
4. Sufficient number of terminals (5 terminals minimum) with associated hardware for the number and size of cables and any other accessories required by the design.
5. Provide calibrated shunts (0.01 ohm) and variable resistors (if necessary) such that the current output of each anode can be determined and adjusted.
6. Test station cables in accordance with cable requirements of this Section.

2.06 BARRIERS

A. Refer to Section 05 50 00 – Metal Fabrications, and Section 03 30 00 – Cast-in-Place Concrete and Drawing 1695-D-109.

2.07 ANODE JUNCTION BOX

A. Enclosed within a NEMA 250, Type 3-R, lockable cabinet constructed of No. 16-gauge or thicker galvanized steel or fiberglass that is weatherproof, lockable, and vented for heat dissipation.

B. Specifically constructed for cathodic protection system installations.

C. Protected as required for permanency.

D. Sufficient number of terminals with associated hardware for the number and size of cables and any other accessories required by the design.

E. Equip with 0.01 ohm calibrated shunt for each anode.

F. Equip with variable resistors for each anode (if necessary) such that the current output of each anode can be determined and adjusted.

G. Engraved 1/4-inch minimum NEMA grade C phenolic panel.

H. Solderless, pressure-type terminals.

I. Identified terminals.

J. Equip with combination bracket for pole or wall mounting.

2.08 PIPELINE CASING END SEALS

A. Casing End Seals: Model “C” Custom Pull-on End Seals, manufactured by Pipeline Seal & Insulator, Inc., 6455 Clara Road, Houston, TX 77041; or equal, having the following essential characteristics:

1. Specifically designed for cathodic protection systems.

2. Minimum 1/8" thick EPDM 60.
3. Custom made to order.
4. Ability for carrier pipe to not be centered in casing.
5. 304 stainless steel bands and hardware.
6. Warranted against failure for manufacturing defects.

2.09 DIELECTRIC COATING FOR METALLURGICAL BONDS

A. Dielectric material: Royston Handy Cap, manufactured by Royston Laboratories, Inc., 128 First St., Pittsburgh, PA, 15238; or equal, having the following essential characteristics:

1. Specifically designed for cathodic protection systems.
2. Applied with primer coat, as needed.
3. Approved dielectric coating material.
4. Suitable for the intended environment.

2.10 WARNING TAPE

A. Polyethylene warning tape for anode cables:

1. Minimum 3 inches wide.
2. Red or yellow with black lettering.
3. Suitable for direct burial.
4. "Caution –Cathodic Protection Cable Buried Below" printed on tape for its full length.

PART 3 EXECUTION

3.01 INSTALLATION OF GALVANIC ANODE CATHODIC PROTECTION SYSTEMS

A. Installation and testing shall be performed or directed by a Cathodic Protection Specialist certified by NACE International.

B. Pipe and fittings shall be electrically isolated from all other metal (e.g. casings, foreign structures, and rebar in concrete).

C. Dielectric materials, other than PVC carrier pipe, that might cause shielding of cathodic protection current (e.g. plastic debris) shall not be left in the excavation with the structure.

D. Cable:

1. Inspect for insulation defects prior to backfilling.
    a. Repair defects using approved methods or replace the cable.
    b. COR will approve all repairs prior to implementation and inspect before backfilling.
2. Install without kinks, stresses, and/or splices.
3. Buried applications:
    a. For all horizontal segments of cable the following requirements must be met in accordance with Drawing 1695-D-94 and Section 31 23 02 Compacting Earth materials:
        1) Minimum burial depth: 30 inches.
        2) Cables shall be buried a minimum of 42 inches in agricultural fields.
        3) Surround cable with minimum 6 inches of sand backfill.
        4) Place warning tape approximately 12 inches above cable for the entire length of cable segments.
    b. Run cable through rigid galvanized conduit, test station pipe, or similar protection once cable emerges from ground.
4. Connect to test station terminals with crimped, ring-tongue connectors.
5. Identify origin of cables terminating in an enclosure:
    a. Cable identification as to the distinct originating structure or anode in accordance with Drawing 1695-D-95.
    b. Printed letters on a shrinkable label attached to the cables clearly visible within the enclosure.
    c. Encase printed labels in clear heat shrink tubing.

E. Structure connections:

1. One test cable and one bond cable per structure at each test station.
2. Connect cables to structures by exothermic metallurgical bond as shown in Specification Drawing 1695-D-95.
    a. Make exothermic metallurgical bond in accordance with the bonding supply manufacturer's instructions.
    b. Bonds shall not damage the linings inside pipes or fittings.
    c. Test metallurgical bond integrity by striking side of weld nugget with a 16-ounce hammer, in presence of the COR.
    d. Coat bare copper, weld nugget, and ferrous materials at metallurgical bonds with an approved dielectric metallurgical bond coating.

3. Allow dielectric material to cure before repair of the damaged structure coating or lining.
    a. Repair dielectric coatings/linings in accordance with Section 09 96 20 – Coatings

F. Galvanic Anodes:
1. Install horizontally or vertically as follows and as directed by the COR:
    a. Location:
        1) Listed in table 26 42 12A – Galvanic Anodes.
        2) Minimum 35 ft. from the nearest part of the structures to be protected unless otherwise noted in Table 26 42 12A – Galvanic Anodes.
        3) Minimum 10 feet from one another.
        4) Minimum one anode length from non-metallic piping.
        5) Bond additional metalwork not listed in Table 26 42 12A – Galvanic Anodes to metalwork within 40 ft.
        6) Install a minimum of one anode on metalwork not included or bonded to metalwork in Table 26 42 12A – Galvanic Anodes.
    b. Depth:
        1) At or below invert of pipe fitting,
        2) Minimum of 7 feet below final grade.
2. Remove outer water resistant covering on the pre-packaged anodes before installation, taking care not to damage the wettable covering containing the backfill and magnesium.
3. At no time shall the anodes be supported by their cables.
4. Do not wet pre-packaged anodes until in the ground, surrounded with compacted earth, and covered by at least 1 foot of compacted backfill.
5. Do not connect anodes to structures at test stations; energizing the systems only at time of testing.
6. Connect individual galvanic anodes to the structures through individual calibrated 0.01 ohm shunts within the test station or junction box for current measurement.
7. Where multiple anodes are involved, a calibrated shunt shall be included for each individual anode.
8. Connect individual anodes to the structure through variable resistors within the test station or junction box to allow for equalizing current from individual anodes (if necessary).

Table 26 42 12A – Galvanic Anodes

Station	Structure	Feature	# Anodes
11+73.43	T-L Turnout	Convex Up Miter, tie to Convex Down Miter (11+90.51), tie to Horizontal Miter (12+05.43)	1
12+54.93	T-L Turnout	Horizontal Miter	1
17+08.32	T-L Turnout	Horizontal Miter	1
18+00.00	T-L Turnout	Convex Up Miter	1
18+76.00	T-L Turnout	Convex Down Miter	1
19+71.13	T-L Turnout	Horizontal Miter	1
20+80.00	T-L Turnout	Convex Up Miter	1
21+38.56	T-L Turnout	Convex Down Miter	1
23+98.56	T-L Turnout	Convex Down Miter tie to Horizontal Miter (24+25.94)	1
24+63.56	T-L Turnout	4” Blowoff	1
28+03.29	T-L Turnout	EOL fitting	1
12510+30.00	Reach 12B	Combined Miter	1
12513+00.00	Reach 12B	Convex Up Miter	1
12516+40.00	Reach 12B	EOL/ Blind Flange	1

*35 ft. minimum anode distance from pipe structure
* locate test station near structure

G. Test Stations and Anode Junction Boxes:

1. Locations:

a. Specifically at all locations listed in table 26 42 12A - Galvanic Anodes, upstream side of both casings, and downstream side of both casings.

1) Corrosion monitoring test station at downstream side of each casing.

2) Anode junction box at upstream side of each casing.

3) Galvanic anode cathodic protection test stations at fittings listed in Table 26 42 12A - Galvanic Anodes and other metallic structures not listed in Table 26 42 12A – Galvanic Anodes.

b. Locate the test stations and anode junction boxes to make them readily accessible.

c. Do not locate test stations and anode junction boxes inside agricultural fields.

d. Locate where test stations and anode junction boxes will not likely be damaged or interfere with personnel and/or equipment (e.g., adjacent to above ground structures). Exact location is subject to approval of COR.

e. Locate as close to each current carrying structure connection as possible and convenient.

f. Place test stations and anode junction boxes inside rectangular barriers at vaults.

2. Details for the test stations and anode junction boxes are shown in Drawings 1695-D-93 and 1695-D-94.

3. Permanently, uniquely, and clearly identify each test station.

4. Terminate cables for a given location within the same test station enclosure. Identify cables as to the distinct originating structure.

5. Test Stations and anode junction boxes should contain three cables, at a minimum:

a. No. 6 AWG current carrying bond cable from the protected structure.

b. No. 12 AWG current carrying cable from the anodes.

c. No. 12 AWG test cable from the protected structure for determining structure-to-soil potentials.

6. All test stations and junction boxes located outside of the Tohlakai Pumping Plant yard fence are to be protected by barriers as shown on Specification Drawing 1695-D-.109

a. Center test stations in triangular barriers.

H. Pipeline Casings:

1. Located as listed in Table 26 42 12B – Pipeline Casings.

2. End seals shall be used to prevent water and mud from entering casing.

a. Install end seal so as not to damage seal material or carrier pipe.

b. Install seal in accordance with manufacturer’s specifications.

c. Ensure steel band is adequately tightened to manufacturer’s specifications.

3. Anode junction box on upstream side shall include two cables from the casing (if metallic), two cables from pipe (if metallic), and one cable from each anode required for casing and pipe.

a. Anode cables connected through a 0.01 ohm calibrated shunt for each in the test station.

b. Variable resistor for each anode (as necessary).

4. Corrosion monitoring test station shall be located at downstream side of each casing.

5. Anodes are not required on casing if it is PVC.

6. Anodes are not required on carrier pipe if it is PVC.

Table 26 42 10B – Pipeline Casings and Anodes

Station Start	Station End	Feature	Casing dia. (in)	# Anodes	Min. Anode Spacing (ft)	Min. Anode Distance from Casing (ft)
121017+81.07	121020+26.83	Highway 491 (Reach 12.1)	48	6	10	40
21+46.52	23+92.35	Highway 491 (Twin Lake Turnout)	30	6	10	40

3.02 FIELD QUALITY TESTING

A. Testing shall include energizing, adjusting, and testing the cathodic protection systems.

B. Testing shall be performed in the presence of COR.

C. COR shall be informed of the date, time, and tests to be performed at least five working days prior to testing.

D. Testing equipment:

1. Portable Voltmeter: Minimum input impedance of 10 megohms and capable of measuring DC voltages between plus or minus 0.1 millivolt to plus or minus 100 volts.
2. Portable $Cu/CuSO_4$ reference electrode

E. Verify that each test station is properly labeled.

F. Troubleshoot and correct any problems determined by the COR.

G. Testing shall be conducted in least two testing cycles:

1. Record and report all readings with final test data submittal.
2. Anode-to-structure resistance utilizing a four-pin resistance method.
   a. Do not perform over cables or anodes.
   b. Shall be determined for each individual anode immediately after coke backfill placement, and after the coke backfill settlement period for the impressed current system.
   c. At each anode installation for galvanic anodes.

H. Submit final data after the last testing cycle when performance criteria have been met and no further adjustments are needed.

I. After reviewing the submittal, the Government may require additional testing cycles, adjustments, and re-submittal to determine if the cathodic protection system conforms to the specification requirements.

END OF SECTION

SECTION 26 51 00

INTERIOR LIGHTING

1.01 MEASUREMENT AND PAYMENT

A. Interior Lighting:

1. Payment: Lump sum price offered in the schedule.

1.02 SUBMITTALS

A. Submit in accordance with Section 01 33 00 – Submittals and Section 01 33 26 – Electrical Drawings and Data.

B. RSN 26 51 00-1, Approval Data:

1. Manufacturer's data.

C. RSN 26 51 00-2, As-built Drawings:

1. As-built conditions of all interior lighting drawings.

PART 2 PRODUCTS

2.01 GENERAL

A. Luminaires: Underwriters Laboratories Inc. (UL) listed.

B. Provide all necessary mounting hardware.

2.02 TYPE A LUMINAIRE

A. Spec-Beam High Lumen Fluorescent High Bay manufactured by Lithonia Lighting, Website: www.lithonia.com, Catalog #: FGB24-6-54T5HO-B1x20-ACL-MVOLT-2/3-GEB10PS-LP841-XXXX; or equal, having the following essential characteristics:

1. Lamp Type: T5, High Output, 54 watt fluorescent tubes.
2. Lamp Count: 6.
3. Color Temperature: 4100 kelvin (K).
4. Color Rendering Index (CRI): 85 minimum.
5. Voltage: 277v.
6. Reflectivity: 95 percent.
7. Length: 96 inches, Width: 24 inches.
8. Mounting: surface or short suspension mounting from roofing structure.
9. Finish: high-gloss white enamel.

10. Internal Wiring: thermally protected to meet temperature requirements of fixture.
11. Internal Access: tool-less entry from below fixture.
12. UL listed for ambient operations up to 45 degrees Celsius and damp locations.
13. Warranty: 5-year, minimum.

2.03 TYPE B LUMINAIRE

A. Corelite Stellar 12" 4T8 Suspended Direct/Indirect manufactured by Cooper Lighting, Website: www.cooperlighting.com, Catalog #: S4-WB-4T8-1-C-277-A-C-48-ST-4; or equal, having following essential characteristics:

1. Lamp Type: T8, 32 watt fluorescent tubes.
2. Lamp Count: 4.
3. Ballast: instant start, electronic ballast.
4. Voltage: 277v.
5. Reflectivity: Direct/Indirect.
6. Efficiency: 93 percent, minimum.
7. Length: 48 inches, Width: 12 inches.
8. Mounting: suspension with adjustable, straight cord, aircraft cable up to 48 inches in length.
9. Finish: white polyester powder coat paint.
10. Warranty: 1-year, minimum.

2.04 TYPE C LUMINAIRE

A. Corelite Stellar 9" 2T8 Suspended Direct/Indirect manufactured by Cooper Lighting, Website: www.cooperlighting.com, Catalog #: S4-WB-2T8-1-C-277-A-C-48-ST-4; or equal, having following essential characteristics:

1. Lamp Type: T8, 32-watt fluorescent tubes.
2. Lamp Count: 2.
3. Ballast: instant start, electronic ballast.
4. Voltage: 277v.
5. Reflectivity: Direct/Indirect.
6. Efficiency: 81 percent, minimum.
7. Length: 48 inches, Width: 9 inches.
8. Mounting: suspension with adjustable, straight cord, aircraft cable up to 48-inches in length.
9. Finish: white polyester powder coat paint.

10. Warranty: 1-year, minimum.

2.05 TYPE D LUMINAIRE

A. The 304 Series Flood Luminaires manufactured by Cree, Website: www.cree.com/lighting, Catalog #: FLD-304-5S-YM-06-D-UL-SV-350-40K; or equal, having the following essential characteristics:

1. Lamp Type: Light Emitting Diode (LED) luminaire.
2. Lamp Count: 60.
3. Voltage: 120v.
4. L70 Value: 60,000 hour, minimum.
5. Lumen Maintenance Factor: 94-percent at 50,000 hours, minimum.
6. Color temperature: LED 4000K.
7. CRI: 70, minimum.
8. Driver: 350mA drive current.
9. BUG Rating: 3, 0, 1 respectively.
10. Finish: silver, epoxy primer with powder topcoat. Resistant to corrosion, ultraviolet degradation, and abrasion.
11. Housing: die-cast extruded aluminum.
12. Mounting: surface yoke mounted on roof components. Adjustable yoke mount from plus/minus 90 degrees in 5 degree increments.
13. Internal Driver Access: below luminaire.
14. IP66 rated, suitable for wet locations.
15. Warranty: 10-year on luminaire and finish, minimum.

2.06 FABRICATION

A. Luminaires requiring special modifications shall be modified and wired by manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install luminaires and accessories as indicated and in accordance with manufacturer's instructions.

B. Install specified lamps in luminaires.

C. Aim and adjust luminaires as indicated.

D. Install fittings and accessories required for complete installation.

E. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

F. Make connections to branch circuits. Use insulated conductors with insulation suitable for temperature conditions within luminaire.

G. Bond luminaires to branch circuit equipment grounding conductor.

H. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

I. Remove dirt and debris from enclosures.

J. Clean photometric control surfaces as recommended by manufacturer.

K. Clean finishes and touch up damage.

L. Clean luminaires and install new lamps for broken or burned out lamps.

END OF SECTION

SECTION 26 52 00

EMERGENCY AND EXIT LIGHTING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Emergency and Exit Lighting:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. National Fire Protection Association (NFPA)

1.	NFPA 70-2011	National Electrical Code (NEC)
2.	NFPA 101-2012	Life Safety Code

B. Underwriters Laboratories (UL)

1.	UL 924-2006	Standard for Emergency Lighting and Power Equipment

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 52 00-1, Approval Data:

1. Manufacturer’s data.

C. RSN 26 52 00-2, As-built Drawings:

1. As-built conditions of all emergency and exit lighting drawings.

PART 2 PRODUCTS

2.01 GENERAL

A. Luminaires: Underwriters Laboratories Inc. (UL) listed.

B. Provide all necessary mounting hardware.

C. Luminaires requiring special modifications shall be modified and wired by manufacturer.

2.02 TYPE E1 LUMINAIRE

A. AA Series Emergency Lighting Units manufactured by Cooper Lighting, Website: www.cooperlighting.com, Catalog #: AA8-SD-1BRWH; or equal, having following essential characteristics:

1. Self-contained emergency lighting unit with adjustable lamps.
2. Three dimensional swivel assembly for lamps.
3. Two, PAR 36, sealed beam lamps.
4. Housing: Die-formed steel with white corrosion-resistant polyester powder coat paint.
5. 120/277-volt AC selectable input.
6. Solid state battery charger. UL 924 listed.
7. Low voltage disconnect (80-percent of battery nominal), brownout protection, and short-circuit protection.
8. Solid-state transfer for switching on/off the AC circuit during outages.
9. Test switch and power indicator light for maintenance purposes.
10. Maintenance free, sealed nickel cadmium battery rated for 90 minutes minimum.
11. Operating temperature range 0-degreesC to 50-degreesC.
12. Warranty: 1-year for unit and 15 years prorated for the battery.

2.03 TYPE E2 LUMINAIRE

A. Quantum Exit Sign by Lithonia Lighting, Website: www.lithonia.com, Catalog #: LQC-X-R-ELN; or equal, having the following essential characteristics:

1. Light Emitting Diode (LED) exit sign.
2. Red LED illumination.
3. Single or double face as indicated.
4. Chevrons as indicated.
5. Wall mounted on end or back as indicated.
6. 120/277-volt AC selectable input.
7. Solid-state voltage charger.
8. Test switch/power indicator light.
9. Maintenance free, sealed nickel cadmium battery rated for 90 minutes minimum.
10. 6 inch letters. Meets UL 924 for viewing distance.
11. Housing: die-cast aluminum, brushed aluminum faceplate.
12. Warranty: 5-year, minimum.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install as indicated and in accordance with manufacturer's instructions, NFPA 70, and NFPA 101.

B. Aim and adjust emergency lighting units per applicable codes.

C. Install fittings and accessories required for complete installation.

D. Install surface mounted emergency lighting units and exit signs plumb and adjust to align with building lines and each other. Secure to prevent movement.

E. Make connections to branch circuits as indicated on the drawings. Use insulated conductors with insulation suitable for temperature conditions within emergency lighting units.

F. Operate each emergency lighting unit and exit sign after installation and connection. Inspect for proper connection and operation.

G. Remove dirt and debris from enclosures.

H. Clean finishes and touch up damage to match surrounding finish.

I. Clean emergency lighting units and exit signs and install new lamps for broken or burned out lamps.

END OF SECTION

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SECTION 26 56 00

EXTERIOR LIGHTING

1.01 MEASUREMENT AND PAYMENT

A. Exterior Lighting:

1. Payment: Lump sum price offered in the schedule.

1.02 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 26 56 00-1, Approval Data:

1. Manufacturer's data.

C. RSN 26 51 00-2, As-built Drawings:

1. As-built conditions of all exterior lighting drawings.

PART 2 PRODUCTS

2.01 GENERAL

A. Luminaires: Underwriters Laboratories Inc. (UL) listed.

B. Provide all necessary mounting hardware.

C. Luminaires requiring special modifications shall be modified and wired by manufacturer.

2.02 TYPE AA LUMINAIRE

A. The Edge LED Security Wall Pack manufactured by Cree,
Website: http://www.cree.com/lighting, Catalog #: SEC-EDG-4MB-WM-04-D-UL-BZ-350-40K; or equal, having the following essential characteristics:

1. Light Emitting Diode (LED) luminaire.
2. L70 value of 150,000 hours minimum.
3. Color temperature: LED 4000K.
4. 40 LEDs per luminaire.
5. 350mA drive current.
6. 120 or 277 volts as indicated
7. BUG rating of 1, 0, 1 respectively.
8. Finish: bronze.

9. International Dark Sky Association Compliance.
10. Die-cast extruded aluminum housing.
11. Resistant finish preventing corrosion, ultraviolet, and abrasion.
12. Wall mounted.
13. UL Wet listed.
14. Operating temperature range: -40-degrees Celsius to +40 degrees Celsius.
15. Warranty: 5-year, minimum.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install luminaries as indicated on drawings and in accordance with manufacturer's instructions.

B. Install fittings and accessories required for complete installation.

C. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

D. Remove dirt and debris from enclosures.

E. Clean photometric control surfaces as recommended by manufacturer.

F. Clean finishes and touch up damage to match surrounding finish.

G. Clean luminaires and install new lamps for broken or burned out lamps.

H. Control exterior luminaires by lighting control panel listed in Section 26 24 41 – Distribution Lighting Panelboards.

END OF SECTION

SECTION 27 15 00
COMMUNICIATIONS CABLING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 REFERENCE STANDARDS

A. Building Industry Consulting Service International (BICSI)

1.	BICSI-TDMM-12th Edition	Telecommunications Distribution Methods Manual (TDMM)

B. Insulated Cable Engineer Association (ICEA)

1.	ICEA S-90-661-2008	Category 3, 5, and 5e Individually Unshielded Twisted Pair Indoor Cables for Use in General Purpose and LAN Communications Wiring Systems

C. National Electrical Contractors Association (NECA)

1.	NECA/BICSI 568-2006	Installing Building Telecommunications Cabling

D. National Fire Protection Association (NFPA)

1.	NFPA 70-2011	National Electrical Code (NEC)

E. Telecommunications Industry Association (TIA)

1.	TIA J-STD-607-2002	Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
2.	TIA-568-C.1-2009	Commercial Building Telecommunications Cabling Standard
3.	TIA-568-C.2-2009	Balanced Twisted-Pair Telecommunications Cabling and Components Standards
4.	TIA-1152-2009	Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling

F. Underwriters Laboratories, Inc. (UL)

1.	UL 444-2008	Communications Cables

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and 01 33 26 - Electrical Drawings and Data.

B. RSN 27 15 00-1, Approval Data:

1. Manufacturer's data.

PART 2 PRODUCTS

2.01 COAXIAL CABLE

A. Type: Radio Communication.

B. RG Type: 58/U.

C. Impedance: 50 Ohms.

D. All copper center conductor.

E. All-copper braided shield with 95 percent braid coverage.

F. Jacket: Low Smoke Polyvinyl Chloride (PVC).

G. For use in radio circuits.

2.02 CAT 6 CABLE

A. Category 6 per ICEA S-90-661, UL 444, and TIA-568-C.2.

1. Four twisted pair, minimum size 24 AWG conductors.
2. Cable shall be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating and length marking at regular intervals.
3. Provide communications rated cabling for the installation purpose it is installed (plenum, riser, general purpose, etc.) in accordance with NFPA 70.
4. Cables installed in conduit between floors shall be UL listed and labeled for wet locations.

2.03 FACEPLATES AND CONNECTORS

A. Terminate unshielded twisted pair (UTP) cables in accordance with TIA-568-C.1 and TIA-568-C.2 with T-568A color configuration.

B. Use registered jack (RJ) 45 modular connector.

C. Provide each location with two port RJ-45 faceplates unless otherwise noted on drawings.

D. Faceplate color shall be white.

2.04 ACCESSORIES

A. Conductor Markers:

1. White.
2. Refer to Section 26 05 10 – Conductors and Cables.
3. Marked both end of conductors with port number and room location of connected switch/punch down block.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with BICSI-TDMM, NECA/BICSI 568, TIA-568-C.2, NFPA 70, and UL standards as applicable.

B. Install per manufacturer's instructions and do not exceed manufacturers' cable pull tensions for copper cables.

C. Install conduit in accordance with Section 26 05 33 – Raceway and Boxes and back boxes for RJ-45 connectors in accordance with Section 26 27 40 – Wiring Devices.

D. Install continuous conductors between termination points. Conductor splices are not acceptable.

E. Do not install power and communication cable in same conduit.

F. Do not damage or chafe outer jacket material.

G. No cable shall contain unterminated elements.

H. Do not splice network cables.

I. Do not untwist Category 6 cables more than one half inch from point of termination to maintain cable geometry.

J. Conduit Installation:

1. Do not pull cable into conduits until conduit runs have been cleaned and are free from obstructions and sharp corners.
2. Draw a clean, dry, tight-fitting rag through conduit immediately before installing cable.
3. Install cable to prevent cuts or abrasions in insulation or protective covering, or kinks in cable.

4. Block cable opening in sleeves under equipment or passing through blockouts, with silicone-foam, fire-retardant type material in accordance with NFPA 70.

5. Lubricant:

   a. Use only as aid to pulling.

   b. Soapstone or other suitable material not injurious to cable sheath.

K. Provide grounding and bonding in accordance with TIA J-STD-607.

L. Terminate networking cables in T568A configuration per TIA-568-C.2.

M. Control Cable and Wire Identification:

1. Provide computer-generated or labeling machine lettering.

2. Provide labels for control cables and individual conductors of the control cable.

3. Control cable designations: Equipment designation as shown.

4. Individual control cable conductors: Designation shown on approved wiring diagrams. Designation to include wire number followed by wire destination.

N. Provide labels for instrumentation cables.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. All test equipment shall conform to TIA-1152.

B. Inspect coaxial connector integrity.

C. Inspect network cabling terminations for T568A color configuration.

D. Remove failed cables from project site upon attenuation test failure.

E. Perform testing for each outlet:

F. Performance Test:

1. Perform Category 5e link tests in accordance with TIA-568-C.1 and TIA-568-C.2.

2. Tests shall include wire map, length, insertion loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay, and delay skew.

END OF SECTION

SECTION 27 20 01
RADIO EQUIPMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Installing Government-Furnished Radio Modems:

1. Payment: Lump sum price offered in the schedule.

B. Radio System:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE C2-2007 National Electric Safety Code

B. National Fire Protection Association, Inc. (NFPA)

1. NFPA 70 – 2011 National Electrical Code (NEC)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 27 20 01-1, Approval Drawings and Data:

1. Drawings in government format.
    a. Layout drawings.
    b. Schematic drawings.
    c. Wiring drawings.
2. Bill of Materials.
3. Manufacturer’s product data.

C. RSN 27 20 01-2, Check Prints:

1. Schematic and wiring diagrams.

D. RSN 27 20 01-3, Operations and Maintenance Manual:

1. Final drawings including “as-built” changes.
2. Final software documentation.
3. Spare parts list.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Handle and store radio equipment in accordance with manufacturer's instructions. Include copy of these instructions with equipment at time of shipment.

1.05 PROJECT CONDITIONS

A. Ambient Temperature Range: -30 degrees Celsius to 40 degrees Celsius.

B. Relative Humidity: 0 to 90 percent.

C. Altitude: 6,800 feet.

D. Wind:

1. Maximum sustained: 45 knots.
2. Maximum gust: 60 knots.

1.06 PERFORMANCE REQUIRMENTS

A. An unlicensed GE MDS 900 MHz radio system will provide a communication link between the pumping plant PLC located in the control room through a 900 MHz tower at Dezza Bluff, NM to the remote monitoring station at Fort Defiance, AZ.

B. The PLC shall communicate with the radio via Ethernet.

C. The radio will communicate with the Fort Defiance workstation via DNP protocol.

D. Upon a fiber optic loss of signal, the radio system shall take over transmitting to the Fort Defiance workstation.

E. Radio shall be capable of transmitting pertinent information for pumping plant monitoring.

1. Alarm inputs from both process and security shall have priority.

F. Video surveillance will not transmit over the radio modem. A local DVR shall record video during a fiber optic loss of signal.

G. Determine the size and ratings of the following:

1. Fuses.
2. Power supplies.
3. Surge suppression devices.

H. These specifications outline the general requirements of the radio system; however, it shall be the Contractor's responsibility to complete the details of the design.

1.07 EXTRA MATERIALS

A. Spare Parts:

1. Provide 20 percent spare fuses.
2. Provide at least 20 percent spare of each type of surge suppression device.

B. Spare parts shall be identical and interchangeable with similar parts furnished under this specification.

C. Spare parts shall be packed in containers suitable for long term storage.

D. Spare parts shall bear labels clearly designating the contents of equipment or components for which they are intended.

E. Recommended spare parts list applicable to equipment furnished under this section. List shall include name of each part, component, module, or printed circuit card; item part number, manufacturer's name and address, quantity recommended, and approximate price (current at time list is prepared) of each item.

PART 2 PRODUCTS

2.01 GOVERNMENT FURNISHED PUMP PLANT RADIO

A. In accordance with 01 64 40 – Government-Furnished Products.

B. Type: Unlicensed 900 MHz FHSS (Frequency Hopping Spread Spectrum).

C. Frequency Band: 902-928 MHz ISM.

D. Data:

1. Interface: Ethernet/RJ-45.
2. Usable throughput: up to 512 kbps.
3. Antenna connection: TNC connector (female).

E. MDS Cyber Security Suit.

F. Transmitter Power Output: 1-Watt, minimum.

G. Power Supply: 10.5 to 30 VDC.

H. Operating Temperature Range: - 30 degrees Celsius to 60 degrees Celsius.

2.02 PUMPING PLANT ANTENNA

A. Type: Yagi.

B. Frequency Band: 902-928 MHz.

C. Designed for all-weather applications.

2.03 INSULATED CONDUCTORS

A. Insulated conductors used to wire the plant radio shall be in accordance with the requirements of Section 26 05 10 – Conductors and Cables and Section 27 15 00 - Communications Cabling.

2.04 SURGE SUPPRESSION

A. DC Blocked Protector.

B. Frequency Range: 902-928 MHz.

C. Surge: 50 kA, 8/20 microsecond waveform.

PART 3 EXECUTION

3.01 INSTALLATION

A. The Contractor shall be responsible for performing any required radio path surveys necessary for communication with the Dezza Bluff, NM antenna tower.

B. The Contractor shall coordinate with the COR to establish a communication link from Tohlakai pumping plant through Dezza Bluff to NTUA headquarters.

C. In accordance with manufacturer’s recommendations.

D. Furnish anchoring and mounting materials required to install antenna tower.

E. The Contractor shall provide all mounting hardware and accessories to make a complete and operable radio system.

F. The Contractor shall install the pumping plant radio equipment inside the industrial network cabinet located inside the Control Room.

G. The Contractor shall install the pumping plant antenna at a location on the roof of the building at a location which provides for the most complete radio coverage.

H. Make cable and conduit connections. Use watertight conduit hubs for conduit connections.

I. Make grounding and bonding connections in accordance with Section 26 05 20 – Grounding and Bonding.

J. Control Cable and Wire Identification: In accordance with Section 27 15 00 - Communications Cabling.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Perform field wiring checkout and test in accordance with Section 26 05 90 – Wiring Checkout and Tests.

B. Perform system testing in accordance with Section 25 08 10 – Automation System Testing, Acceptance, and Training.

END OF SECTION

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SECTION 27 30 01
TELEPHONE SYSTEM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Telephone System:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. Institute of Electrical and Electronic Engineers (IEEE)

1. IEEE C2-2012 National Electrical Safety Code (NESC)

B. National Electrical Manufacturer's Association (NEMA)

1. NEMA 250-2008 Enclosures for Electrical Equipment (1000 Volts Maximum)

C. National Fire Protection Association (NFPA)

1. NFPA 70-2011 National Electrical Code (NEC)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 27 30 01-1, Approval Drawings and Data:

1. Bill of Materials.
2. Manufacturer's product data.

C. RSN 27 30 01-2, Check Prints:

1. Drawings in government format:
   a. Layout drawings.
   b. Schematic diagrams.
   c. Wiring diagrams

D. RSN 27 30 01-3, Operations and Maintenance Manual:

1. Final drawings including "as-built" changes.
2. Final Software Documentation.
3. Spare parts list.

E. RSN 27 30 01-4, Field Operational Checkout Test Report.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Handle and store telephone equipment in accordance with manufacturer's instructions. Include copy of these instructions with equipment at time of shipment.

1.05 PROJECT CONDITIONS

A. Ambient Temperature Range: -30 degrees Celsius to 40 degrees Celsius.

1.06 PERFORMANCE REQUIRMENTS

A. Design a solution to interface with the existing ShoreTel VOIP phone system at Fort Defiance.

B. Provide for future expansion of additional phones.

C. Functional testing of the telephone system hardware and software.

D. Make system fully operational.

E. Provide a list of recommended equipment that may be used to expand the telephone system, including original manufacturer's equipment, and/or a list of other vendor's phone system equipment, where applicable.

F. The system shall be able to support at least 8 phone connections.

G. Provide new cable of Category 6, Ethernet switches, wire, connectors, wall plates, etc., to complete a working system.

H. The telephone system, as a whole, shall comply with voice quality standards. Any amplification or attenuation required to the signal must be applied where necessary to maintain consistency in volume and clarity between calls. For instance, if white noise is introduced, it shall not interfere with the voice quality.

I. The POE network switch shall also be used for site surveillance in accordance with Section 28 10 01 – Security and Surveillance Equipment.

1.07 EXTRA MATERIALS

A. Furnish following spare parts:

1. One telephone set.
2. Spare parts shall be packed in containers suitable for long term storage.
3. Spare parts shall bear labels clearly designating the contents of equipment or components for which they are intended.

B. Any additional equipment not specified in these specifications but necessary to make the system complete and operational shall be provided by the Contractor.

PART 2 PRODUCTS

2.01 TELEPHONES

A. General Plant:

1. LCD display.
2. Display indicates when new voice mail is waiting to be acknowledged or heard.
3. Ethernet bridge 10/100.
4. Speaker phone.
5. Enable call forwarding to an internal extension or external number.
6. Head set connection: RJ 11.
7. Powered over Ethernet (POE).
8. Noise canceling microphone.
9. Volume control handset.
10. Handset cord: Hytrel®, 25 feet.
11. Chlorine Injection Room:
12. See General Plant phone requirements above.
13. Enclosure: NEMA Type 4X.

2.02 INDUSTRIAL NETWORK SWITCH

A. Rack-mounted, industrial, managed Ethernet switch.

B. Physical Features:

1. Copper ports:
   a. Ten 10/100BaseTX, RJ-45, PoE, minimum.
2. Fiber ports: two 100BaseFX, single-mode 1310nm, ST connectors.
3. Up to 30 watts per PoE port.
4. Status indicators on each port.
5. Power: redundant 24 VDC inputs.
6. Enclosure: Metal case.

C. Network Features:

1. IEEE 802.3 compliance.

2. IEEE 802.3af/at compliance.
3. Full/Half Duplex operation on all ports.
4. 100-Mbps throughput, minimum.

2.03 MEDIA CONVERTERS

A. PoE to single-mode fiber.

B. Two RJ-45 ports, minimum.

C. ST Connectors.

D. Operating temperature: -40 degrees Fahrenheit to 120 degrees Fahrenheit.

2.04 CAT 6 CABLE

A. In accordance with Section 27 15 00 - Communications Cabling.

2.05 NAMEPLATES AND DEVICE MARKINGS

A. Nameplates: As indicated on standard drawing 40-D-6234.

B. Each principal device or item of the system including chassis, modules, etc. that cannot be readily identified by markings or tags shall have identifiable nameplates.

C. Locate nameplates for convenient observation by operational and maintenance personnel.

D. Mark all interconnecting conductor and plug-in assemblies.

E. Mount red warning nameplates inside access openings of any equipment that contains hazardous voltages in excess of 50 volts. Mount warning nameplates as close as possible to hazards.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer’s recommendations.

B. Provide all mounting hardware and accessories to install the telephone sets.

C. Install in accordance with drawing 1695-D-282.

D. Mount the telephone sets at locations specified on drawing 1695-D-283.

E. Make cable and conduit connections. Use watertight conduit hubs for conduit connections.

F. Provide necessary hazardous area certified equipment where required.

G. Make power connections to equipment.

H. Connections points for power shall be approved by the COR.

I. Gradual and uniform pulling stresses only will be permitted on cable.

J. Where lubricant is needed as an aid to the pulling of cable, only soapstone or other approved material not injurious to cable outer sheath shall be used.

K. Make grounding and bonding connections in accordance with Section 26 05 60 - Grounding and Bonding.

L. Make grounding connections to existing grounding systems.

M. Cable and Wire Identification: In accordance with Section 27 15 00 - Communications Cabling.

3.02 FIELD CHECKOUT

A. Notify Government in writing at least 15 days prior to beginning of tests.

B. Testing will be witnessed by Government personnel. Government personnel will actively oversee testing.

C. All material and equipment furnished under this contract shall be subjected to tests by the Contractor, and at the expense of the Contractor at the times and location specified.

D. Furnish all necessary testing equipment and pay all cost of tests.

E. Tests shall verify that system functional, performance, and design requirements as set forth in this solicitation are met.

F. Perform Field Operational Checkout Test (FOC).

G. Demonstrate satisfactory voice quality of all equipment provided as a part of this contract.

H. Telephone System Test Minimum Requirements:

1. Exercise basic call-handling capabilities.
2. Demonstrate Graphical User Interface (GUI) programs, use of controls, dialogs, and forms, continuity of prompts and general navigation.
3. Manual Call Testing: Use each phone to place and receive calls to and from all other phones. Verify the calls in this test are completed successfully with high voice quality. Call in with a variety of phone types (i.e., cell phones, outside phone systems).

4. Multi-line Performance Test: Generate multiple simultaneous calls into the system and verify high voice quality.

5. Auto Attendant Features: Call transfer to designated voicemail or phone number.

I. Perform field wiring checkout and test in accordance with Section 27 15 00 - Communications Cabling.

J. Acceptance of equipment, or the waiving of tests thereof, shall in no way relieve the Contractor of the responsibility of furnishing equipment and materials meeting specification requirements.

END OF SECTION

SECTION 28 10 01
SECURITY AND SURVEILLANCE EQUIPMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Security and Surveillance System:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE C2-2007 National Electric Safety Code

B. National Electrical Manufacturer's Association (NEMA)

1. NEMA 250-2008 Enclosures for Electrical Equipment (1000 Volts Maximum)

C. National Fire Protection Association, Inc. (NFPA)

1. NFPA 70 – 2011 National Electrical Code (NEC)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 28 10 01-1, Approval Drawings and Data:

1. Data:
    a. Manufacturer's product data.
    b. Electrical characteristics.
    c. Bill of materials.
2. Drawings in government format.
    a. Detailed installation drawings and instructions of system being provided.
    b. Device, conduit and circuit plan layouts.
    c. Schematic and wiring diagrams.

C. RSN 28 10 01-2, Test Procedure and Start Date.

D. RSN 28 10 01-3, Test Report:

1. Certification of performance and results of test.

E. RSN 28 10 01-4, Check Prints:

1. Schematic and wiring diagrams.

F. RSN 28 10 01-5, Final Drawings and Operations and Maintenance Manuals:

1. Final Drawings including “As-built” changes.
2. Operations and Maintenance Manuals.
3. List of recommended spare parts and components.
4. Final bill of materials.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Handle and store equipment in accordance with manufacturer’s instructions. Include copy of these instructions with equipment at time of shipment.

1.05 PROJECT CONDITIONS

A. Ambient Temperature Range: -30 degrees Celsius to 40 degrees Celsius.

B. Relative Humidity: 0 to 90 percent.

C. Altitude: 6,700 feet.

D. Wind:

1. Maximum sustained: 45 knots.
2. Maximum gust: 60 knots.

1.06 PERFORMANCE REQUIRMENTS

A. Any additional equipment not specified in these specifications but necessary to make the system complete and operational shall be provided by the Contractor.

B. Provide all software essential for the system to meet all the functional requirements.

C. Design the video surveillance system to accommodate the following:

1. Digital Video Recorder:
    a. Automatic control and recording of each camera in the system.
    b. Manual control of each camera in the system via keyboard, mouse and monitor.
2. Cameras:
    a. Limit stops shall be programmed to limit the pan range of the camera to the wall adjacent to the camera.
    b. Pumping plant building:

1) The camera(s) shall power up upon authorized entry into the building and provide continuous scan of the building until alarm system is set.

2) The camera's shall power up upon unauthorized entry into the building and provide a continuous scan of the building until the alarm is cleared.

3) The camera shall power up upon entry indication into the building and pan to the opened door.

4) The camera shall begin a continuous scan of the entire room once initial preset is reached.

c. Pumping plant yard:

1) Allow coverage of the entire treatment facility yard from camera(s) mounted in the facility yard.

2) The camera(s) shall provide a continuous scan of the entire facility yard.

D. Design the security system to accommodate the following.

1. Balanced magnetic contact mounted on doors shall indicate which door opened.

2. Security keypad/control panel:

a. Allow user selectable time to enter disarming code after the door is opened.

b. Allow user selectable time after entering the arming code to exit the building.

3. Provide alarm zone detection designations to the surveillance system.

4. Provide input to Programmable Logic Controller upon unauthorized intrusion.

5. Call phone number upon unauthorized entry as designated by Government.

a. Phone number will be given at time of testing.

6. Audible Alarm:

a. Allow user selectable times.

b. Initial settings:

1) Alarm will sound after 30 seconds if keypad code is not entered.

2) Sound alarm for 30 seconds on and 30 seconds off for the first 2 minutes.

3) Sound alarm for 30 second on and 90 seconds off after 2 minutes.

c. Shall alarm both inside the pumping plant building, the chlorination building, and in the yard.

PART 2 PRODUCTS

2.01 DIGITAL VIDEO RECORDER

A. Type: Rack mount for inside Industrial Server Rack.

B. NTSC/PAL signal system compatible.

C. On-Site Storage Requirements:

1. 10 days at 10 frames per second, minimum.

D. Pan/Tilt/Zoom (PTZ) Control, with full remote control via TCP/IP network.

E. Ports:

1. 10/100BaseT Ethernet.
2. Video Inputs: 4, minimum.
3. Mouse and keyboard.
4. USB ports, 3, minimum.

F. Archive Devices:

1. For long term storage, greater than 30 days.
2. DVDRW.
3. USB.

G. Remote/ Web-Client capable.

H. Features:

1. 720p.
2. De-interlace function.
3. H.264 compression.
4. HDMI.

I. Monitor:

1. Screen dimension, 24 inches, minimum.
2. Resolution: 1080p.
3. Screen Type: Flat panel, LCD.
4. Video input: HDMI.

2.02 PAN/TILT/ZOOM (PTZ) DOME CAMERAS

A. Type: Heavy Duty.

B. Construction:

1. Type: pendant.
2. Back box: aluminum.

C. Auto-focus.

D. Zoom: 18x optical minimum.

E. Resolution: 720p, minimum.

F. Power over Ethernet PoE capable.

G. Outdoor camera to include the following:

1. Enclosure: Nema 4X.
2. Dome: smoked polycarbonate.
3. Protective cage: stainless steel.
4. Day/Night mode.
5. Operating temperature: -40 degrees Fahrenheit to 120 degrees Fahrenheit.
6. High Powered POE injector for heater element.
7. Corner mounting for 270 degree view around plant.

2.03 SECURITY KEYPAD/CONTROL PANEL

A. Type: designed for security control applications.

B. Communication: IP Ethernet.

C. Input and Outputs on Board:

1. 8 inputs, minimum.
2. 2 outputs, minimum.

D. Input and Outputs Off-board Modules:

1. 4 inputs, minimum.
2. 2 outputs, minimum.

E. Memory: store data in case of power failure.

F. User Code:

1. Control alarm ON/OFF.
2. Beep upon successful code entry.

G. Remote keypad.

H. Alarm contact for PLC connection.

2.04 BALANCED MAGNETIC CONTACT

A. Designation: Balanced magnetic contact.

B. Separate magnet housing and contact.

C. All metal housing.

2.05 AUDIBLE ALARM

A. Type:

1. Heavy duty.
2. Surface mount.

B. Decibels at 10 feet: 101 dB.

C. Outdoor housing for plant yard.

2.06 SURVEILLANCE SIGNS

A. Type: Aluminum construction.

B. Size: 10 inches by 14 inches, minimum.

C. Sign shall read “RESTRICTED AREA MONITORED BY VIDEO CAMERA”.

2.07 SURGE SUPRESSION DEVICES

A. Type: Designed to protect outdoor cameras.

2.08 INSULATED CONDUCTORS

A. Insulated conductors used to wire the security and surveillance system shall be in accordance with the requirements of Section 27 15 00 – Communications Cabling.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with manufacturer’s recommendations.

B. All connections shall be made to place the security and surveillance system into operation.

C. Door contact, and video camera cables shall be installed in the instrumentation wireway around the building and through conduit down to installation locations. See drawings 1695-D-236, 1695-D-237, and 1695-D-238.

D. Off-board modules will be mounted inside the enclosure at the chlorination building for magnetic contacts and siren outputs within the chlorination building.

E. Run appropriate cable inside the fiber optic cable conduit from the security control panel in the pumping plant Control Room to the fire panel enclosure at the Chlorination building for utilization of off-board modules.

F. Make grounding and bonding connections in accordance with Section 26 05 20 – Grounding and Bonding and NFPA 70.

G. Control Cable and Wire Identification shall be in accordance with Section 27 15 00 – Communications Cabling.

H. Mount security panel in Control Room within the pumping plant as shown on drawing 1695-D-110.

I. Mount security keypad panel within easy access from the main entry door as shown on drawing 1695-D-110.

J. Mount security cameras as specified on drawing 1695-D-295.

K. Mount digital video recorder on shelf inside the SCADA equipment cabinet designated on drawing 1695-D-284.

L. Place monitor and control station in the Office within the Pumping Plant as shown on drawing 1695-D-110.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Perform field wiring checkout and test in accordance with Section 27 15 00 – Communications Cabling.

B. Government will witness test. Notify COR in writing at least twenty (20) days prior to the beginning of the Security and Surveillance system testing.

C. The purpose of the test is to demonstrate the functionality, performance and stability of the hardware and software.

D. The test shall verify that all hardware and software meet the requirements of the specifications and drawings.

3.03 TRAINING

A. The contractor shall provide, at the project site, competent instructors to instruct Government personnel in system operations, hardware and software; all that relate to the security and surveillance system.

B. Training shall be a minimum of four hours in duration.

C. Training shall include a minimum of four trainees for local Government personnel.

END OF SECTION

SECTION 28 31 00

FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Fire Detection and Alarm:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. National Fire Protection Association (NFPA)

1.	NFPA 70-2011	National Electrical Code (NEC)
2.	NFPA 72-2010	National Fire Alarm and Signaling Code
3.	NFPA 90A-2012	Installation of Air Conditioning and Ventilating Systems
4.	NFPA 101-2012	Life Safety Code
5.	NFPA 1221-2010	Installation, Maintenance and Use of Emergency Services Communications Systems

B. Underwriters Laboratories, Inc. (UL)

1.	UL 38-2008	Manual Signaling Boxes for Fire Alarm Systems
2.	UL 94-2013	Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
3.	UL 268-2009	Smoke Detectors for Fire Alarm Systems
4.	UL 268A-2008	Smoke Detectors for Duct Application
5.	UL 464-2011	Standard for Audible Signal Appliances
6.	UL 864-2011	Standard for Control Units and Accessories for Fire Alarm Systems
7.	UL 1481-2006	Standard for Power Supplies for Fire-Protective Signaling Systems
8.	UL 1638-2001	Standard for Visual Signaling Appliances – Private Mode Emergency and General Utility Signaling
9.	UL 1971-2008	Signaling Devices for the Hearing Impaired

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and 01 33 26 - Electrical Drawings and Data.

B. RSN 28 31 00-1, Approval Data:

1. Manufacturer's data.

a. Include manufacturer's name, model numbers, ratings, power requirements, and complete wiring point-to-point diagrams.

2. Installation companies current National Institute for Certification in Engineering Technologies (NICET) (minimum Level II Fire Alarm Technology) certification.

C. RSN 28 31 00-2, Testing Notification.

D. RSN 28 31 00-3, Test Reports.

E. RSN 28 31 00-4, As-built Drawings.

F. RSN 28 31 00-5, Operation and Maintenance Instruction Book:

1. This submittal does not relieve the Contractor of providing hard copy books to government personnel prior to training.

a. Rate of frequency in days, months, or years for each device to be tested. Rate of frequency shall be based on the manufacturer's recommendations and/or NFPA 72 testing requirements, whichever is more stringent.

1.04 SYSTEM DESCRIPTION

A. General:

1. All devices for a complete system shall be manufactured by a single manufacturer or division thereof (except for the early warning detector for the control room listed below).

2. Activation of the system into 'alarm mode' will occur by actuation of any alarm initiating device. System will remain in 'alarm' until the initiating device is reset and the FACP is reset and restored to 'normal mode.'

3. Fire alarm system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc.

4. Size each signal line circuit (SLC) to provide 40 percent expansion without hardware modifications to the panel.

5. A single ground or open on any initiating device circuit or notification appliance circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.

6. The secondary power source will be capable of providing at a minimum, 24 hours of backup power and the ability to sustain 15 minutes in alarm mode at the end of the backup period. Batteries will require a derating factor of 40 percent.

7. See drawings for the sequence of operation of devices.

8. Any substitution to devices listed below will require a full battery calculation submittal showing the system meets the requirements listed above.

9. In addition to IP communication interfaces, fire alarm control panels (FACP and FACP2) shall communicate trouble and alarm status to the Programmable Logic Controller (PLC) listed in Section 25 00 02 – Programmable Controller via programmable relays.

B. Fire Alarm Control Panels:

1. The main pumping plant building will contain 2 fire alarm control panels; one to be dedicated to detection and release of suppression in the control room (FASP), and one to be the main fire alarm control panel (FACP) for the rest of the building with monitored connection points to the suppression control panel. On activation of any detection device in the control room, the FASP will send the alarm signal to the FACP for building notification. The FASP will control one blue lens notification device at the location shown on the drawings. This device will only annunciate when suppression has been released into the control room.

2. The chlorine building will contain one fire alarm control panel (FACP2) that will monitor detection and control notification for the chlorine building. This panel will also communicate to a central supervising station via internet protocol.

C. Fire Alarm Suppression Panel (FASP) Operation:

1. General Operations:

a. All detection signals (includes manual station and automatic smoke detection):

1) The FASP will send an alarm signal to the FACP for building notification.

b. When a release signal is sent to the suppression system, the FASP will also annunciate the room exterior blue lens strobe indicating a release of suppression.

2. The FASP will monitor manual and automatic smoke detection devices. Upon detection activation the following sequence of operations will occur:

a. Manual Release Station:

1) The FASP will send a release signal to the suppression system to release suppression.

2) If the abort station is depressed during this activation, there will be no effect.

b. Aspirating Smoke Detection (ASD):

1) The FASP will activate the discharge relay timer. This timer shall be set to 30 seconds delay before releasing suppression into the space.

2) If the abort station is depressed during this activation, the abort function will be activated as defined below.

3. The Abort function will provide the ability to stop an agent release that was initiated by an automatic detection device. The Abort function shall be programmed such that a releasing event starts the Pre-discharge timer. If the Abort Switch is pressed while the Delay Timer continues to count down, the timer counts down to 10 seconds and holds there. If the Abort Switch is released, the timer resumes the countdown from 10 seconds.

D. Early Warning System:

1. The early warning detectors shall be installed such that all racks (control and networking) have automatic aspirating smoke detection installed.

2. Piping shall be installed in all racks and connected to the aspirating detectors

3. Initial installation of detectors shall go through a week of supervised functioning during normal plant operations. During this time period the detectors shall be in 'learning mode' which allows automatic environment sensing to reduce nuisance alarms.

PART 2 PRODUCTS

2.01 FIRE ALARM CONTROL PANEL (FACP) FOR MAIN BUILDING

A. Addressable Fire Alarm Control Panel with Digital Alarm Communicator/Transmitter (DACT) manufactured by FireLite Alarms, Website: www.firelite.com, Catalog #: MS-9050UD; or equal, having the following essential characteristics:

1. Input voltage: 120 VAC.

2. Output voltage: 24 VDC.

3. Supervise and monitor all initiating device circuits and alarm notification circuits for trouble and alarm conditions.

4. Detect the operation of any initiating device circuit and the location of the alarm condition.

5. Operate all notification appliance devices as designed.

6. Visually and audibly annunciate any trouble, supervisory or alarm condition on panel display.

7. Addressable devices: up to 50.

8. Capable of strobe synchronization.

9. Piezo sounder for local alarm, trouble, and supervisory alarms.

10. The system shall have a built in digital communicator.
11. Two independently programmable notification appliance circuits (NAC).
12. Two programmable relays and one trouble relay.
13. Built-in programmer.
14. Telephone line active LEDs.
15. IP communicator compatible.
16. Integral 80-character liquid crystal display (LCD) with backlighting.
17. Automatic detector sensitivity testing per NFPA 72.
18. The system shall have Light Emitting Diode (LED) indicators. The system LEDs shall indicate, at a minimum, the status of the following system parameters:
    a. AC Power: Green.
    b. Fire Alarm: Red.
    c. Supervisory: Yellow.
    d. Trouble: Yellow.
    e. Alarm Silenced: Yellow.
19. The system shall include a history log with 500 event storage. The history shall be accessible from the main system display.
20. The system shall include a real-time clock/calendar with daylight savings time control.
21. The system shall be capable of the following operations:
    a. Acknowledge/Silence Switch:
        1) Activation of the control panel tone silence switch in response to alarms troubles and supervisory conditions shall silence the local panel electric signal and change the LED from flashing mode to steady-ON mode. Occurrence of any new conditions in the system shall cause the control panel to resound the local sounder and repeat the alarm, trouble, or supervisory sequences.
        2) Depression of the Acknowledge switch shall also silence all remote annunciator sounders.
    b. Alarm Silence Switch: Activation of the alarm signal silence switch shall cause all alarm notification appliances to return to the normal condition after an alarm condition.
    c. System Reset Switch: Activation of the System Reset Switch shall cause all electronically-latched initiating devices, as well as all associated output devices and circuits, to return to their normal condition. Holding system reset switch down shall perform a LAMP TEST function and will activate the sounder.

d. Alarm Activate (Drill): Activation of the Alarm Activate switch shall activate all notification appliance circuits without activating the communicator. The drill function shall latch until the panel is silenced or reset.

e. Lamp Test: The System RESET switch shall also function as a Lamp Test switch and shall activate all system LEDs and light each segment of the liquid crystal display.

22. FACP shall have red factory finish lockable enclosure. Provide 4 sets of keys.

23. Enclosure shall be capable of storing two batteries.

24. Panel shall contain integral battery charger.

25. UL listed meeting the requirements of UL 864, 9th edition.

B. Programming Software by FireLite Alarms, Website: www.firelite.com, Catalog #: PK-CD; or equal, having the following essential characteristic:

1. Windows based programming software for FACP.

C. IP Fire Alarm Communicator by FireLite Alarms, Website: www.firelite.com, Catalog #: IPDACT-2UD; or equal, having the following essential characteristics:

1. A communicator that converts the analog signals into digital signals allowing the FACP to communicate via internet protocol (IP).

2. Allows full duplex communication to the panel.

3. Allows programmer to upload and download data between PC and FACP via IP.

D. IP Communicator Mounting Kit by FireLite Alarms, Website: www.firelite.com, Catalog #: IPBRKT; or equal, having the following essential characteristics:

1. Ability to mount the IP communicator in the FACP enclosure.

E. Sealed Lead-Acid Batteries by FireLite Alarms, Website: www.firelite.com, Catalog #: BAT-1270; or equal, having the following essential characteristics:

1. Sealed, maintenance-free lead acid battery.

2. Overcharge protection.

3. Casing: Rugged construction, high-impact.

4. 24-volt direct current (DC) output via two 12-volt DC batteries.

5. Seven amp-hours (Ah), minimum.

F. Auxiliary Power Supply for Notification Appliance Circuits (NAC) by FireLite Alarms, Website: www.firelite.com, Catalog #: FCPS-24FS6; or equal, having the following essential characteristics:

1. Remote power supply with battery charger.

2. Contains two fully-isolated input/control circuits which are triggered from the FACP.
3. Six-amp full load output, capable of handling all notification appliance circuits in the pumping building.
4. Three-amp maximum output for any one circuit.
5. Compatible with coded inputs.
6. Contains power-supervision relay for FACP monitoring purposes.
7. Fully regulated and filtered power output of 24VDC.
8. Meets UL power-limiting requirements.
9. Form C trouble relay.
10. Supervised power supply, battery, and NACs.
11. Lockable cabinet.
12. Input voltage: 120VAC.
13. Contains two batteries resulting in 7 amp-hours (Ah) minimum. See Article 2.01E.
14. Ability to synchronize all strobe flashes with the FACP NAC circuit.
15. UL 864 and 1481 listed.

2.02 FIRE ALARM CONTROL PANEL (FACP2) FOR CHLORINE BUILDING

A. Addressable Fire Alarm Control Panel with Built-in Communicator manufactured by FireLite Alarms, Website: www.firelite.com, Catalog #: MS-25 Rev2; or equal, having the following essential characteristics:

1. Input voltage: 120 VAC.
2. Output voltage: 24 VDC.
3. Supervise and monitor all initiating device circuits and alarm notification circuits for trouble and alarm conditions.
4. Detect the operation of any initiating device circuit and the location of the alarm condition.
5. Operate all notification appliance devices as designed.
6. Visually and audibly annunciate any trouble, supervisory or alarm condition on panel display.
7. Addressable devices: up to 25.
8. Capable of strobe synchronization.
9. Piezo sounder for local alarm, trouble, and supervisory alarms.
10. The system shall have a built in digital communicator.
11. Two independently programmable notification appliance circuits (NAC).

12. Two programmable relays and one trouble relay.

13. Built-in programmer; no software required.

14. IP communicator compatible or contains accessories for connecting the IP communicator.

15. Automatic detector sensitivity testing per NFPA 72.

16. The system shall have LED indicators. The system LEDs shall indicate, at a minimum, the status of the following system parameters:

    a. AC Power: Green.

    b. Fire Alarm: Red.

    c. Supervisory: Yellow.

    d. Trouble: Yellow.

    e. Alarm Silenced: Yellow.

    f. Disabled: Yellow.

17. The system shall include a real-time clock/calendar with daylight savings time control.

18. The system shall be capable of the following operations:

    a. System reset switch: Activation of the System Reset Switch shall cause all electronically-latched initiating devices, as well as all associated output devices and circuits, to return to their normal condition.

    b. Lamp test: The Lamp Test and shall activate all system LEDs.

    c. Silence switch: Activation of the alarm signal silence switch shall cause all alarm notification appliances to return to the normal condition after an alarm condition. If left in silence mode for more than 24 hours or if a new signal event occurs, the panel shall annunciate again.

    d. Acknowledge switch:

        1) Activation of the acknowledge switch in response to alarms troubles and supervisory conditions shall silence the local panel electric signal. Occurrence of any new conditions in the system shall cause the control panel to resound the local sounder and repeat the alarm, trouble, or supervisory sequences.

    e. Viewing Active Alarm Points: The panel shall be able to scroll through all active alarm points.

19. FACP shall have red factory finish lockable enclosure. Provide 4 sets of keys.

20. Panel shall contain integral battery charger.

21. UL listed meeting the requirements of UL 864, 9th edition.

B. IP Fire Alarm Communicator by FireLite Alarms, Website: www.firelite.com, Catalog #: IPDACT-2UD; or equal, having the following essential characteristics:

1. A communicator that converts the analog signals into digital signals allowing the FACP to communicate via internet protocol (IP).
2. Allows full duplex communication to the panel.
3. Allows programmer to upload and download data between PC and FACP via IP.

C. Sealed Lead-Acid Batteries by FireLite Alarms, Website: www.firelite.com, Catalog #: BAT-12120; or equal, having the following essential characteristics:

1. Sealed, maintenance-free lead acid battery.
2. Overcharge protection.
3. Casing: Rugged construction, high-impact.
4. 24-volt direct current (DC) output via two 12-volt DC batteries.
5. Twelve amp-hours (Ah), minimum.

D. Battery Backbox by FireLite Alarms, Website: www.firelite.com, Catalog #: BB-26; or equal, having the following essential characteristics:

1. Backbox capable of storing batteries for FACP2.

2.03 FIRE ALARM SUPPRESSION PANEL (FASP) FOR CONTROL ROOM

A. Agent Release Control Panel manufactured by FireLite Alarms, Website: www.firelite.com, Catalog #: MRP-2002; or equal, having the following essential characteristics:

1. Agent release rated panel for suppression as listed in Section 21 22 00 – Clean Agent Fire Extinguishing System. Panel shall initiate agent release as described in Section 21 22 00 – Clean Agent Fire Extinguishing System.
2. Compatible with conventional input devices such as two-wire and four-wire smoke detectors, pull stations, waterflow devices, tamper switches, and other normally-open contact devices.
3. Normal operating voltage: 20VDC for initiating device circuits, and 24VDC for notification appliance and releasing circuits.
4. Adjustable pre-discharge and discharge delay timers.
5. Six programmable initiating device circuits.
6. Four programmable output circuits.
7. Three programmable relays.
8. Capable of strobe synchronization.
9. Built-in programmer.
10. Integral 80-character liquid crystal display (LCD) with backlighting.
11. The system shall include a real-time clock/calendar with daylight savings time control.

12. The system shall include a history log with 256 event storage. The history shall be accessible from the main system display.

13. Piezo sounder for local alarm, trouble, and supervisory alarms.

14. Panel shall contain integral battery charger.

15. The system shall have LED indicators. The system LEDs shall indicate, at a minimum, the status of the following system parameters:

    a. AC Power: Green.

    b. Fire Alarm: Red.

    c. Supervisory: Yellow.

    d. Trouble: Yellow.

    e. Alarm Silenced: Yellow.

    f. Discharged: Red.

    g. Pre-discharge: Red.

    h. Abort: Yellow.

16. The system shall be capable of the following operations:

    a. Acknowledge/step switch:

        1) Activation of the control panel acknowledge/step switch in response to alarms troubles and supervisory conditions shall silence the local sounder and change the LED from flashing mode to steady-ON mode. Occurrence of any new conditions in the system shall cause the control panel to resound the local sounder and repeat the alarm, trouble, or supervisory sequences. The acknowledge switch will have no effect on the NACs. During multiple events, subsequent pressing of the acknowledge switch steps through each active event.

    b. Alarm silence switch: Activation of the alarm signal silence switch shall cause all alarm notification appliances to return to the normal condition after an alarm condition.

    c. System reset switch: Activation of the Reset Switch shall cause all electronically-latched initiating devices, as well as all associated output devices and circuits, to return to their normal condition. Holding system reset switch down shall perform a LAMP TEST function, will activate the sounder, and light each segment of the liquid crystal display.

    d. Alarm activate (drill): Activation of the Alarm Activate switch shall activate all notification appliance circuits without activating the releasing circuit.

17. FACP shall have red factory finish lockable enclosure. Provide 4 sets of keys.

18. UL listed. Panel shall meet requirements of UL 864, 9th edition.

B. Sealed Lead-Acid Batteries by FireLite Alarms, Website: www.firelite.com, Catalog #: BAT-12550; or equal, having the following essential characteristics:

1. Sealed, maintenance-free lead acid battery.
2. Overcharge protection.
3. Casing: Rugged construction, high-impact.
4. 24-volt direct current (DC) output via two 12-volt DC batteries.
5. 55 amp-hours (Ah), minimum.

C. Battery Backbox by FireLite Alarms, Website: www.firelite.com, Catalog #: BB-55; or equal, having the following essential characteristics:

1. Backbox capable of storing batteries for FASP.

D. External Battery Charger by FireLite Alarms, Website: www.firelite.com, Catalog #: CHG-75; or equal, having the following essential characteristics:

1. External battery charger capable of charging batteries for FASP.

2.04 CENTRAL STATION RECEIVER

A. IP Alarm Receiver for MIP and IPDACTR Modules by FireLite Alarms, Website: www.firelite.com, Catalog #: VisorALARM-Plus; or equal, having the following essential characteristics:

1. IP Alarm receiver capable of communication with IP devices listed in Articles 2.01C and 2.02B.
2. Monitors connectivity status with all registered devices.
3. Monitors the status of network access to avoid false technical alarms under a communication failure situation.
4. Support for dynamic and static IP address programming.
5. Uses a minimum of 512 bit AES encryption for all communications with registered devices.
6. Communicates alarms to servers via serial connection. Serial cord shall be provided with the unit.
7. Compatible with Surgard, Radionics, and Ademco protocols.
8. Contains external card used to save all configuration information that can be used for immediate system replacement during crash recovery situations.
9. Ability to switch to a secondary support receiver during outage of this device.
10. Local management through serial connection.
11. Remote management through telnet session.
12. Embedded operating system.

13. Display and keyboard for the ability to manage and validate monitoring and alarms directly from the receiver.
14. Memory for up to 42000 alarms storage.
15. Two programmable inputs.
16. One programmable output.
17. Two serial ports.
18. Input voltage: 100-240VAC.
19. Connector: RJ45 female.
20. Device meets requirements of UL 864.

2.05 MANUAL PULL STATION

A. Addressable Pull Station by FireLite Alarms, Website: www.firelite.com, Catalog #: BG-12LX; or equal, having the following essential characteristics:

1. Addressable manual pull station.
2. Dual-action with key-lock reset.
3. Compatible with fire alarm control panels FACP and FACP2 listed in Articles 2.01 and 2.02.
4. Adjustable addressable module to be housed inside of the pull station.
5. Meet Americans with Disabilities Act (ADA) requirements for a 5-pound maximum pull force.
6. Contain Braille text on handle.
7. Operating temperature range: 0 degrees Celsius to 49 degrees Celsius.
8. UL listed meeting the requirements of UL 38.

2.06 OUTDOOR RATED MANUAL PULL STATION

A. Manual Pull Station by FireLite Alarms, Website: www.firelite.com, Catalog #: BG-12LOB; or equal, having the following essential characteristics:

1. Manual pull station.
2. Dual-action with key-lock reset.
3. Complete with UL approved outdoor gasket and accompanying outdoor backbox.
4. Compatible with fire alarm control panel FACP2 listed in Article 2.02.
5. Meet Americans with Disabilities Act (ADA) requirements for a 5-pound maximum pull force.
6. UL listed meeting the requirements of UL 38.

2.07 AGENT RELEASE PULL STATION

A. Dual Action Agent Release Station by FireLite Alarms, Website: www.firelite.com, Catalog #: BG-12LRA; or equal, having the following essential characteristics:

1. Dual-action pull station.
2. Compatible with fire alarm suppression panel FASP listed in Article 2.03.
3. Power-on indication.
4. Released indication.
5. Abort switch integrated into the pull station.
6. UL listed.

2.08 ADDRESSABLE PHOTOELECTRIC SMOKE DETECTOR

A. SD355 Series Addressable Photoelectric Smoke Detector by FireLite Alarms, Website: www.firelite.com, Catalog #: SD355; or equal, having the following essential characteristics:

1. Addressable photoelectric detector.
2. Plug-in design for easy mounting.
3. Compatible with fire alarm control panel FACP listed in Article 2.01.
4. Adjustable addressing per device.
5. Low profile design.
6. Built-in tamper-resistance.
7. Removable cover with insect-resistant screen for simple field cleaning.
8. Capable to withstand air velocities up to 4,000 feet per minute without false alarming.
9. Visible communication identification.
10. Visible alarm state identification.
11. Mounting: direct surface or electrical box.
12. Rated V-0 for plastic flammability per UL 94.
13. Sealed against back pressure.
14. Sensitivity: 1.5-percent/foot nominal.
15. Voltage: 24VDC.
16. Operating Temperature Range: 0 degrees Celsius to 49 degrees Celsius.
17. UL listed meeting the requirements of UL 268.

2.09 PHOTOELECTRIC SMOKE DETECTOR

A. i^3 Series Photoelectric Smoke Detector by FireLite Alarms, Website: www.firelite.com, Catalog #: 2W-B; or equal, having the following essential characteristics:

1. Conventional photoelectric smoke detector.
2. Plug-in design for easy mounting.
3. Compatible with fire alarm suppression panel FASP.
4. Capable of remote annunciation for cleaning via maintenance module.
5. Capable of local identification for: normal standby, out of sensitivity, alarm, or freeze trouble conditions.
6. Mounting: direct surface or electrical box.
7. Removable cover and chamber for simple field cleaning.
8. Drift compensation and smoothing algorithms to reduce nuisance alarms.
9. Built-in test switch.
10. Sensitivity: 2.5-percent/foot nominal.
11. Freeze trouble threshold at 5 degrees Celsius.
12. Voltage: 24VDC.
13. Operating Temperature Range: 0 degrees Celsius to 49 degrees Celsius.
14. UL listed meeting the requirements of UL 268.

B. Maintenance Module for Detector by FireLite Alarms, Website: www.firelite.com, Catalog #: 2W-MOD2; or equal, having the following essential characteristics:

1. Two wire loop test module for photoelectric smoke detector.
2. Compatible with detector.
3. Allows the fire alarm suppression panel to receive a ‘maintenance’ signal that the detector needs cleaning.
4. Local identification for normal standby, trouble, alarm, out of sensitivity, freeze trouble, and wiring fault.

2.10 ASPIRATING SMOKE DETECTOR

A. Fire Alarm Aspiration Sensing Technology (FAAST) by System Sensor, Website: www.systemsensor.com, Catalog #: 8100; or equal, having the following essential characteristics:

1. Dual source (blue LED and infra-red laser) optical smoke detection device.
2. Sensitivity Range: 0.00046 to 6.25 percent obstruction/foot.
3. Five programmable alarm levels for latching or non-latching relays.

4. Two sensitivity modes. One mode to automatically adjust to the current environment to reduce nuisance alarms.
5. Dual flow detection including ultrasonic and electronic sensing for pipe and chamber air flow measurement.
6. Advanced detection algorithms for reduction in nuisance alarms.
7. Field replaceable filter. Contractor shall purchase three replacement air filters for this device and provide to building owner. Replacement air filters catalog #: F-A3384-000.
8. Ethernet cable for network connection.
9. Integral display for configuration.
10. Eight form C relays for communication to fire alarm suppression panel (FASP).
11. Programmable alarm delay from 0 to 60 seconds.
12. Voltage: 24VDC.
13. Operating Temperature Range: 0 degrees Celsius to 38 degrees Celsius.
14. Coverage area: 8000 square feet.
15. Air velocity: up to 4,000 feet/minute.
16. Detection for up to 260 feet of connected piping.
17. Event log storage capable of 18,000 events.
18. UL listed.

B. Aspiration Piping by System Sensor, Website: www.systemsensor.com, Catalog #s: P-COUPLING, P-ELB-45, P-ELB-90, P-ENDCAP, P-LABEL-P, P-LABEL-T, P-PIPE-210, P-TEE, and P-UNION; or equal, having the following essential characteristics:

1. Piping must be capable of air tight seals at all location with exception to air sampling ports.
2. Piping and accessories shall be 3/4-inch nominal schedule 40 chlorinated polyvinyl chloride (CPVC).
3. Fittings shall be rated for continuous service of 175 pounds per square inch at 65 degrees Celsius.
4. Piping shall be labeled continuously along entire piping length. Labeling shall state along the lines of ‘Smoke Detector Sampling Tube Do Not Disturb’.
5. Sampling points of the piping shall be labeled with ‘Fire Detection System Sampling Point Do Not Paint’ or similar wording.

2.11 DUCT SMOKE DETECTOR

A. InnovairFlex Intelligent Non-Relay Photocelectric Duct Smoke Detector by FireLite Alarms, Website: www.firelite.com, Catalog #: D355PL; or equal, having the following essential characteristics:

1. Intelligent non-relay photoelectric duct smoke detector.
2. Housing shall be pivoting to allow for fit in both square and rectangular footprints capable of mounting to a round or rectangular duct.
3. Airflow velocity range: 100 to 4,000 feet/minute.
4. Operating Temperature Range: -20 degrees Celsius to 70 degrees Celsius.
5. Sensor head shall be easily accessible for maintenance.
6. Tamper feature indicating a trouble signal for a removed or improperly installed sensor cover.
7. Front or back mounting of sampling tube with no required tools.
8. Clear cover for visual inspection.
9. Remote testing capable.
10. Requires com line power only.
11. UL listed meeting the requirements of UL 268A.

B. Weather resistant housing by FireLite Alarms, Website: www.firelite.com, Catalog #: DNRW; or equal, having the following essential characteristics:

1. NEMA 4 rated housing. Watertight, UV resistant enclosure providing protection against falling dirt, rain, and windblown dust, splashing and hose directed water.
2. Housing must be compatible with duct smoke detector.

C. Remote Test Station by FireLite Alarms, Website: www.firelite.com, Catalog #: RTS151KEY; or equal, having the following essential characteristics:

1. Remote test station for duct smoke detector.

D. Metal sampling tubes by FireLite Alarms, Website: www.firelite.com, Catalog #: DST3; or equal, having the following essential characteristics:

1. Metal sampling tubes compatible with duct smoke detector.
2. Tubing shall be purchased and installed to fit the duct work size. See drawings for duct work sizes.

2.12 STROBE NOTIFICATION DEVICE

A. Wall Strobe Notification Appliance by FireLite Alarms, Website: www.firelite.com, Catalog #: SW; or equal, having the following essential characteristics:

1. Wall mounted strobe notification device.

2. Strobe light shall be a xenon flash tube.
3. Strobe rate: 1 flash per second.
4. Compatible with fire alarm suppression panel (FASP).
5. White housing.
6. Candela: 30cd.
7. Voltage: 24VDC.
8. Operating Temperature Range: 0 degrees Celsius to 49 degrees Celsius.
9. Shall connect via synchronization module compatible with both notification device and fire alarm control panel.
10. UL 1971 listed.

B. Blue Lens by System Sensor, Website: www.systemsensor.com, Catalog #: LENS-B; or equal, having the following essential characteristics:

1. Blue lens cover for wall mounted strobe.
2. Compatible with strobe notification device.
3. UL 1638 listed.

2.13 HORN/STROBE NOTIFICATION DEVICE

A. Selectable Output Notification Appliance by FireLite Alarms, Website: www.firelite.com, Catalog #s: P2R (indoor) and P2RK (outdoor); or equal, having the following essential characteristics:

1. Wall mounted clear strobe/horn.
2. Strobe light shall be a xenon flash tube.
3. Red housing.
4. Candela: 15 – 110 selectable. See drawings for specific locations.
5. Strobe rate: 1 flash per second.
6. The horn shall have three audibility options and an option to switch between a temporal 3 pattern and a non-temporal pattern.
7. Device to have multi-switch for changing between horn modes as well as candela levels.
8. Voltage: 24VDC.
9. See drawings for specific location of indoor or outdoor device.
10. Operating Indoor Temperature Range: 0 degrees Celsius to 49 degrees Celsius.
11. Operating Outdoor Temperature Range: -40 degrees Celsius to 66 degrees Celsius.

12. Shall connect via synchronization module compatible with both notification device and fire alarm control panel.

13. Outdoor units shall be listed for use with weatherproof backbox.

14. UL 1971 and 464 listed.

PART 3 EXECUTION

3.01 INSTALLATION

A. The Central Station Receiver is to be furnished to the CO for installation at a remote location.

B. Provide and test the microprocessor controlled, intelligent reporting fire alarm equipment required to form a complete, operative, and coordinated system as described in this Section.

C. Install all work as shown and specified herein, in accordance with NFPA 70, NFPA 72, NFPA 90A, NFPA 101, NFPA 1221, and in accordance with the manufacturer's diagrams and recommendations.

D. Provide end of line resistors as needed.

E. Provide a lockable, red marked, circuit breaker dedicated to power each fire alarm panel and external batteries dedicated to fire alarm systems; label the circuit breaker as indicated. See panelboard schedules for specific circuit location. A lockable breaker is accomplished by using a circuit breaker lock that is listed for use with the circuit breaker and that allows the breaker to trip, but does not allow tampering with the breaker.

F. Install conduit and conductor in accordance with Specification Sections 26 05 33 – Raceways and Boxes and 26 05 10 – Conductors and Cables.

G. Smoke detectors shall not be installed until construction is essentially complete and the building has been thoroughly cleaned.

H. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of other systems.

I. Fire detection and alarm conduit and conduit accessories shall be dedicated to this system and factory painted red (except aspirating piping). Upon complete installation, contractor shall touch up paint as needed.

J. All fire alarm panels shall be mounted so that no part of the enclosing cabinet is less than 30-inches or more than 78-inches above finished floor.

K. FACP2 shall be mounted in exterior enclosure, see Section 26 27 16 – Electrical Cabinets and Enclosures.

L. Detectors shall be at least 12 inches from any part of any lighting fixture.

M. Detectors shall be located at least 3 feet from diffusers of air handling systems.

N. Notification appliances shall be mounted 80 inches above the finished floor or 6 inches below the ceiling, whichever is lower.

O. Early Warning System:

1. The early warning detectors shall be installed such that all racks (control and networking) have automatic aspirating smoke detection piping installed.

2. Piping and accessories shall be installed in all racks and connected to the aspirating detectors. See drawings for detector locations.

3. Initial installation of detectors shall go through a week of supervised functioning during normal plant operations. During this time period the detectors shall be in 'learning mode' which allows automatic environment sensing to reduce nuisance alarms. No testing shall be performed prior to this 'soak' period.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Submit for approval at least 30 days prior to commencement of formal operational testing. Include detailed procedures for operational testing of each fire detection and alarm component prepared and signed by a NICET Level III fire alarm technician for performance of an operational system test.

B. Operational Test:

1. Perform fire detection and alarm testing in witness of Government Representative and pumping plant operators.

2. Demonstrate each detection device operates per manufacturer's instructions with IP communicator disconnected.

3. Perform one test showing successful digital communicator operation in contacting the proper supervising personnel.

4. Upon completion of successful testing, provide all documentation, security codes, replacement devices, and other relevant material to Government representative.

C. Test Report:

1. Submit test reports bound together showing field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system.

2. Each test report shall document readings, test results and indicate the final position of controls. Include the NFPA 72 Certificate of Completion and NFPA 72 Inspection and Testing Form, with the appropriate test reports.

3. Provide dates of testing and correctional items found during testing with remedies.

4. Supply contact information including address, telephone, website, etc. for local certified fire alarm technician.

5. Test report shall be signed by Government representative witnessing operational test.

3.03 TRAINING

A. Submit lesson plans, operating instructions, maintenance procedures, and training data, furnished in manual format, for the training courses.

B. The operations training shall familiarize designated government personnel with proper operation of the fire alarm system.

C. Conduct the course in the building where the system is installed or as designated by the CO.

D. The instructions shall cover items contained in the operating and maintenance instructions book.

E. In addition, training shall be provided on performance of expansions or modifications to the fire detection and alarm system.

F. The maintenance training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

G. Manuals shall be provided prior to training outlining step-by-step procedures required for system startup, operation, and shutdown.

H. The manual shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features.

3.04 WARRANTY

A. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of 5 years after expiration of the warranty.

END OF SECTION

SECTION 31 02 10

WATER FOR DUST ABATEMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Water for Dust Abatement:

1. Measurement: Volume of water applied for dust abatement as directed by the COR.
    a. Only water used for dust abatement as directed by the COR will be included.
    b. Quantity will be measured by calibrated water meter approved by COR.
2. Payment: M (1,000) gallons price offered in the schedule.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 APPLYING WATER FOR DUST ABATEMENT

A. Provide water in accordance with Section 01 51 00 - Temporary Utilities.

B. Provide means of conveying water to point of use and applying water.

C. Use pressure spray or distributor bar to apply water evenly.

D. Do not use water for dust abatement on temporary equipment roads unless directed by the COR.

E. Apply water for dust abatement as directed by the COR.

END OF SECTION

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SECTION 31 02 30
DUST PALLIATIVE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Dust Palliative for Reseeded Areas:

1. Measurement: Area covered as approved by the COR.
    a. Only palliative applied in areas approved by the COR will be included.
2. Payment: Acreage price offered in the schedule.

B. Dust Palliative for Non-reseeded Areas:

1. Measurement: Area covered as approved by the COR.
    a. Only palliative applied in areas approved by the COR will be included.
2. Payment: Acreage price offered in the schedule.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 31 02 30-1, Dust Palliative for Reseeded Areas:

1. Proposed application area for dirt glue.
2. Include dust palliative composition, equipment and application.
3. Certification that dust palliative does not inhibit revegetation.

C. RSN 31 02 30-2, Dust Palliative for Non-reseeded Areas.

1. Proposed application area for Magnesium Chloride.
2. Application equipment.

PART 2 PRODUCTS

2.01 DUST PALLITIVE FOR RESEEDED AREAS

A. Dirtglue, as manufactured by Dirtglue Enterprises, Website: www.dirtglue.com, or equal, with the following essential characteristics:

1. Biodegradeable.
2. Water based.
3. Won’t inhibit revegetation.

2.02 DUST PALLIATIVE FOR NONRESEEDED AREAS

A. Magnesium Chloride

1. Furnish in liquid or dry powder.
2. Dry-weight content of magnesium chloride: 94 percent minimum.
3. Application solution: 28 percent concentration, minimum.

2.03 WATER

A. Required for mixing and application.

PART 3 EXECUTION

3.01 PREPARATION

A. Surface Preparation:

1. Shape and grade surface.
2. Loosen surface with rock rake or blade grader to depth of 1 to 2 inches.
3. Water loose surface so it is visibly moist.
4. In areas without surfacing materials: Do not disturb subgrade, moisten only.

3.02 APPLICATION

A. Equipment: Designed for uniform application on variable widths at predetermined rates.

B. Access roads and ROW as directed by COR.

C. Apply within 24 hours after completion of surface preparation.

D. Time:

1. Not during rain.
2. Not if rain is anticipated within four hours following treatment.
3. Do not apply to frozen ground.

E. Application Rate:

1. Dust Palliative for Reseeded Area: As recommended by manufacturer.
2. Dust Palliative for Non-reseeded Areas: 0.3 gallons per square yard.
3. If material runs off during application, make repeated passes at lesser rates.

F. Compaction: By equipment travel.

1. Keep traffic off treated surface until dust palliative has penetrated and cured enough to prevent excessive pickup under traffic.

END OF SECTION

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SECTION 31 03 33

REMOVAL OF WATER FROM EXCAVATION

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in applicable prices offered in the schedule for items of work requiring removal of water from excavations.

1.02 DEFINITION

A. Dewatering: Removal and control of groundwater from pores or other open spaces in soil or rock formations to allow construction activities to proceed as intended, and includes relief of groundwater pressure.

B. Unwatering: Control and removal of ponded, seeping, or flowing surface water or emerging subsurface water from excavated surfaces and from precipitation within and adjacent to excavations and construction zones using channels, ditches, gravel drains, gravel blankets, pipe, sumps, and discharge lines. Includes control and discharge of effluent waters.

1.03 SYSTEM DESCRIPTION

A. Design, install, operate, maintain, and monitor water removal facilities.

B. Design and lay out facilities to collect discharge water from water removal systems and convey water to designated approved discharge points.

C. Locate water removal facilities to maximize water removal and minimize construction interference.

D. Select pump types and design discharge systems and settling ponds.

E. Provide required equipment and monitor as required by permit.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 31 03 33-1, Removal of Water Plan:

1. Showing proposed method for removal of water from foundations.

2. The plan may be placed in operation upon approval, but nothing in this paragraph shall relieve the Contractor from full responsibility for the adequacy of the water removal installation.

1.05 REGULATORY REQUIREMENTS

A. Obtain required Federal, State, and local permits for water discharge and other activities associated with removal and control of water.

B. Refer to Section 01 57 30 - Water Pollution Control.

1.06 PROJECT CONDITIONS

A. Conditions which may influence the unwatering include:

1. Frequency and rate of precipitation at the site.
2. Subsurface conditions including natural layering, thickness, permeability, and storativity of materials, and groundwater levels.
3. Efficiency of pumps, collectors, and discharge systems.

B. Water content and water levels in subsurface materials vary with location, depth, and material.

C. Refer to Section 53 20 00 - Records of Geologic and Subsurface Investigations.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 REMOVAL OF WATER

A. Provide, maintain, and operate necessary facilities for removal of water from various parts of the work and for maintaining foundations and other parts of the work free from water as required for constructing each part.

B. Where excavation for pipe trenches and excavation for structures extends below ground-water level, dewater the portion below the water level in advance of excavation.

3.02 UNWATERING

A. Use ditches or sumps to lower and control water levels in advance of excavation.

B. Construct ditches and sumps to collect seepage and runoff in work areas. Use sandbags, sand and gravel filter bedding, and other materials and techniques to control localized seepage.

3.03 DEWATERING

A. Accomplish dewatering by use of sufficient number of properly screened wells or other equivalent methods.

B. Dewater to prevent loss of fines from the foundation, maintain stability of excavated slopes and bottom of excavations, and to result in construction operations being performed in the dry.

3.04 SEEPAGE CONTROL

A. Pipe and Structures:

1. Before excavating to final grade for pipe and structures, bring the water level to an elevation at least 3 feet below the bottom of the pipe and structures.
2. Maintain this water level until pipe has been placed and the structures completed, and backfill has been placed around and over the pipe and about the structures.
3. After the pipeline and structures have been completed and backfilled, subject to the approval of the COR, allow ground water to rise about the pipe and structures.
4. Control pumping operations so that the water level rises slowly and uniformly along the entire length of each reach of pipe and about each structure.

END OF SECTION

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SECTION 31 11 00
CLEARING AND GRUBBING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 DEFINITIONS

A. Vegetation: Trees, shrubs, brush, stumps, exposed roots, down timber, and branches.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 GENERAL

A. Obtain inspection and permits before clearing and grubbing.

B. Obtain COR to approval before clearing and grubbing.

3.02 CLEARING

A. Clear rights-of-way to be occupied by permanent construction.

B. Clear adjacent to cut or fill sections to a minimum distance of 3 feet outside of slope lines.

C. Obtain COR approval before removing trees.

D. Remove vegetation, rubbish, and objectionable material as determined by COR.

3.03 DISPOSAL OF CLEARED MATERIAL

A. Dispose of material in accordance with Section 01 74 00 – Cleaning and Waste Management or as directed by the COR.

END OF SECTION

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SECTION 31 14 10

TOPSOIL STRIPPING AND PLACEMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered for excavation.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 GENERAL

A. Obtain inspection and permits before clearing and grubbing.

B. Obtain COR approval before clearing and grubbing and stripping.

C. Strip entire site to expose unknown cultural resources directly after mobilization. Refer to Section 01 57 90 – Preservation of Historical and Archeological Data if cultural are discovered.

3.02 STRIPPING

A. Remove topsoil in areas to be disturbed to a depth of 6 inches. If a true topsoil structure does not exist, consider the surface soils removed to be topsoil for the purpose of these specifications.

3.03 STOCKPILE

A. Transport and stockpile topsoil as necessary prior to final hauling and placing.

B. Do not compact topsoil in stockpile.

C. Cover stockpile with a non-permeable tarp or dust palliative as approved by COR.

3.04 PLACEMENT

A. Remove trash, weeds, stones larger than 3 inches, and large pieces of vegetative materials.

B. Place topsoil in areas of earthen surface disturbed by construction.

C. Place topsoil to a minimum thickness of 6 inches.

D. Limit equipment travel over topsoil to avoid compaction.

E. Seed in accordance with Section 32 92 20 – Seeding.

END OF SECTION

SECTION 31 14 20

SUBSURFACE STRIPPING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered for excavation.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 GENERAL

A. Strip entire site to expose unknown cultural resources directly after Topsoil Stripping. Refer to Section 01 57 90 – Preservation of Historical and Archeological Data if cultural are discovered.

B. Apply dust palliative to exposed areas in accordance with 31 02 30 – Dust Palliative.

3.02 STRIPPING

A. Remove subsurface soil in areas to be disturbed to a depth of 6 inches.

3.03 STOCKPILE

A. Stockpile for future use or haul offsite in accordance with Section 31 23 39 - Disposal of Excavated Materials.

B. Cover stockpile with a non-permeable tarp or dust palliative as approved by COR.

3.04 PLACEMENT

A. Incorporate into backfill in accordance with Section 31 23 10 - Earthwork.

END OF SECTION

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SECTION 31 23 02

COMPACTING EARTH MATERIALS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include cost of compacting earth materials in prices offered in the schedule items of work where earth materials are required to be compacted.
    a. Includes furnishing water and moistening materials.
    b. Includes Contractor Quality Testing.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM D422 - 63(2007)	Particle-Size Analysis of Soils
2.	ASTM D653 - 11	Terminology Relating to Soil, Rock, and Contained Fluids
3.	ASTM D698 - 12	Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
4.	ASTM D1140 - 00(2006)	Amount of Material in Soils Finer than the No. 200 (75-µm) Sieve
5.	ASTM D1556 - 07	Density and Unit Weight of Soil in Place by the Sand-Cone Method
6.	ASTM D2216 - 10	Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
7.	ASTM D2487 - 11	Classification of Soils for Engineering Purposes (Unified Soil Classification System)
8.	ASTM D2488 - 09a	Description and Identification of Soils (Visual-Manual Procedure)
9.	ASTM D4318 - 10	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
10.	ASTM D4564 - 08	Density of Soil in Place by the Sleeve Method
11.	ASTM D4718-87(2007)	Correction of Unit Weight and Water Content for Soils Containing Oversize Particles

12.	ASTM D4914-08	Density of Soil and Rock in Place by the Sand Replacement Method in a Test Pit
13.	ASTM D5030-13	Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit
14.	ASTM D5080-08	Rapid Determination of Percent Compaction
15.	ASTM D6938-10	In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depths)
16.	ASTM D7382-08	Determination of Maximum Dry Unit Weight and Water Content Range for Effective Compaction of Granular Soils Using a Vibrating Hammer

B. Bureau of Reclamation (USBR)

1. USBR EM - Earth Manual, Part 2, Third Edition (1990)

2. Procedure No. and Title:

a.	USBR 3900-89	Standard Definitions of Terms and Symbols Relating to Soil Mechanics
b.	USBR 5000-86	Determining Unified Soil Classification (Laboratory Method)
c.	USBR 5005-86	Determining Unified Soil Classification (Visual Method)
d.	USBR 5300-89	Determining Moisture Content of Soil and Rock by the Oven Method
e.	USBR 5325-89	Performing Gradation Analysis of Gravel Size Fraction of Soils
f.	USBR 5330-89	Performing Gradation Analysis of Fines and Sand Size Fraction of Soils, Including Hydrometer Analysis
g.	USBR 5335-89	Performing Gradation Analysis of Soils Without Hydrometer
h.	USBR 5350-89	Determining the Liquid Limit of Soils by the One-Point Method
i.	USBR 5360-89	Determining the Plastic Limit and Plasticity Index of Soils
j.	USBR 5500-89	Performing Laboratory Compaction of Soils--5.5-lbm Rammer and 18-in Drop
k.	USBR 5530-89	Determining the Maximum Index Unit Weight of Cohesionless Soils

l.	USBR 7205-89	Determining Unit Weight of Soils In-Place by the Sand-Cone Method
m.	USBR 7220-89	Determining Unit Weight of Soils In-Place by the Sand Replacement Method in a Test Pit
n.	USBR 7221-89	Determining Unit Weight of Soils In-Place by the Water Replacement Method in a Test Pit
o.	USBR 7230-89	Determining Unit Weight and Moisture Content of Soil In-Place - Nuclear Moisture-Density Gauge
p.	USBR 7240-89	Performing Rapid Method of Construction Control

3. *Guidelines for Earthwork Construction Control Testing of Gravelly Soils*, Earth Sciences and Research Laboratory, Technical Service Center, Bureau of Reclamation, Denver, Colorado, September 2008.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 31 23 02-1, Test Results:

1. Results of tests listed in Table 31 23 02A – Contractor Materials Testing Requirements and Frequency.
2. Include test date, time, location and person performing tests.
3. Notify COR within 2 hours if testing does not meet specified requirements.

1.04 DEFINITIONS

A. Use definitions from ASTM D653 (USBR 3900).

B. Control Fraction: The portion of a soil sample consisting of particles smaller than a designated sieve size. The fraction is used to compare in-place unit weight with standard laboratory unit weight. The control sieve size depends on the laboratory test used to determine laboratory maximum density.

C. C-Value: The ratio expressed as a percentage of (1) in-place unit weight at fill moisture content to (2) the wet unit weight of a laboratory-compacted specimen prepared at fill moisture content as determined by the rapid method of construction control in accordance with ASTM D5080 (USBR 7240). The C-Value is a comparison of compactive effort of field compaction equipment to standard laboratory compactive effort.

D. D-value: The ratio expressed as a percentage of (1) in-place wet unit weight at fill moisture content to (2) laboratory maximum wet unit weight as determined from a compaction curve constructed at fill moisture content as determined by the rapid method of construction control ASTM D5080 (USBR 7240). The D-value is the equivalent of percent compaction in accordance with ASTM D698 (USBR 5500).

E. Percent Compaction: The percent compaction of a cohesionless soil where the laboratory maximum density is determined by Maximum Dry Unit Weight test in accordance with ASTM D7382.

F. Special compaction: Compaction close to structures or in spaces not accessible by standard width rollers.

1.05 AMBIENT CONDITIONS

A. Do not place and compact soil under following conditions:

1. Rain that creates puddles in clayey or silty materials.
2. Heat or wind or both that dries material below specified moisture conditions.
3. Ice, frost, or snow pockets are visible in soil being placed or on working surface.

B. Ambient air temperature below freezing may make placement and compaction operations difficult.

1. Minimize interruptions of operations.
2. Continuous operations may be required to eliminate freezing of materials.
3. Obtain COR approval, before performing operations when ambient air temperatures are below freezing.
4. Cease operations when placed materials are freezing or below freezing.

PART 2 PRODUCTS

2.01 CLASSIFICATION

A. When required, classify earth materials using the Unified Soil Classification System (USCS) according to ASTM 2487 (USBR 5000) or ASTM D2488 (USBR 5005).

1. Gradation tests for classification: ASTM D422 or D1140 (USBR 5325, 5330, or 5335).
2. Atterberg limits testing for classification: ASTM D4318 (USBR 5350, 5335, or 5360).

2.02 SOIL TYPES

A. Clean Fill:

1. Any soil except soils with classifications Peat (PT), Organic Silts and Organic Clays (OL and OH), or Elastic Silt (MH) per ASTM D2487 (USBR 5000).
2. Free of roots, stumps, limbs, vegetation, organic matter, and ice.
3. Does not contain construction debris, scrap materials, refuse, man-made wastes, or chemical or hydro-carbon contamination.

B. Do not use frozen soils.

C. Special Gradations and Plasticity:

1. In some cases, such as embankment materials embedment for buried pipe, special gradations and/or plasticity characteristics may be required. These requirements are in the applicable Section.

2.03 DESIGNATION OF SOILS FOR COMPACTION

A. Requirements for lift thickness, method of compaction, and method of determining degree of compaction depends on whether soil is considered to be silty or clayey, cohesionless, or cohesionless containing some silt and clay.

B. Silty or Clayey Soils:

1. Contains appreciable amounts of fines (more than 15 percent plastic fines or 30 percent non-plastic fines).

C. Cohesionless Soils:

1. Contains few fines (less than 5 percent fines).

D. Cohesionless Soils Containing Some Clay and Silt:

1. Contains some clay and silt (between 5 percent fines and 15 percent plastic fines or 30 percent non-plastic fines).
2. Controlled by ASTM D7382.

2.04 MAXIMUM PARTICLE SIZE

A. Soil for Compacted Backfill:

1. Maximum particle size limitations described in appropriate Sections for backfill against specific structures.
2. Otherwise, no cobbles larger than 5 inches or boulders.

PART 3 EXECUTION

3.01 SURFACE PREPARATION

A. Clear, grub, and strip.

B. Prepare surface so that first compacted lift will be placed on firm, stable base. Compact surface to specified compaction, if necessary.

C. For water-retaining compacted fill, scarify and moisten surface to provide satisfactory bonding surface before placing layer of material to be compacted.

3.02 SOIL MOISTURE CONTENT

A. Moisten or aerate material, as necessary, to provide moisture content that will readily facilitate obtaining specified compaction. Add water to soil only in increments that will permit moisture content to be uniform and homogenous throughout each layer after mixing.

B. Silty and Clayey Soils and Cohesionless Soils Containing Some Silt and Clay:

1. Add no more than 2 percent water to fill by sprinkling just prior to compaction when fill is clayey and contains dry clods of clay.

   a. If clayey borrow soil is more than 2 percent below optimum moisture, pre-conditioning and curing may be required to obtain uniform and homogenous distribution of moisture in the clods.

   b. Use of disks, harrows, or rakes may be required to blend moisture in the borrow area.

2. Moisture content during compaction:

   a. Soils controlled by impact compaction

      1) Not greater than 2 percentage points wet or not less than 4 percentage points dry of optimum moisture content.

   b. Soils controlled by the vibrating hammer.

      1) Within the water content range for effective compaction as determined by ASTM D7382.

3. Determine moisture as follows:

   a. Soils controlled by impact compaction.

      1) Variation from Optimum Moisture Content:

         a) Difference between optimum moisture and compaction moisture measured in accordance with ASTM D5080 (USBR 7240).

      2) Moisture Content Comparison:

         a) Optimum moisture content determined by ASTM D698 (USBR 5500).

   b. Soils controlled by the vibrating hammer.

      1) Within the water content range for effective compaction as determined by ASTM D7382.

   c. Soils controlled by either impact compaction or vibrating hammer:

      1) Compare field compaction moisture content with moisture contents determined in accordance with:

         a) ASTM D2216 (USBR 5300), or

b) ASTM D6938 (USBR 7230). Correct moisture from the nuclear gage for gauge error for the specific soils tested and the moisture content of the total material may require adjustment for the control fraction (see USBR 7230, Method C; ASTM D 4718).

C. Cohesionless Soils:

1. Add water during compaction, as necessary, since these soils are free-draining.

3.03 PLACEMENT

A. Place soils to be compacted in horizontal layers.

B. If necessary, blend materials so that compacted fill is homogenous and free from lenses, pockets, streaks, voids, laminations, or other imperfections.

3.04 COMPACTION

A. Compact material with following methods and techniques appropriate to type of soil.

B. Silty or Clayey Material:

1. Compact with mechanical impact tampers, tamping rollers, vibrating pad foot rollers, rubber tire rollers, other suitable compaction equipment, or equipment travel.

a. Uniformly distribute equipment passes.

b. Compact in horizontal layers to compacted thickness of 6 inches or less.

2. Special compaction: Compact with hand held impact tampers, or small tamping equipment.

a. Uniformly distribute effort.

b. Compact in horizontal layers to compacted thickness of 4 inches.

3. Density:

a. Percent Compaction, minimum 95, or

b. D-value:

1) Minimum 95 percent with moisture content +/-2 percent of optimum content.

2) Minimum 98 percent with moisture content 2 to 4 percent dry of optimum.

C. Cohesionless Free-draining Material:

1. Compact with crawler-type tractors, vibrating drum rollers, surface plate vibrator, or similar equipment.

a. Uniformly distribute equipment passes.

b. Compact in horizontal layers to compacted thickness of 12 inches or less.

2. Special compaction: Compact with hand held impact tampers, vibrating plate tampers, or small tamping equipment.

a. Uniformly distribute effort.

b. Compact in horizontal layers to compacted thickness of 6 inches.

3. Density:

a. Percent Compaction, minimum: 95 percent.

D. Cohesionless Soils Containing Some Silt and Clay:

1. Compact in accordance with either procedure above.

2. Density:

a. Percent Compaction, minimum: 95 percent.

E. Adjustment:

1. Silty and clayey soils containing more than 20 percent oversize particles: Required D ratio or Percent Compaction may be adjusted in accordance with appropriate curve on Figure 3 in USBR *Guidelines for Earthwork Construction Control Testing of Gravelly Soils*.

F. Demonstration:

1. Lift thicknesses may vary depending on equipment and methods. Before changing requirements in this Section, demonstrate that required density will be obtained.

3.05 MEASURE OF COMPACTION

A. Determine unit weight of soils in-place using one of the following methods:

1. Silty or clayey and cohessionless soils:

a. ASTM D1556 (USBR 7205) or,

b. ASTM D4914 (USBR 7220) or,

c. ASTM D5030 (USBR 7221) or,

d. ASTM D6938 (USBR 7230).

2. Cohesionless soil: ASTM D 4564.

B. Determine degree of soil compaction by one of the following.

1. Silty or clayey soils:

a. Percent Compaction:

1) Rapid Method: ASTM D5080 (USBR 7240).

2) Laboratory Compaction Test: Comparison of in-place density of minus no. 4 sieve size control fraction to laboratory maximum dry density as determined by ASTM D 698, Procedure A (USBR 5500).

3) Silty and clayey soils containing more than 5 percent gravel:

a) In-place unit weight of minus no. 4 size control fraction determined by screening gravel, washing, and determining mass and volume by assuming surface saturated dried moisture as outlined in ASTM D 4718.

2. Cohesionless soils:

a. Percent Compaction:

1) In-place dry unit weight of minus 2-inch control fraction compared to the maximum dry unit weight determined by ASTM D 7382.

2) In-place unit weight of minus 3–inch size control fraction determined by screening cobbles, washing, and determining mass and volume by assuming surface saturated dried moisture as outlined in ASTM D 4718.

3. Cohesionless soils containing some silt and clay:

a. Using whichever testing procedure result requires higher in-place dry density.

3.06 CONTRACTOR FIELD QUALITY TESTING

A. Testing:

1. Independent testing laboratory shall perform sampling, testing, and reporting as required in Table 31 23 02A - Contractor Materials Testing Requirements and Frequency.

a. Independent testing laboratory shall meet requirements specified in Section 01 43 20 - Testing Laboratory Services.

2. Notify the independent testing laboratory and Government 24 hours before compaction work begins and 24 hours before significant change in compaction operations (major change in equipment or procedure used).

3. Notify the independent testing laboratory and Government immediately of equipment change due to breakdown, or re-deployment.

4. Testing Frequency:

a. At a minimum, perform test at frequencies specified in Table 31 23 02A - Contractor Materials Testing Requirements and Frequency.

b. Greater frequency of testing is normally performed at beginning of new work, new work crew, or new equipment.

c. After a successful work operation pattern is established, testing frequency may be performed at the minimum guidelines.

d. Perform additional tests at sites considered questionable by the Government; such as suspected incomplete compaction, surfaces that may have become excessively wet or dry since compaction, compacted surfaces torn up by subsequent equipment travel, or other similar circumstances. Frequency of additional testing is at discretion of the Government.

Table 31 23 02A - Contractor Materials Testing Requirements and Frequency

PROCEDURE	TEST STANDARD	STANDARD TITLE	STANDARD REQUIREMENT	MINIMUM FREQUENCY OF TESTING
Soil Classification	ASTM D 2487 (USBR 5000)	Classification of Soils for Engineering Purposes	Unified Soil Classification System.	As necessary to classify material to meet specification requirements or to index material for determining density by nuclear method.
	ASTM D 2488 (USBR 5005)	Description and Identification of Soils		
Moisture Content	ASTM D 2216 (USBR 5300)	Laboratory Determination of Water (Moisture Content of Soil and Rock by Mass.	+2/-4 percent of optimum.	With in-place density or as required to index material for determining density by nuclear method.
Sand Cone	ASTM D1556 (USBR 7205)	Density and Unit Weight of Soil in Place by the Sand-Cone Method		Not less than 1 test per day per compacted backfill operation.
Rapid Construction Control	ASTM D5080 (USBR 7240)	Rapid Determination of Percent Compaction	Percent compaction > 95 percent with optimum moisture ±2 percent or Percent Compaction >98 with optimum moisture 2 to 4 percent of dry.	Not less than 1 test per day per compacted backfill operation

Table 31 23 02A - Contractor Materials Testing Requirements and Frequency

PROCEDURE	TEST STANDARD	STANDARD TITLE	STANDARD REQUIREMENT	MINIMUM FREQUENCY OF TESTING
Laboratory Maximum Density	ASTM D 698, Procedure A. (USBR 5500)	Laboratory Compaction Characteristics of Soil Using Standard Effort	Percent compaction > 95 percent with optimum moisture ±2 percent or Percent Compaction >98 with optimum moisture 2 to 4 percent of dry.	Not less than 1 test per day per compacted backfill operation
Rock Factor	ASTM D4718 (USBR 7205)	Correction of Unit Weight and Water Content for Soils Containing Oversize Particles	According to USBR Guidelines, Figure 3	When oversize material is > 20 percent
Nuclear Method	ASTM D6938 (USBR 7230)	In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)	Percent compaction > 95 percent with optimum moisture ±2 percent or Percent Compaction >98 with optimum moisture 2 to 4 percent of dry.	Not less than 1 test per day per compacted backfill operation
Vibratory Hammer	ASTM D7382	Determination of Maximum Dry Unit Weight and Water Content Range for Effective Compaction of Granular Soils Using a Vibrating Hammer	95 percent	Not less than 1 test per day per compacted backfill operation

B. Contractor Support:

1. Provide timely access to areas for density testing and excavate and level an area in compacted material to provide a surface for testing.

   a. Test fills compacted by sheepsfoot rollers one or two lifts below surface.

2. When density is being measured by a sand-cone device ASTM D1556 (USBR 7205), cease construction activity in immediate vicinity of testing.

3. Dig test pits as requested to examine compacted soil against structures or pipe.

4. Backfill test pits to original requirements.

5. Provide warning lights, flags, or other safety devices as needed by testing personnel.

6. Provide adequate lighting for performing test if required because of darkness.

3.07 FIELD QUALITY ASSURANCE

A. The Government may perform test as required to verify contractor quality testing. If the Government performs quality assurance testing, provide support as required for contactor quality testing.

END OF SECTION

SECTION 31 23 10
EARTHWORK

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Excavation:

1. Measurement: Made to Foundation Excavation paylines shown on the drawings or to paylines directed by the COR.
    a. Regardless of quantities removed, measurement for payment will be made to the prescribed paylines.
    b. For safety or other reasons, the Government reserves the right to require the Contractor to excavate beyond the prescribed paylines.
    c. Measurement for payment for additional excavation will be made to limits directed by COR.
2. Payment: Cubic yard price offered in the schedule.
    a. Includes cost of labor and materials for pumping and dewatering; work necessary to maintain excavations in good order during construction; removing such temporary construction, where required, and disposing the excavated material.
    b. Overexcavation performed beyond specified or directed paylines and backfill and compaction of backfill for such overexcavation shall be at the expense of the Contractor.

B. Rock Excavation:

1. Measurement: Volume of Rock removed, made to Foundation Excavation paylines shown on the drawings or to paylines directed by the COR.
    a. Regardless of quantities removed, measurement for payment will be made to the prescribed paylines.
    b. For safety or other reasons, the Government reserves the right to require the Contractor to excavate beyond the prescribed paylines.
    c. Measurement for payment for additional excavation will be made to limits directed by COR.
2. Payment: Cubic yard price offered in the schedule.
    a. Includes cost of labor and materials for mechanical breaking, shoring, sheeting, bracing, timbering, safety sloping, and other temporary construction; of pumping and unwatering; of removing such temporary

construction where required; stockpiling excavated material for backfill; and disposal of unused or wasted excavated materials.

b. Overexcavation performed beyond specified or directed paylines and backfill and compaction of backfill for such overexcavation shall be at the expense of the Contractor.

C. Processing Foundation Materials:

1. Measurement: Made to Foundation Excavation paylines shown on the drawings.

2. Payment: Cubic yard price offered in the schedule.

a. Includes cost of moistening, mixing, stockpiling and compacting material in stockpile as it is removed from excavation.

D. Compacting Backfill:

1. Measurement: Made to Foundation Excavation paylines shown on the drawings.

2. Payment: Cubic yard price offered in the schedule.

a. Includes cost of placing, moistening and compacting stockpiled material back in excavation.

E. Does not include costs included in Pipe Trench Earthwork and Earthwork for Structures.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1. ASTM D 4546-08 One-Dimensional Swell or Collapse of Cohesive Soils

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 31 23 10-1, Processing Plan:

1. Describe equipment and methods for removing, stockpiling, processing, moistening, placing, and compacting material.

2. Provide schedule and sequence.

3. Include working and stockpiling areas and haul route plans.

1.04 DEFINITIONS

A. Additional Excavation: Excavation beyond specified lines as directed by the COR to remove unsuitable foundation material.

B. Overexcavation: Excavation performed for the convenience, fault, or operation of the Contractor beyond specified or directed additional excavation lines.

C. Cover: Distance between the top surface of buried cables, conductors, or conduits and the finished grade.

D. Rock Excavation: Refer to 31 23 22 – Pipe Trench Earthwork.

1.05 PROJECT CONDITIONS

A. Soil and rock conditions are described in Section 53 10 00 – Geologic Investigations.

B. Expansive soils, as defined in Section 53 10 00 – Geologic Investigations, were encountered during the geological investigation. Excavate, process and place site soils to provide a stable foundation for tank, pumping plant, retaining walls and other structures.

PART 2 PRODUCTS

2.01 EXCAVATED MATERIALS

A. The Contractor's operations in excavations shall be such that excavations will yield as much suitable material for use in permanent construction required under these specifications as practicable.

2.02 MATERIAL FOR BACKFILL

A. Obtain backfill material from required excavations. If sufficient suitable material is not available from this source, obtain additional material from approved source.

1. The Government makes no guarantee that specified backfill materials are contained in or can be processed from materials excavated.

B. Excavated and processed material containing no particles larger than 2 inches in diameter.

C. Refer to Division 26 for backfill requirements within 2 inches of buried electrical grounding cables, insulated cables, and conduit:

PART 3 EXECUTION

3.01 EXCAVATION, GENERAL

A. Excavate to elevations shown on the drawings or established by the COR.

B. The Government reserves the right, during progress of work, to vary slopes, grades, and dimensions of excavations from those specified.

C. The Government does not represent that excavation performed under these specifications can be made to or maintained at paylines shown on the drawings or described in these specifications.

D. Perform excavation in the dry.

E. Do not excavate in frozen materials without written approval.

F. Take precautions to preserve material below and beyond established lines of excavation in the soundest possible condition.

1. Damage to work due to the Contractor's operations shall be repaired by and at the expense of the Contractor.

2. Material beyond required or prescribed excavation lines which is loosened by the Contractor's operations shall be removed at the expense of the Contractor.

3.02 PROCESSING AND STOCKPILING BACKFILL

A. Stockpile material in maximum 12 inch lifts as it is removed from excavation.

B. Sandy material was encountered on the southern portion of the site. Mix these soils with the expansive material.

C. Wet material as it is stockpiled to a minimum of optimum moisture content.

D. Test moisture content in accordance with 31 23 02 – Compacting Earth Materials.

E. Crush or pulverize material with approved equipment to a soil-like mass with a 2-inch maximum particle size.

3.03 PREPARATION OF FOUNDATIONS

A. Prepare foundations at structure sites by methods which will provide firm foundations for structures.

1. Finish bottom and side slopes of excavation, upon or against which the structure is to be placed, to prescribed dimensions.

2. Moisten and compact prepared surfaces with suitable tools to form firm foundations upon or against which to place the structure.

B. Where unsuitable material is encountered in the foundation for a structure, the COR will direct performance of additional excavation to remove unsuitable material.

1. Refill additional excavation with compacted backfill in accordance with Section 31 23 02 - Compacting Earth Materials.

3.04 FOUNDATION INSPECTION

A. Inspection will be performed by Government to obtain a geologic record of final foundation surface.

1. Provide safe access for Government personnel during inspection.

2. Notify COR at least 2 days before reaching final excavation elevation for foundation.

3. Once an adequate foundation has been obtained, Government will require 2 days days, to inspect, map and survey foundation.

   a. Clean surface with straight edge of equipment bucket to expose foundation as directed by COR.

4. Maintain prepared surfaces free of debris and standing water until inspection and geologic mapping are completed.

5. Do not operate equipment in area being inspected until inspection and survey are complete.

3.05 OVEREXCAVATION

A. If foundation material is excavated beyond lines required to receive the structure, fill overexcavation with suitable materials and compact in accordance with Section 31 23 02 - Compacting Earth Materials.

B. If foundation material is disturbed or loosened during excavation or otherwise, compact foundation in place or remove and replace it with suitable material and compact in accordance with Section 31 23 02 - Compacting Earth Materials.

3.06 TRENCHES FOR BURIED ELECTRICAL GROUNDING CABLES, INSULATED CABLES OR CONDUCTORS, AND CONDUIT

A. Refer to Division 26.

3.07 DISPOSAL OF EXCAVATED MATERIALS

A. Dispose of excavated materials which are unsuitable for or are in excess of backfill, or other earthwork requirements as provided in Section 31 23 39 - Disposal of Excavated Materials.

3.08 PLACING AND COMPACTING BACKFILL

A. Place backfill to the lines and grades shown on the drawings, or as directed by the COR.

B. Place, moisten, and compact materials in backfill as provided in Section 31 23 02 - Compacting Earth Materials, except the average daily moisture content shall not be less than 1 percent wet of optimum beneath the tanks, pumping plant structure, and retaining wall.

C. In addition to testing requirements in 31 23 02 – Compacting Earth Materials, test in place material for swell potential in accordance with ASTM D4546.

1. Take one test per 5,000 square feet per lift. Take a minimum of one test per day.

2. Swell Potential: 1 percent or less under 1,000 psf.

3.09 PROTECTION

A. To provide adequate protection for compacted backfill, the Government reserves the right to direct the Contractor to place a sufficient amount of backfill over compacted backfill within 72 hours after completion of compacting backfill.

END OF SECTION

SECTION 31 23 11

EARTHWORK FOR STRUCTURES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in applicable price offered in the schedule for the flowmeters, valves, chlorination system, and blowoff.

1.02 DEFINITIONS

A. Additional Excavation: Excavation beyond specified lines as directed by the COR to remove unsuitable foundation material.

B. Overexcavation: Excavation performed for the convenience, fault, or operation of the Contractor beyond specified or directed additional excavation lines.

C. Cover: Distance between the top surface of buried cables, conductors, or conduits and the finished grade.

PART 2 PRODUCT

2.01 EXCAVATED MATERIALS

A. The Contractor's operations in excavations shall be such that excavations will yield as much suitable material for use in permanent construction required under these specifications as practicable.

B. Place excavated materials which are too wet for immediate compaction temporarily in stockpiles until moisture content is reduced sufficiently to permit them to be placed.

2.02 MATERIAL FOR BACKFILL

A. Type and amount of material used for backfill, and manner of depositing material shall be subject to approval.

B. Obtain backfill material from required excavations. If sufficient suitable material is not available from this source, obtain additional material from other sources approved by the COR.

1. The Government makes no guarantee that specified backfill materials are contained in or can be processed from materials excavated.

C. Do not place material in backfill when either the material or the surfaces on which it is to be placed are frozen.

D. Do not use expansive clays or shale for backfill material.

E. Backfill material to be compacted shall contain no stones larger than 3 inches in diameter.

F. Maximum stone size placed in backfill material not to be compacted: 5 inches in diameter.

G. Backfill within 2 inches of buried electrical grounding cables, insulated cables, and conduit: Sand or equally fine earth material.

2.03 MATERIAL FOR COMPACTED BACKFILL

A. Material containing no stones larger than 3 inches in diameter, approved by the COR, and obtained from required excavation or other sources.

PART 3 EXECUTION

3.01 EXCAVATION, GENERAL

A. Excavate structure foundations to elevations shown on the drawings or established by the COR.

B. The Government reserves the right, during progress of work, to vary slopes, grades, and dimensions of excavations from those specified.

C. The Government does not represent that excavation performed under these specifications can be made to or maintained at paylines shown on the drawings or described in these specifications.

D. Perform excavation in the dry.

E. Do not excavate in frozen materials without written approval.

F. Where excavating in backfill and embankment placed under these specifications, excavate in accordance with applicable provisions for excavation.

G. Take precautions to preserve material below and beyond established lines of excavation in the soundest possible condition.

1. Damage to work due to the Contractor's operations shall be repaired by and at the expense of the Contractor.
2. Material beyond required or prescribed excavation lines which is loosened by the Contractor's operations shall be removed at the expense of the Contractor.

3.02 PREPARATION OF STRUCTURE FOUNDATIONS

A. Prepare foundations at structure sites by methods which will provide firm foundations for structures.

1. Finish bottom and side slopes of excavation, upon or against which the structure is to be placed, to prescribed dimensions.

2. Moisten and compact prepared surfaces with suitable tools to form firm foundations upon or against which to place the structure.

B. Where unsuitable material is encountered in the foundation for a structure, the COR will direct performance of additional excavation to remove unsuitable material.

1. Refill additional excavation with compacted backfill in accordance with Section 31 23 02 - Compacting Earth Materials.

C. Keep surfaces of shale exposed by excavation moist until concrete, coarse aggregate, or earth material are placed on it. Test moisture content of foundation subgrade no more than 12 hours prior to placing concrete in accordance with 31 23 02 – Compacting Earth Materials.

3.03 OVEREXCAVATION

A. If foundation material is excavated beyond lines required to receive the structure, fill overexcavation with suitable materials and compact in accordance with Section 31 23 02 - Compacting Earth Materials.

B. If foundation material is disturbed or loosened during excavation or otherwise, compact foundation in place or remove and replace it with suitable material and compact in accordance with Section 31 23 02 - Compacting Earth Materials.

3.04 DISPOSAL OF EXCAVATED MATERIALS

A. Dispose of excavated materials which are unsuitable for or are in excess of embankment, backfill, or other earthwork requirements, as determined by the COR, as provided in Section 31 23 39 - Disposal of Excavated Materials.

3.05 PLACING BACKFILL

A. Place backfill to the lines and grades shown on the drawings, or as directed by the COR.

B. Place backfill carefully and spread in uniform layers so that all spaces about rocks and clods will be filled.

C. Backfill trenches to the finished lines of adjacent earthwork.

3.06 COMPACTING BACKFILL

A. Place, moisten, and compact materials in backfill as provided in Section 31 23 02 - Compacting Earth Materials.

3.07 PROTECTION

A. To provide adequate protection for compacted backfill about a structure, the Government reserves the right to direct the Contractor to place a sufficient amount of backfill or embankment material over compacted backfill within 72 hours after completion of compacting backfill.

END OF SECTION

SECTION 31 23 22

PIPE TRENCH EARTHWORK

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Excavation for Pipeline Trenches:

1. Measurement: Made to paylines and lengths shown on drawings and trench lengths of common excavated material.

   a. Regardless of actual widths, bottoms, and side slopes excavated, measurement will be made to paylines shown on drawings or rock surface and to original ground surface.

   b. Measurement for payment for additional excavation will be made to trench widths W_p shown on drawings and to depth directed by COR.

   c. Measurement for payment will be continuous through pipe fittings.

   d. Measurement for payment for excavation for concrete for pipe fittings that is outside the trench excavation paylines will be made to lines and dimensions shown on the drawings or to the neatlines of the concrete.

2. Payment: Cubic yard price offered in the schedule.

   a. Includes cost of labor and materials for shoring, sheeting, bracing, timbering, safety sloping, and other temporary construction; of pumping and unwatering; of removing such temporary construction where required; stockpiling excavated material for backfill; and disposal of unused or wasted excavated materials.

   b. No direct payment will be made for excavation for pipe trenches outside the paylines shown on drawings. Include cost of excavation for pipe trenches required outside paylines prices offered in the schedule for Excavation for Pipe Trenches.

   c. Overexcavation performed beyond specified or directed paylines and backfill and compaction of backfill for such overexcavation shall be at the expense of the Contractor.

   d. Where excavation is performed in backfill, no payment will be made for the resulting excavation, backfill, and compacting backfill.

B. Backfill for Pipeline Trenches:

1. Measurement:

a. Made to the excavation paylines for pipe trenches, to lengths shown on the drawings, or as directed.

b. Measurement for payment for backfill in pipe trenches for additional excavation of pipe trenches will be made to the trench widths W_p shown on drawings and to the depth directed by the COR.

c. Backfill material mounded or spread over the trench above the original ground surface will not be measured for payment as backfill in pipe trenches.

2. Payment: Cubic yard price offered in the schedule.

a. Includes cost of work associated with the excavation or procuring, processing, and hauling of necessary material.

b. Material from required excavation used for backfill in pipe trenches will be paid for both as excavation when removed from original position and as backfill when placed.

c. Where backfill material is obtained from other sources, payment will be made for backfill only. Include the cost of excavating or procuring, hauling, and processing of such material in the unit price offered in the schedule for backfill in pipe trenches.

d. No direct payment will be made for backfill in pipe trenches for flexible pipe outside paylines shown on drawings. Include cost of backfill outside these paylines in the prices offered in the schedule for Backfill of Pipe Trenches.

e. No payment will be made for backfill required to fill overexcavation performed by the Contractor.

f. No payment will be made for the removal and reconstruction of defective and nonconforming backfill compacted to an insufficient density.

3. Cost:

a. Include cost of CLSM in the price offered for line pipe in the schedule.

C. Compacting Backfill in Pipeline Trenches:

1. Measurement: Made in place to the paylines and lengths shown on drawings, and will be made only for the quantities actually compacted within the excavation paylines for pipe trenches.

a. The volume of pipe will be deducted based on the diameters (Dp) shown on drawings, regardless of the actual diameters of pipe furnished.

b. Measurement for payment for compacting backfill in pipe trenches for additional excavation of pipe trenches will be made to the trench widths W_p shown on drawings and to the depth directed by the COR.

2. Payment: Cubic yard price offered in the schedule.

   a. Includes cost of furnishing water and moistening the material.

   b. No direct payment will be made to the Contractor for compacting backfill in pipe trenches for flexible pipe outside the paylines shown on drawings. Include cost of compacting backfill required outside paylines for trench in the prices offered in the schedule for compacting backfill in pipe trenches.

   c. Compacting backfill for overexcavation outside specified or directed excavation paylines will be at the expense of the Contractor.

D. Rock Excavation for Pipe Trenches:

1. Measurement: Made to paylines shown on drawings and trench lengths of rock material excavated.

   a. Regardless of actual widths, bottoms, and side slopes excavated, measurement will be made to the paylines shown on drawings and to the rock surface.

   b. Measurement for payment for additional excavation will be made to W_p and trench bottom shown on drawings and to depth directed by COR.

   c. Measurement for payment will be continuous through pipe fittings.

   d. Measurement for payment for excavation for concrete for pipe fittings that is outside the trench excavation paylines will be made to lines and dimensions shown on the drawings or to the neatlines of the concrete.

2. Payment: Cubic yard price offered in the schedule.

   a. Includes cost of labor and materials for mechanical breaking, shoring, sheeting, bracing, timbering, safety sloping, and other temporary construction; of pumping and unwatering; of removing such temporary construction where required; stockpiling excavated material for backfill; and disposal of unused or wasted excavated materials.

   b. No direct payment will be made for rock excavation for pipe trenches outside the W_p, depth and length listed above. Include cost of rock excavation for pipe trenches required outside payline prices offered in the schedule for Rock Excavation for Pipe Trenches.

   c. Overexcavation performed beyond specified or directed paylines and backfill and compaction of backfill for such overexcavation shall be at the expense of the Contractor.

1.02 REFERENCE STANDARDS

A. American Association of State Highway Officials (AASHTO)

1. AASHTO SSHB-02 Standard Specifications for Highway Bridges, 17th Edition

1.03 DEFINITIONS

A. Additional Excavation: Excavation beyond specified lines as directed by the COR to remove unsuitable foundation material.

B. Overexcavation: Excavation performed for the convenience, fault, or operation of the Contractor beyond specified or directed additional excavation lines.

C. Rock Excavation:

1. Material that cannot be ripped with a 400 horsepower or larger crawler tractor equipped with a ripper rated for hard rock with a rock tooth.

2. Material that cannot be excavated with a 300 horsepower or larger hydraulic excavator, with rock teeth, in areas where it is not feasible for ripping with a crawler tractor.

1.04 PROJECT CONDITIONS

A. Soil conditions are described in Section 53 10 00 – Geologic Investigations.

B. Material that may require Rock Excavation was encountered between Station 11+73.43 to Station 12+05.43 on the Twin Lakes Turnout.

C. Table 31 23 22A – Twin Lakes Turnout, 31 23 22B – Reach 12B and Table 31 23 22 – Reach 12.1 summarize the Government's interpretation of the geological investigations to predict native material properties. Conditions in the field may vary. Bidders are encouraged to come to their own conclusions relating to the excavation characteristics of site materials.

Table 31 23 22A - Twin Lakes Turnout

Station	Expected Springline Native Material Properties*
11+73.43 to 12+05.43	1
12+05.43 to 21+46.52	2
23+92.35 to 28+03.29	3

*Refer to Drawing 1695-D-199 for explanation of Native Material Properties

Table 31 23 22B - Reach 12B

Station	Expected Springline Native Material Properties*
12509+93.42 to 12510+30	3
12510+30 to 12516+40	2

*Refer to Drawing 1695-D-199 for explanation of Native Material Properties

Table 31 23 22C - 12.1

Station	Expected Springline Native Material Properties*
121010+38.98 to 21010+44.66	3
121010+44.66 to 21017+81.07	2
121020+26.83 to 121020+80	3

*Refer to Drawing 1695-D-199 for explanation of Native Material Properties

PART 2 PRODUCTS

2.01 BEDDING AND EMBEDMENT

A. Controlled low strength materials in accordance with Section 31 23 70 - Controlled Low Strength Materials (CLSM).

2.02 MATERIALS FOR BACKFILL

A. Use materials removed in excavating for pipe trenches or from other sources arranged for by the Contractor.

1. The Government makes no guarantee that specified backfill materials are contained in or can be processed from materials excavated from pipe trenches.
2. All reasonable effort shall be expended to obtain suitable backfill material from required excavation prior to obtaining commercial sources.

B. Do not use expansive clays in compacted backfill.

C. Provide processing equipment and perform work necessary to process excavated materials to produce materials meeting the requirements of these specifications.

D. Maximum backfill particle size within 1-foot of the outside of pipe: 3/4 inches.

E. Particle size of material placed in compacted backfill, maximum: 3 inches.

F. Particle size of material placed in uncompacted backfill, maximum: 5 inches.

2.03 WARNING TAPE:

A. Polyethylene tape.

B. Thickness: 4 mils.

C. Non-detectable.

D. Width, minimum: 6 inches.

E. Color: Blue with silver lettering.

F. Legend repeated at least every 3 feet: "CAUTION: WATERLINE BURIED BELOW – FOR MORE INFORMATION CONTACT THE NAVAJO TRIBAL UTILITIES AUTHORITY"

PART 3 EXECUTION

3.01 GENERAL

A. Perform operations so that land can be restored to original conditions.

B. Do not excavate pipe or keep pipe trench open more than 100 feet ahead of pipelaying, backfilling, or compacting backfill operations, unless approved by COR. Backfill and compacting backfill operations shall progress and not fall behind the pipe laying and excavation operations, allowing for CLSM to obtain required strength shown on the drawing 1695-D-199. If backfilling and compacting fall behind pipe laying operations due to lack of progress or equipment breakdowns, stop excavation and pipe laying operations until sufficient progress has been made as directed by the COR.

C. Install warning tape over center of pipe at least 18 inches below ground and at least 18 inches above pipe.

3.02 EXCAVATION

A. Excavate pipe trenches for pipelines and pipeline accessories to lines, grades, and dimensions shown on drawings.

B. Finish bottom of trench accurately to lines and grades shown on drawings.

C. Perform excavation in the dry.

D. Do not excavate in frozen materials without written approval of the COR.

3.03 ADDITIONAL EXCAVATION

A. Perform additional excavation in trench bottom for pipe foundations as shown on drawings and other additional excavation beyond specified lines, as directed by the COR.

3.04 OVEREXCAVATION

A. When foundation material is overexcavated beyond specified or directed lines, fill the overexcavation with backfill materials and compact in accordance with Section 31 23 02 – Compacting Earth Materials.

B. If foundation material is overexcavated by being disturbed or loosened during excavation, compact material in place or remove and replace with backfill material and compact in accordance with Section 31 23 02 - Compacting Earth Materials.

3.05 STOCKPILING

A. Stockpile excavated materials until processed or used as backfill material.

3.06 DISPOSAL

A. Dispose of excess excavated materials in accordance with Section 31 23 39 - Disposal of Excavated Materials.

1. Excess excavated materials: Materials which are not used or processed for use as backfill material and waste materials from such processing.

3.07 BEDDING AND EMBEDMENT

A. Place to lines shown on drawings or as directed by COR.

B. Do not drop directly on pipe.

C. Place CLSM in accordance with Section 31 23 70 – Controlled Low Strength Material (CLSM) and as shown on the drawings.

D. Place to widths and depths shown on drawings.

E. Place at the same elevation on both sides of the pipe to prevent unequal loading and displacement of pipe. Elevation difference on sides of pipe shall not exceed 6 inches.

3.08 BACKFILL PLACEMENT

A. Place backfill in pipe trenches to lines shown on drawings, or as directed by the COR.

B. Do not place material in backfill when either the material or the surfaces on which the backfill is to be placed are frozen.

C. Place backfill for overexcavation performed outside specified or directed paylines for excavation for pipe trenches in the same manner as specified for adjacent backfill or embedment.

D. Do not drop backfill directly on pipe.

E. Place backfill carefully and spread in uniform layers so that spaces about rocks and clods will be filled.

F. Place backfill in lifts:

1. Backfill to be compacted: In accordance with Section 31 23 02 - Compacting Earth Materials.
2. Maximum lift height of other backfill: 1 foot.

G. Backfill above compacted backfill may be placed as soon as compacting of backfill is completed although placing of this backfill shall be delayed at locations designated by the COR for the procurement of samples of compacted backfill for testing.

H. Place backfill over pipe as approved by COR, if backfilling operations are interrupted for more than 24 hours.

3.09 COMPACTING BACKFILL

A. Compact backfill in pipe trenches in layers having about the same top elevation on both sides of the pipe to prevent unequal loading and displacement of the pipe.

B. Compact backfill as specified in Section 31 23 02 - Compacting Earth Materials.

C. Location of Compacted Backfill:

1. As shown on drawings.
2. Backfill for foundation.
3. Backfill on outside of horizontal curves.
4. Backfill where pipeline cross under roadways and driveways.
5. Backfill where utility pipelines cross pipeline: To horizontal centerline of the utility crosses pipeline.
6. Backfill at tees with horizontal outlets, pipe bends, encasements, collars including collar-type blocking, and pipe plugs as shown on drawings.
7. Backfill around valve boxes and manholes as shown on drawings.
8. Where additional excavation for pipe trenches is directed by the COR to remove foundation material or other material, compact backfill within paylines for this additional excavation.

D. When tests indicate insufficient density of compacted backfill about pipe.

1. Remove backfill above compacted backfill.
2. Compact backfill until proper density is obtained.
3. Replace backfill above compacted backfill.
4. This work shall be at the Contractor's expense.

3.10 PROTECTION

A. To provide adequate protection for compacted backfill in pipe trenches, the Government reserves the right to direct the Contractor to place a sufficient amount of backfill material over compacted backfill within 72 hours after compacting of backfill has been completed.

B. Place uncompacted backfill to a minimum depth of 3 feet or compact backfill to a minimum depth of 2 feet above top of pipe before allowing construction equipment to travel over pipe.

1. After these minimum earth covers are in place, the maximum equipment loading allowed over the pipe shall be HS-20 loading (16,000-pound wheel load) in accordance with AASHTO SSHB.

2. If construction equipment that exerts a larger wheel load is proposed to be used, submit construction equipment loadings to the COR for analysis and determination of required backfill depths or other protective measures.

END OF SECTION

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SECTION 31 23 39
DISPOSAL OF EXCAVATED MATERIALS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for items of work requiring excavation.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 31 23 39-1, Agreement and Permits:

1. Copy agreement with owner of land where unused excavated materials shall be placed.
2. Copy of federal, tribal, state and local permits needed to place excavated materials.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 DISPOSAL OF EXCAVATED MATERIALS

A. Haul material from required excavation which is not suitable or required for backfill or topsoil to an approved location offsite.

B. Haul materials larger than 6 inches to an approved location offsite.

END OF SECTION

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SECTION 31 23 50
EARTHWORK FOR ROADS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Excavation for Roads:

1. Measurement: Lines, grades, and dimensions shown on drawings or prescribed by COR.
2. Payment: Cubic yard price offered in the schedule. Includes cost of disposing of excavated materials.
3. No payment will be made for excavation and replacement or refill of excavation beyond prescribed excavation lines.

1.02 PROJECT CONDITIONS

A. Government may vary lines, grades, and dimensions of excavations from those shown on drawings based on actual materials and foundations encountered during excavation.

PART 2 PRODUCTS

2.01 MATERIALS

A. Clean fill materials in accordance with Section 31 23 02 - Compacting Earth Materials.

B. Maximum Particle Size: 3 inches.

C. Source: Obtain and process materials from excavated materials.

PART 3 EXECUTION

3.01 EXCAVATION

A. Excavate to lines, grades, and dimensions shown on drawings or prescribed by COR.

B. Excavate in dry conditions.

3.02 OVEREXCAVATION

A. Preserve materials below and beyond prescribed excavation lines in soundest possible condition. Repair damage to work caused by construction operations.

B. Replace excavation beyond prescribed excavation lines with additional concrete where concrete is to be placed on excavated surfaces.

C. Refill excavation beyond prescribed excavation lines with compacted backfill in accordance with Section 31 23 02 - Compacting Earth Materials.

D. Remove foundation material adjacent to excavation which is disturbed or loosened during excavation operations or other work. Replace as specified above for overexcavation.

3.03 PROTECTION

A. Provide temporary construction, pumping, bailing, draining, shoring, sheeting, bracing, and other work necessary to maintain excavations during construction operations.

3.04 DISPOSAL

A. Use suitable excavated materials for required backfill. Locations and procedures for stockpiling will be subject to approval by COR.

B. Dispose of excavated materials which are not used or suitable for backfill in accordance with 31 23 39 – Disposal of Excavated Materials.

C. Grade disposal areas with even and uniform surfaces.

3.05 PLACING

A. Placing and Compacting:

1. Place in layers and compact in accordance with Section 31 23 02 - Compacting Earth Materials.

3.06 PREPARATION

A. Grade and prepare subgrade free from depressions and soft spots.

B. Obtain Government approval of subgrade before placing surfacing.

END OF SECTION

SECTION 31 23 70

CONTROLLED LOW STRENGTH MATERIALS (CLSM)

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include price CLSM used in the pipe trench in the prices offered in the schedule for the Line Pipe as detailed in Section 33 11 10 – Pipeline General Requirements.
2. Include price of CLSM used elsewhere in the applicable item of work.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM C33 / C33M - 13	Concrete Aggregates
2.	ASTM C40 / C40M - 11	Organic Impurities in Fine Aggregates for Concrete
3.	ASTM C94 / C94M - 13	Ready-Mixed Concrete
4.	ASTM C114 - 11b	Chemical Analysis of Hydraulic Cement
5.	ASTM C143 / C143M - 12	Slump of Hydraulic-Cement Concrete
6.	ASTM C150 / 150M - 12	Portland Cement
7.	ASTM C595 / 595M - 13	Blended Hydraulic Cements
8.	ASTM C618 - 12a	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
9.	ASTM C1602/C1602M - 12	Mixing Water Used in the Production of Hydraulic Cement Concrete
10.	ASTM D422 - 63(2007)	Particle-Size Analysis of Soils
11.	ASTM D1588 - 10	Moisture Content Penetration Resistance of Fine Grained Soils
12.	ASTM D4318 - 10	Liquid Limit, Plastic Limit and Plasticity Index of Soils
13.	ASTM D4832 - 10	Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinder
14.	ASTM D6024 - 07	Ball Drop on Control Low Strength material (CLSM) to determine Suitability for Load Application

15. ASTM D6103 - 04 Flow Consistency of Controlled Low Strength Material (CLSM)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 31 23 70-1, Approval Data:

1. Mix design with test results showing conformance with specified requirements for soil source and gradation, plasticity, compressive strength and spread.
2. If on site mixing is used:
   a. Soil processing and mixing equipment.
   b. Qualifications.
3. Method to prevent pipe flotation while placing CLSM.
4. Method to maintain specified strengths.

C. RSN 31 23 70-2, On-site Mix Design:

1. If onsite batching is used provide:
   a. Mix design for each soil or aggregate type to be used.
   b. If proposed material has more than 30 percent passing the 200 sieve, provide mix designs for:
      1) 10 to 30 passing 200 sieve.
      2) 30 to 50 passing 200 sieve.
2. Foreman references.

D. RSN 31 23 70-3, Trial Test Results.

E. RSN 31 23 70-4, Quality Control Test Results:

1. Notify COR within 2 hours if testing does not meet specified requirements.

F. RSN 31 23 70-5, Revised Mix Design:

1. If Quality control test results show the CLSM is not meeting specified requirements, submit a revised mix design to meet the requirements.

1.04 DELIVERY, STORAGE, AND HANDLING

A. For CLSM delivered from ready mix plants furnish batch ticket with each batch of CLSM in accordance with ASTM C 94. Deliver ticket to COR at jobsite during batch delivery.

1.05 QUALIFICATIONS

A. References for foreman in charge of CLSM placement, if on-site batching is used:

1. For three projects within the last three years.

PART 2 PRODUCTS

2.01 CEMENTITIOUS MATERIALS

A. Cement and Pozzolan shipments shall be accompanied by shipping documents containing the following:

1. Manufactures Certification that the material meets applicable requirements of these specifications.
2. Type or class of material shipped.
3. Manufacturing locations and dates.
4. Lot (bin) number.
5. Date of shipment.
6. Quantity of material shipped.
7. A copy of these shipping documents shall be provided to the COR.

B. Cementitious Materials Options:

1. Specified Portland cement plus 20 to 80 percent by weight of total cementitious (cement + pozzolan) specified Pozzolan, in accordance with ACI 318.

C. Portland Cement:

1. ASTM C 150, Type V.
2. Meet equivalent alkalies requirements of ASTM C 150 - Table 2.
3. Meet false-set requirements of ASTM C 150 - Table 4.

D. Pozzolan:

1. ASTM C 618, Class F, except,
    a. Sulfur trioxide for Class F, maximum: 4.0 percent.
    b. Loss on ignition, maximum: 2.5 percent.
    c. Test for effectiveness in controlling alkali-silica reaction under optional physical requirements in Table 2 of ASTM C 618. Use low-alkali cement for test.
    d. Does not decrease sulfate resistance of CLSM by use of pozzolan.
        1) Demonstrate pozzolan will have an "R" factor less than 2.5.
        2) R = (C-5)/F.
        3) C: Calcium oxide content of pozzolan in percent determined in accordance with ASTM C 114.

4) F: Ferric oxide content of pozzolan in percent determined in accordance with ASTM C 114.

2.02 WATER

A. ASTM C 1602.

2.03 AGGREGATE OR SOIL

A. Use one of the following materials.

1. Aggregate: ASTM C 33Fine Aggregate.
   a. If CLSM aggregate is procured from aggregate plants.
   b. Maximum particle size: 3/8-inch or 1/8 of open distance between pipe and trench wall, whichever is less.
2. Non-plastic soil:
   a. For use at either ready mix plant or for on-site mixing:
      1) Non Plastic according to ASTM D 4318.
      2) Gradation:
         a) Passing U.S. Standard No. 200 sieve, by weight, maximum: 50 percent.
         b) Passing U.S. Standard No. 100 sieve, by weigh, maximum: 70 percent.
         c) Maximum particle size: 1/8 of open distance between pipe and trench wall or 3/8-inch, whichever is less.
      3) Select or process soil so that particles remain in suspension, i.e., no segregation occurs, when CLSM is placed.
      4) Clay balls:
         a) Maximum percent, by weight of soil: 10 percent.
         b) Maximum size: 3/8-inch.

2.04 MIX

A. Mixture of aggregate or soil, cementitious materials, water, and admixtures:

1. Cementitious material content: Percent by dry weight of aggregate or soil to obtain specified compressive strength.
2. Make trial mixes prior to placing CLSM to determine mixture adequacy.
   a. Determine compressive strength in accordance with ASTM D 4832.
   b. Determine spread in accordance with ASTM D 6103.

B. Use one of specified cementitious materials options.

C. Water content: Not to exceed that required to provide a mix that will flow and can be pumped.

D. Seven-day Compressive strength, ASTM D 4832: Not less than 50 lb/in^2 and not more than 150 lb/in^2.

E. Consistency:

1. Spread, ASTM D 6103: 8 to 9 inches.
2. Except, when a stiffer mix required to prevent slurry from flowing down trenches on a steep slope:
    a. Slump, ASTM C 143: 8-10 inches.

2.05 CLSM TEMPERATURE

A. CLSM temperature at time of placement: 50 degrees Fahrenheit to 85 degrees Fahrenheit (10 to 30 degrees Celsius).

PART 3 EXECUTION

3.01 BATCHING EQUIPMENT

A. Design and operation of mixers: Discharged CLSM shall be uniform in composition and consistency throughout each batch.

1. Adjust the amount of water and aggregates batched for CLSM to compensate for variations in the moisture content or grading of the aggregates as they enter the mixer.
2. Inform the COR prior to and after adjustments in batching equipment and control instrumentation.
3. Equip truck mixer with dial or digital water meter accurate to within 1 percent of total mix water located between water supply and mixer.
4. Provide a revolution counter which indicates the total number of revolutions of the drum per batch.
    a. Visible from outside the truck.
    b. Reset to zero for each batch.
5. Attach metal plate attached in a prominent place on the mixer listing:
    a. Manufacturer’s recommended drum capacity.
    b. Mixing and agitating speeds in accordance with ASTM C 94.
6. Initial Mixing: Not less than 70 revolutions and not more than 100 revolutions after ingredients are in the drum.
7. Mix 30 revolutions after addition of tempering water.

8. Mix 10 to 12 revolutions after a prolonged period of agitation.

9. Discharge CLSM before 300 drum revolutions.

B. Manufacture and deliver in accordance with ASTM C 94.

1. In addition to the requirements of ASTM C 94, use a water meter approved by the COR to measure and record mix water for each batch.

C. Provide the following information to the COR:

1. A copy of current calibration of scales and water meters.

2. Mix water information.

3.02 TRIAL BATCH

A. Perform a trial run with proposed equipment and material prior to placing CLSM for both batch plant and on site batching.

1. Perform a trial run with proposed equipment and material prior to placing CLSM.

2. Obtain representative sample of soil material :

a. If on site material are used, Mix material from the top of the trench to the proposed invert.

b. Discard plastic material.

3. Test material for gradation, plasticity, compressive strength and spread.

3.03 PREPARATION

A. Place pipe on soil pads or other approved compressible material such as extruded polystyrene foam insulation. Soil pads shall maintain horizontal and vertical alignment during backfilling operations.

1. Do not create point loads on the pipe.

a. Soil pads shall have a lower compressible strength than the surrounding CLSM.

3.04 PLACING

A. Notify COR at least 24 hours before batching CLSM. Include the quantity of CLSM required for each daily placement. Unless inspection is waived, preform batching in the presence of a Government inspector.

B. Do not place CLSM during rain.

C. Do not mix or place CLSM when ambient temperature is below 40 degrees Fahrenheit. Except when, ambient temperature is 35 degrees Fahrenheit and rising and the daily high is predicted to be above 40 degrees Fahrenheit, CLSM may be placed if approved by the COR.

D. Place CLSM to lines, grade, and dimensions shown on drawings.

1. Initially, place CLSM from one side of pipe. Where necessary, rod or vibrate CLSM so that CLSM flows under pipe and appears on other side.

2. Add CLSM to both sides of pipe and rod or vibrate until CLSM completely fills space between pipe and trench.

3. Do not disturb pipe trench or allow foreign material to become mixed with CLSM.

E. Restrain pipe to prevent flotation during placement of CLSM.

F. Do not place backfill material over CLSM until CLSM has reached initial set:

1. As determined by ASTM D 6024 (the ball drop test) or ASTM D 1558 in the presence of the COR.

2. Refer to drawing 1695-D-199, for limits on placing backfill and compacted backfill over the CLSM.

3. Do not place greater than 10-feet of backfill over the pipe until the CLSM has a compressive strength of 50 pounds per square inch or greater.

3.05 CONTRACTOR FIELD QUALITY TESTING

A. Testing:

1. Independent testing laboratory shall perform sampling, testing, and reporting.

a. Independent testing laboratory shall meet requirements specified in Section 01 46 20 - Testing Laboratory Services.

b. Government may inspect testing laboratory facilities. COR will notify testing facilities 72 hours before inspection. Periodic inspection may be required by the CO.

2. If on-site batching is used:

a. Obtain and test soil samples for gradation and plasticity once every 14 days at a minimum or if a change in soil is visually noted.

1) Test material 14 days ahead of placement from the top of the trench to the proposed invert.

b. During CLSM batching, provide an inspector from the testing laboratory to monitor soil characteristics and operations.

1) Modify material and or batching operations as recommended by testing laboratory.

2) Notify COR within 24 hours of modifications.

3. Obtain samples and test to determine compressive strength in accordance with ASTM D 4832 and spread in accordance with ASTM D 6103.

a. Testing frequency:

1) At least once for each shift when placing CLSM.

2) Once every 100 yd^3.

b. Acceptance Criteria:

1) Seven-day Compressive strength, ASTM D 4832: Not less than 50 lb/in^2 and not more than 150 lb/in^2.

c. Make necessary adjustments to the mixture to comply with the strength requirements.

d. Stop work if specified requirements are not met.

3.06 FIELD QUALITY ASSURANCE

A. The Government will obtain samples and test for compressive strength in accordance with ASTM D 4832 and spread in accordance with ASTM D 6103.

3.07 PROTECTION

A. When subsequent lifts of CLSM are to be placed, maintain surface of CLSM in a moist condition by use of tarps or water mist until subsequent lift of CLSM is placed.

B. If backfill will not be placed over CLSM within 8 hours, place 6-inch minimum cover of moist backfill over CLSM. Maintain moisture in 6-inch soil cover until additional backfill is placed.

C. If ambient temperature is forecast to be 50 degrees Fahrenheit or less within 8 hours of placing CLSM, place 12-inch minimum additional cover of loose backfill over 6-inch moist backfill cover before end of work day. Do not allow CLSM to freeze

END OF SECTION

SECTION 31 24 15
GRAVEL DRAIN

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Gravel Drain:

1. Measurement:

   a. Volume of in place completed gravel drain within neatlines shown on the drawings or as directed by COR.

   b. Survey gravel drain foundations and completed surfaces; prepare cross sections and compute quantities of in place fill placed using surveys and neatline templates.

   c. No allowance for shrinkage, settlement, or consolidation.

2. Payment: Unit price per cubic yard offered in the schedule.

1.02 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO)

1.	AASHTO M 288-06	Geotextile Specification for Highway Application

B. ASTM International (ASTM)

1.	ASTM A240 / A240M - 13a	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
2.	ASTM D448 - 12	Standard Classification for Sizes of Aggregate for Road and Bridge Construction
3.	ASTM D1785 - 12	Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 31 24 15-1, Source of Materials:

1. Source name, address, and contact name and telephone number.

C. RSN 31 24 15-2, Pipe Data:

1. Details and materials for pipe connections and anticipated field fabricated joints.
2. Installation plan:
    a. Manufacturer's installation instructions.
    b. Method to protect pipe and hold pipe in place during backfill.
    c. Method for working backfill material under haunches.
    d. Anticipated locations of joints and fittings.

D. RSN 31 24 15-3, Certification and Test Results:
1. Certification.
2. Laboratory test results verifying that material meets specified requirements.

PART 2 PRODUCTS

2.01 GRAVEL DRAIN MATERIAL

A. Quality, soundness, and deleterious substances: Conform to ASTM C 33 coarse aggregate.

B. Gradation: In accordance with ASTM D448, #57.

2.02 PERFORATED PIPE

A. ASTM D 1785: Schedule 40.

B. Perforations:
1. Two rows of holes 1/2-inch diameter on 5-in centers. Parallel to the axis of the pipe and 120 +/- 5 degrees apart.
2. Tolerances:
    a. Diameter: 1/16-inch.
    b. Spacing: + 1/4, -0.

2.03 GEOTEXTILE

A. AASHTO M288, nonwoven, Class 2.

PART 3 EXECUTION

3.01 GENERAL

A. Place adjacent to retaining walls as shown on the drawings.

B. Install Geotextile per manufacturer's recommendation.

C. Connect to solid PVC as shown on drawings and per Section 33 11 16 – Site Water Utility Piping.

3.02 PIPE INSTALLATION

A. Lay pipe as necessary to facilitate the collection and removal of water from behind retaining wall

B. Install fittings as needed around corners and bends.

C. Protect pipe ends from damage. Remove or replace broken, cracked, or unsuitable pipe and replace at no additional cost to the Government.

D. Before and during assembly of a joint, keep all parts free of mud, oil, or grease. Keep the pipe interior free from deposits of mud, sand, gravel, or other foreign matter and in good working condition until the contract is complete and accepted.

E. Maintain pipe grade and alignment during placement of material adjacent to and over pipe. Provide complete circumferential support for pipe to prevent uneven pressures and unacceptable ring deflections.

3.03 GRAVEL DRAIN

A. Minimize handling materials to prevent breakdown.

B. Place in accordance with Section 31 23 02 – Compacting Earth Material.

C. Clean equipment to remove mud and debris prior to travel over Gravel Drain material to prevent contamination.

D. Place material to the lines, grades, and dimensions indicated on drawings.

E. Maximum Lift Thickness: 9 inches prior to compaction.

F. Handle and place material to minimize segregation, breakdown, and contamination.

1. Do not drop from a height greater than 2 feet.

G. No equipment travel directly on Gravel Drain material to prevent contamination.

H. Special Compaction: See Section 31 23 02 – Compacting Earth Materials.

END OF SECTION

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SECTION 31 31 30

SOIL-APPLIED HERBICIDE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 31 31 30-1, Use Plan.

C. RSN 31 31 30-1, Applicator Certification.

1.03 QUALIFICATIONS

A. Applicators: Certified by appropriate State or local agencies, as required.

1.04 REGULATORY REQUIREMENTS

A. Comply with label directions, and applicable EPA, State, and local laws and regulations.

PART 2 PRODUCTS

2.01 HERBICIDES

A. Label: EPA (Environmental Protection Agency) pesticide registration number.

B. Provide soil-applied herbicide conforming to one of the following:

C. Atrazine:

1. Composed of a finely divided, wettable powder containing a minimum of 80 percent chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine and related compounds.

2. Mix: Minimum of 2 gallons of water per pound of dry product.

D. Bromacil:

1. Composed of a finely divided, wettable powder containing a minimum of 80 percent bromo-3-sec-butyl-6-methyluracil.

2. Mix: Minimum of 2 gallons of water per pound of dry product.

E. Prometon:

1. Composed of a liquid emulsifiable solution containing a minimum of 25 percent 2-methoxy-4, 6-bis isopropylamino-s-triazine.

2. Mix with water:

a. For small areas, add sufficient water to provide thorough and uniform coverage.

b. For large areas, add concentrate to 100 gallons of water per acre.

F. Commercial mixtures meeting requirements may be used.

PART 3 EXECUTION

3.01 PREPARATION

A. Apply herbicide after gravel surfacing has been placed.

3.02 APPLICATION

A. Apply herbicide to gravel surfacing placed under these specifications.

1. Select one herbicide from those specified.

2. Apply soil-applied herbicide at following rate:

a. Atrazine: Equivalent of 0.035 pound of dry product per 100 square feet (about 15 pounds per acre).

b. Bromacil: Equivalent of 0.035 pound of dry product per 100 square feet (about 15 pounds per acre).

c. Prometone: Equivalent of 0.017 gallon of herbicide concentrate per 100 square feet (about 7-1/2 gallons per acre).

B. Apply herbicide only with approval of the COR.

C. Apply uniformly.

D. During application, continuously agitate suspension.

END OF SECTION

SECTION 31 37 00
GROUTED COBBLE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Grouted Cobble:

1. Measurement: Volume measured to outlines placed and to thickness shown on drawings or as directed by COR.
2. Payment: Cubic yard price offered in the schedule.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM C33 / C33M - 13	Concrete Aggregates
2.	ASTM C88 - 05	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
3.	ASTM C97 / C97M - 09	Absorption and Bulk Specific Gravity of Dimension Stone
4.	ASTM C150 / C150M - 12	Portland Cement
5.	ASTM C260 / C260M - 10a	Air-Entraining Admixtures for Concrete
6.	ASTM C494 / C494M - 13	Chemical Admixtures for Concrete
7.	ASTM C1017 / C1017M - 07	Chemical Admixtures for Use in Producing Flowing Concrete
8.	ASTM C1602 / C1602M - 12	Mixing Water Used in the Production of Hydraulic Cement Concrete

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 31 37 00-1, Approval Data and Test Results:

1. Name and location of commercial rock source.
2. Gradation of rock.
3. Certified laboratory test results demonstrating rock meets specified material requirements.

PART 2 PRODUCTS

2.01 ROCK

A. Hard, dense, and durable.

1. Specific gravity, ASTM C 97, minimum: 2.50.
2. Absorption, ASTM C 97, maximum: 2 percent.
3. Loss, Sulfate Soundness, ASTM C 88, maximum: 10 percent.

B. Shape:

1. Maximum dimension not greater than 3 times minimum dimension.

C. Reasonably well graded within limits shown in Table 31 37 00A - Cobble Gradation.

Table 31 37 00A - Cobble Gradation

Diameter, in.	Percent Smaller than Given Size by Weight
8	60 - 100
4	2 - 60

2.02 GROUT

A. Portland Cement:

1. ASTM C 150, Type V.
2. Meet false-set requirements of ASTM C 150 – Table 4.

B. Aggregate Materials:

1. Fine aggregate: ASTM C 33.
2. Course aggregate: ASTM C 33, Size No. 8.

C. Water: ASTM C 1602, including optional requirements of Table 2.

D. Admixtures:

1. Air-Entraining Admixture:
   a. ASTM C 260.
   b. Use a neutralized vinsol resin formulation for air-entraining admixture used with ASTM C 494, Type F or G; and ASTM C 1017, Type I or II chemical admixtures.
2. Allowable chemical admixtures:

a. ASTM C 494, Type F and G.

b. ASTM C 1017, Type I or II.

c. Do not use chemical admixtures which contain more than 0.1 percent chloride, by weight.

E. Grout Mix:

1. Net water-cement ratio, maximum: 0.47, by weight.

2. Minimum cement content:

a. 750 pounds per cubic yard of concrete.

b. 710 pounds if a high-range water-reducing admixture is used.

3. Aggregate: 52 to 58 percent fine aggregate, by total volume of aggregate.

4. Slump:

a. Design slump, maximum: 4 inches.

b. Use high-range water-reducing, or plasticizing admixture to increase slump to assure grout penetration into voids.

5. Air entrainment: 6-1/2 to 8-1/2 percent.

6. Waste grout that has become to stiff that proper placing without retempering.

PART 3 EXECUTION

3.01 AREAS TO GROUTED COBBLE

A. Clear vegetation/debris from placement area.

B. Place to the outlines and thicknesses as shown on the drawings.

3.02 PLACING

A. Place so rocks are evenly distributed.

B. Dump and smooth by moving rocks into position so that material when in place is stable.

C. Begin placement at toe and proceed up slope.

D. Leave no unreasonably large unfilled spaces.

3.03 GROUT

A. Reasonably clean in place cobble prior to placement to ensure bonding of grout with cobble.

B. Wet cobble before placing grout.

C. Place grout in voids as directed by the COR.

D. Rod grout to assure penetration into voids.

E. Curing:

1. Apply curing compound to grouted surface to provide water-retaining film. Reapply as necessary to maintain a continuous, water-retaining film on surface for 28 days.

2. Thoroughly mix compound and spray apply in one coat to provide a continuous, uniform film over surface.

END OF SECTION

SECTION 32 15 10
GRAVEL SURFACING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Gravel Surfacing:

1. Measurement: Volume of in-place compacted material to be covered or as directed by COR.
2. Payment: Cubic yard price offered in the schedule.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM D1241 - 07	Materials for Soil-Aggregate Subbase, Base, and Surface Courses
2.	ASTM D4632 - 08	Grab Breaking Load and Elongation of Geotextiles
3.	ASTM D4751 - 12	Determining Apparent Opening Size of a Geotextile
4.	ASTM D6241 - 04(2009)	Static Puncture Strength of Geotextiles and Geotextile-related Products Using a 50-mm Probe.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals

B. RSN 32 15 10-1-1, Installation:

1. Manufacturer’s recommendation for installing Geofabric.

C. RSN 32 15 10-2, Certifications:

1. Geofabric meets specified chemical, physical, and manufacturing requirements.
2. Aggregate meets ASTM D 1241 abrasion loss criteria.

PART 2 PRODUCTS

2.01 GRAVEL

A. Gravel: ASTM D 1241, Type I, Gradation C, surface-course materials, except,

1. Fine aggregate:
   a. Minimum passing No. 200 sieve: 8 Percent.

b. Fraction passing No. 40 sieve:

1) Liquid limit, maximum: 35.

2) Plasticity index range: 4 to 9.

2.02 GEOFABRIC

A. 170N non-woven geotextile, manufactured by Mirafi, Website: www.tencate.com or equal with the following essential characteristics:

1. Grab Tensile Strength (ASTM D 4632): 180 pounds (lbs).
2. Elongation (ASTM D 4632): 50 percent.
3. Puncture Strength (ASTM D 6241): 400 lbs.
4. Apparent Opening Size (D 4751): 70 US Sieve size.

PART 3 EXECUTION

3.01 PREPARATION

A. Grade and prepare subgrade free from depressions and soft spots.

B. Obtain Government approval of subgrade before placing surfacing. Dispose of unsuitable material in accordance with 31 23 39 – Disposal of Excavated Materials.

3.02 PLACING

A. Place geofilter in accordance with manufacturer's recommendations.

B. Do not tear filter fabric during placing of gravel surfacing.

C. Place, moisten, and compact gravel surfacing in accordance with Section 31 23 02 - Compacting Earth Materials.

D. Dispose of excess and unsuitable materials in accordance with 31 23 39 – Disposal of Excavated Materials.

END OF SECTION

SECTION 32 31 10
CHAIN LINK FENCE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Chain Link Fence:

1. Measurement: Length of chain link fence.
2. Payment: Linear foot price offered in the schedule.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A121 - 13	Metallic-Coated Carbon Steel Barbed Wire
2.	ASTM A392 - 11a	Zinc-Coated Steel Chain-Link Fence Fabric
3.	ASTM A824 - 01(2012)	Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence
4.	ASTM C33 / C33M - 13	Concrete Aggregates
5.	ASTM F567 - 11a	Installation of Chain-Link Fence
6.	ASTM F626 - 08(2013)	Fence Fittings
7.	ASTM F900 - 11	Industrial and Commercial Swing Gates

B. Chain Link Fence Manufacturers Institute (CLFMI)

1.	CLFMI 2445-10	Product Manual

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 32 31 10-1, Certification:

1. Manufacturers' certification that fence materials, fittings, and accessories meet specified requirements.
2. Include manufacturers' names and product designations and specified product standards in the certification.

PART 2 PRODUCTS

2.01 CHAIN LINK FABRIC

A. Zinc-Coated Steel Fabric: ASTM A 392.

1. Size of mesh: 2-inch.
2. Coat before weaving.
3. Diameter of coated wire: 0.148 inch (no. 9-gauge).
4. Coating weight: Class 1.

2.02 INTERMEDIATE POSTS

A. CLFMI 2445, Type I round pipe.

2.03 TERMINAL POSTS, BRACES, AND RAILS

A. CLFMI 2445, Type I round pipe.

2.04 TENSION WIRE

A. Zinc-coated Steel Marcelled Tension Wire: ASTM A 824.

1. Coating: Type II, Class 4.

2.05 BARBED WIRE

A. Steel Barbed Wire: ASTM A 121.

1. Coating: Type Z, Class 3.
2. Design Number: 12-2-4-14R.

2.06 FITTINGS

A. Post and Line Caps, Rail and Brace Ends, Braces, and Bands: ASTM F 626, zinc-coated steel or zinc-coated cast iron.

B. Toprail Sleeves, Tension Bars, and Truss Rods: ASTM F 626, zinc-coated steel.

C. Tie Wires, Clips, and Bands: ASTM F 626.

1. Standard round wire ties.
   a. 9 gage steel.
   b. Zinc coating, minimum: 1.2 oz/ft^2.

D. Barbed wire arms: ASTM F 626, Type I.

2.07 GATES

A. Gates: ASTM F 900.

1. Double-swing type.
2. Directions of swing: 180 degrees outward opening.

B. Frame: CLFMI 2445, Type I round pipe.

1. Corners:
   a. Welded or heavy fittings.
   b. Rigid and watertight.

C. Fabric: Same type used in fence.

D. Accessories:

1. ASTM F 900.
2. Gate hinges, latches, stops, and keepers: Zinc-coated steel or zinc-coated cast iron.

2.08 CONCRETE

A. Manufacture and delivery: In accordance with Section 03 30 00 - Cast-In-Place Concrete.

B. Fine and coarse aggregates: ASTM C 33.

1. Coarse aggregate size, maximum: 3/4-inch.

C. Compressive strength at 28 days, minimum: 2,500 lb/in^2.

PART 3 EXECUTION

3.01 INSTALLATION

A. Erect chain-link fence and gates at locations shown on drawings.

B. Install chain link fences of heights shown on drawings.

C. Install fence and gates as shown on drawings, complete with fabric, posts, braces, rails, fittings, accessories, concrete footings, and other materials required for complete installation of the fence and gates.

D. Install chain link fence in accordance with ASTM F 567 and CLFMI 2445, except as shown on the drawing or specified.

E. Terminal Posts:

1. Maximum intervals: 500 feet.
2. At vertical and horizontal changes in alignment equal to or greater than 30 degrees.

F. Undamaged chain link fence fabric removed from existing fence may be used in permanent fence.

1. Reuse of fence posts not allowed.
2. Straighten fabric.
3. Obtain approval of materials to be reused from COR before installation.

3.02 GROUND CONNECTIONS

A. Provide connections for fence in accordance with Section 26 05 20 – Grounding and Bonding.

3.03 REPAIR

A. Repair damage to zinc coatings in accordance with Section 09 96 20 - Coatings.

3.04 TESTING AND ADJUSTING

A. After installation, test and adjust gates for proper operation.

END OF SECTION

SECTION 32 31 70

CATTLE GUARDS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cattle Guards:

1. Measurement: Number of cattle guards installed.
2. Payment: Cattle guard price offered in the schedule.
    a. Includes earthwork, concrete foundations, paint, and fastening adjacent fence lines to cattle guards.

1.02 REFERENCE STANDARDS

A. Department of Transportation (NMDOT)

1. NMDOT Specifications — Standard Specifications for Road and Bridge Construction, 2007 and 2011 Supplemental Specifications.

1.03 DESIGN REQUIREMENTS

A. Design cattle guard structure to provide for passage of vehicular traffic through fence lines and through which livestock cannot pass.

B. Clear travel roadway width for vehicular treads: Not less than 24 feet.

C. Length along line of traffic: Not less than 8 feet.

D. Design in accordance with NMDOT Specifications.

E. Provide suitable cleanouts.

F. Whenever feasible, provide method of draining cattle guard through end of concrete foundation.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 32 31 70-1, Drawings and Data.

PART 2 PRODUCTS

2.01 MATERIALS

A. In accordance with NMDOT Section 610.

PART 3 EXECUTION

3.01 CONSTRUCTION

A. Construct in accordance with NMDOT Section 610.

B. Excavate for cattle guard construction and for suitable drainage of cattle guard.

C. Construct cattle guard foundations to match roadway cross slope or superelevation specified at cattle guard site.

D. Handle and erect cattle guards to prevent damage and paint abrasion.

3.02 REPAIR AND REPLACEMENT

A. Repair or replace damaged cattle guards.

B. Repaint damaged painted surfaces.

END OF SECTION

SECTION 32 91 60

EROSION CONTROL BLANKET

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Erosion Control Blanket:

1. Measurement: Surface area required to be covered, except no allowance will be made for overlaps, repairs, or waste.
2. Payment: Square yard price offered in the schedule.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 32 91 60-1, Manufacturer's Information:

1. Manufacturer's literature listing specified essential characteristics.
2. Manufacturer's installation instructions.

C. RSN 32 91 60-2, Installation Plan:

1. Describe sequence of placing blanket.

PART 2 PRODUCTS

2.01 EROSION CONTROL BLANKET

A. AEC Premier Coconut erosion control blanket, as manufactured by American Excelsior Company, 850 Avenue H East, Arlington, TX, Telephone: 800-777-7645, or equal, having the following essential characteristics:

1. Machine-assembled mat with 100 percent aspen or coconut excelsior within two layers of netting stitched to form a three-dimensional matrix.
   a. Netting: Jute or other natural biodegradable fiber.
2. Consistent thickness with aspen or coconut excelsior curled, interlocked, and evenly distributed over entire area of mat.
3. Excelsior color: Green.
4. Minimum dry unit weight: 8 oz/yd^2.
5. Thread pattern: 4-inch wide by 4-inch long.
6. Thickness, minimum: 1/2-inch.

B. Supply blanket in protected, rolled mat form.

2.02 ANCHORS

A. Biodegradible staples, 6 inch minimum length, as recommended by manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install erosion control blanket on seeded slopes steeper than 3:1 or as directed by COR and in accordance with manufacturer's recommended installation procedures and submitted, approved installation plan.

B. At overlaps, shingle the upstream matting over the downstream matting.

C. Secure erosion control blanket in a 6- by 6-inch anchor trench at top and bottom of berms and at upstream and downstream ends of mats.

D. Before backfilling anchor trenches, pin or staple the topsoil erosion control matting into anchor trench no more than 12-inch spacing as recommended by manufacturer.

E. Outside the anchor trench, anchor topsoil erosion control matting with 3 to 4 staples per square yard as recommended by manufacturer.

3.02 REPAIR

A. Repair or replace topsoil erosion control matting damaged during installation at Contractor's expense.

END OF SECTION

SECTION 32 92 20

SEEDING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Seeding:

1. Measurement: Area disturbed or as directed by the COR.
2. Payment: Acre price offered in the schedule.

1.02 DEFINITIONS

A. Pure live seed content: Weight of seed times percent purity times percent germination.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 32 92 20-1, Seeding Plan:

1. Equipment.
2. Name and address of seed suppliers.

C. RSN 32 92 20-2, Certifications:

1. Origin of seed.
2. Percent purity and germination.
3. Prohibited and restricted weed seed content.

1.04 DELIVERY STORAGE AND HANDLING

A. Seed Containers:

1. Sealed.
2. Labeled:
    a. Identify seed origin on label.
        1) Intrastate shipping: In accordance with New Mexico State Seed Laws and Regulations.
        2) Interstate shipping: In accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act.

1.05 AMBIENT CONDITIONS

A. Do not seed when ambient temperature is below 38 degrees Fahrenheit without approval of the COR.

B. Do not seed when ground is snow covered.

C. Do not seed when wind velocities prevent uniform application of materials or would drift materials.

PART 2 PRODUCTS

2.01 SEED

A. Weed seeds classified by State Seed Department:

1. Prohibited noxious weeds: None allowed.
2. Restricted noxious weeds: 0.5 percent maximum, by weight.

B. Seed Mixture:

1. Purity, minimum: 85 percent.
2. Germination, minimum: 85 percent.
   a. Germination test: Less than 1-year old at time of seeding.
3. Uniform mixture shown in Table 32 92 20A - Seed Mixture.

Table 32 92 20A - Seed Mixture

Common Name	Cultivar	Seeding Rate (Pounds pure live seed per acre)
Western Wheatgrass	Arriba	3
Streambank Wheatgrass		2
Intermediate Wheatgrass	Oahe	3
Indian Rice Grass	Paloma	2
Blue Grama		2
Sideoats Grama		2
Little Bluestem		2
Rock Mountain Penstemon		1

PART 3 EXECUTION

3.01 SEEDBED PREPARATION

A. Complete prior to seeding and mulching.

B. Scarify or harrow and rake topsoil to minimum depth of 3 inches.

C. Remove stiff clods, lumps, roots, litter, stones, and other foreign material greater than 6 inches in size from the surface.

D. Fill or smooth topsoil surface to remove rills, gullies and depressions.

E. Protect prepared topsoil surfaces from erosion and washouts. Repair damaged surfaces as required.

3.02 SEEDING

A. Apply seed and mulch by one of the following methods.

1. Broadcast seeding.
2. Drilling seed followed.

B. Seed only between June 15 and August 15 of each year. Submit an alternative seed mix to COR for approval, if project is completed outside of specified dates.

3.03 BROADCAST SEEDING

A. Broadcast seed only in areas not accessible for drilling.

B. Mechanical Broadcasting:

1. Equipment:
    a. Centrifugal type.
    b. Pull type similar to fertilizer spreader.
2. Designed and regulated to apply seed uniformly at proper rate per acre.

C. Hand Broadcasting:

1. By hand broadcaster.
2. By hand.
3. Uniformly applied.

D. Cover seed with soil to depth of 1/4-inch to 1/2-inch immediately after broadcasting.

1. Use hand rake or float.
2. Do not use log chain or similar device.

3.04 DRILLING SEED

A. Regulate drill to uniformly distribute seed at rate specified and cover with soil depth of 1/4-inch to 1/2-inch.

B. Drill crosswise to general slope where possible to safely operate equipment.

END OF SECTION

SECTION 33 05 22
BORED ROAD CROSSING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Road Crossings:

1. Payment: Applicable lump sum prices offered in the schedule for each road crossing.

a. Includes installing carrier pipes in casing pipes.

B. Cost:

1. Include cost of material of carrier pipes in prices offered in schedule of Line Pipe.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A36 / A36M - 12	Carbon Structural Steel
2.	ASTM A283 / A283M - 12	Low and Intermediate Tensile Strength Carbon Steel Plates

B. American Water Works Association (AWWA)

1.	AWWA C200-12	Steel Water Pipe – 6-inches (150 mm) and Larger

C. Bureau of Reclamation (USBR)

1.	RSHS-2009	Reclamation Safety and Health Standards

D. Western Wood Products Association (WWPA)

1.	WWPA G5	Western Lumber Grading Rules 2011

1.03 SUBMITTALS

A. Submit the following in accordance with section 01 33 00 – Submittals.

B. RSN 33 05 22-1, Placement Plan:

1. Detail the work including boring, casing materials and equipment used.

a. Clearly detail:

1) Assembly.

2) Casing geometry.

3) Cross section of installation including soil/bedrock profile.

C. RSN 33 05 22-2, Material Certification:

1. Certification, signed by material producer and Contractor that each material item complies specified requirements.

D. RSN 33 05 22-3, Copy of Application for Utility Permit.

1.04 SITE CONDITIONS

A. Bedrock may be encountered during the boring operations. Refer to Section 53 10 00 – Geologic Investigations.

1.05 PERMITS

A. Apply for and obtain a Permit to Install Utility Facilities within Public Right-of-Way in accordance with the Railroads and Utilities Manual from the New Mexico Highway and Transportation Department.

PART 2 PRODUCTS

2.01 CASING PIPE

A. Smooth Steel Pipe:

1. In accordance with Section 33 11 11 – Steel Line Pipe, except:

a. Hydrostatic test is not required.

b. Thickness: 0.25-inches.

c. Diameter: Varies.

d. Epoxy lined.

e. Welded joints.

2.02 CARRIER PIPE

A. See Section 33 11 10 - Pipeline General Requirements.

2.03 SPACERS AND RUNNERS

A. Insulated casing spacers and runners, per manufacturer's recommendations.

2.04 END SEAL

A. Model AW Wrap Around End Seal, Manufactured by Advance Products & Systems, Incorporated, Website: www.apsonline.com or equal with the following essential characteristics:

1. Rubber end seal with stainless steel clamps.
2. Rubber seal manufactured with butyl mastic strips.

PART 3 EXECUTION

3.01 GENERAL

A. Verify utility locations prior to excavation.

1. Expose 14-inch waterline on the west side of SH 491, before beginning boring operations.
    a. City of Gallup will be present when waterline is exposed.
        1) Notify City of Gallup and COR 48 hours before exposing pipe

B. Remove and replace fence in accordance with 01 56 20 – Existing Fences.

C. Excavate suitable pits or trenches for the boring operations.

1. Strip in accordance with 31 14 10 – Topsoil Stripping.
2. Perform earthwork in accordance with Section 31 23 11 – Earthwork for Structures.

D. Where excavation extends below ground water levels, dewater the portion below the water line in advance of the excavation in accordance with Section 31 03 33 – Removal of Water from Excavation. Work shall be conducted in the dry to provide a safe and stable work area and suitable foundation.

E. Normal operations of the highway, street, or other facilities shall not be interfered with. Other than for the safety of the public in accordance with approved traffic plan.

F. Boring under highways, streets, or other facilities shall not weaken or damage any part of the highway, street or facility. Damage, as determined by the COR, shall be repaired at the Contractors expense.

G. Remove and replace, without additional cost, pipe damaged during the boring operations.

H. Install casing pipes to lines and grades shown on drawings.

1. Final position of the pipe shall not vary more than 1-inch in 40 feet laterally or vertically and such variation shall be regular and in only one direction.
2. Grout bored annulus, outside of the casing pipe, if the annulus exceeds 1-inch.

I. No pit or trench, excavated to install pipe, shall remain open longer than 5 days after installation, unless otherwise approved by the COR.

J. Safety fencing shall be installed around pit or trenches in accordance with Section 01 56 32 – Temporary Safety Fence. Remove as required for construction

3.02 BORING

A. Pilot Hole Method:

1. Bore a pilot hole the entire length of the crossing.
2. Check line and grade of bore from the exit hole, and correct where necessary.
3. Use pilot hole as centerline for the larger diameter hole to be bored.

B. Auger Method:

1. Provide proper diameter steel pipe equipped with a cutter head to mechanically perform the excavation.
2. Augers shall be of sufficient diameter to convey the excavated material to the work pit.

C. Use a gel-forming colloidal drilling fluid containing at least 10 percent of high grade, processed Bentonite to consolidate the cuttings of the bit, seal the holes in the boring wall, and furnish lubrication for cuttings removal and immediate installation of line pipe. Use water or other fluids in boring only to lubricate cuttings for removal. Jetting will not be permitted.

D. Dispose of drilling fluid in accordance with Section 01 74 00 – Cleaning and Waste Management,

3.03 CARRIER PIPE

A. Install carrier pipe, spacers, runners and end seal per manufacture's recommendations.

3.04 BACKFILL

A. If pit or trench is backfilled prior to installation of carrier pipe, install a wooden bulk head at ends of the casing to keep backfill material out of the casing pipe. Mark ends with of casing pipe with Utility Markers to allow for relocation.

B. Backfill in accordance with accordance with Section 31 23 11 – Earthwork for Structures.

C. Reconstruct highway slopes and embankments with same materials excavated and to existing dimensions.

D. Dispose of excavated material in accordance with Section 31 23 39 – Disposal of Excavated Materials.

END OF SECTION

SECTION 33 09 12

MAGNETIC FLOWMETER SYSTEMS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Magnetic Flowmeter Systems:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American Water Works Association (AWWA)

1.	AWWA C207-13	Steel Pipe Flanges for Waterworks Service Sizes 4 In. Through 144 In.

B. National Electrical Manufacturer's Association (NEMA)

1.	NEMA 250-2008	Enclosures for Electrical Equipment (1000 Volts Maximum)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 33 09 12-1, Approval Data:

1. Commercial products data for flowmeter, transmitter, and transient protection unit for the signal line. Include manufacturer's name, model number, and specifications that illustrate components meets these specification requirements.

2. Detailed installation instructions and drawings showing installation details, detail dimensions, and locations of conduit connections. Include manufacturer's instructions for attaching flowmeter to pipes and cabling to flowmeter display transmitter.

C. RSN 33 09 12-2, Check Prints:

1. Schematic and wiring diagrams for electrical equipment as required by Division 26 – Electrical.

D. RSN 33 09 12-3, Final Data:

1. Service Manuals: Bound service manuals containing complete parts identification lists, and detailed instructions for installation, operation, and maintenance of flowmeter systems.

2. Hard copy of the parameters program.

E. RSN 33 09 12-4, Simulated Test Report:

1. Field test report of the simulated field test for each magnetic flowmeter system.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect equipment from corrosion, deformation and other types of damage during shipping, storage, and handling.

PART 2 PRODUCTS

2.01 ELECTROMAGNETIC FLOWMETER SYSTEMS

A. Design Requirements:

1. One 12-inch diameter electromagnetic flowmeter system to measure flow in the Twin Lakes Turnout steel pipeline. Install flowmeter with remote transmitter in Flowmeter Vault No. 2.
2. One 30-inch diameter electromagnetic flowmeter system to measure flow in the Reach 12.1 steel pipeline. Flowmeter with remote transmitter installed in Flowmeter Vault No. 1. Provide concentric pipe reducer, if required for flowmeter.
3. One 36-inch diameter electromagnetic flowmeter system to measure flow in the Reach 12B steel pipeline. Flowmeter with remote transmitter installed in Flowmeter Vault No. 1. Provide concentric pipe reducer, if required for flowmeter.
4. Flowmeters capable of measuring flow, indicating instantaneous flowrate, and totalizing flow in both the forward and reverse directions.
5. Refer to system pipe parameters tabulated in Table 33 09 12A – System Pipe Parameters.

Table 33 09 12A – System Pipe Parameters

Pipe Size	12.75 inches O.D.	30 inches O.D.	36 inches O.D.
Pipe Thickness	1/4-inch	1/4-inch	1/4-inch
Pipe Material	Carbon Steel	Carbon Steel	Carbon Steel
Velocity Range (for flowmeter accuracy requirements)	1 to 33 ft/sec	1 to 33 ft/sec	1 to 33 ft/sec
Maximum Flowrate (based on velocity range above)	24 ft^3/sec	140 ft^3/sec	215 ft^3/sec
Maximum Pipe Pressure	50 lb/in^2	250 lb/in^2	150 lb/in^2

B. Electromagnetic Flowmeters:

1. Model FM656 TigermagEP, as manufactured by Sparling Instruments, 4097 North Temple City Boulevard, El Monte, CA; or equal, having the following essential characteristics for each flowmeter:

    a. Accuracy: Plus or minus 0.5 percent of all flowrate, over the range of measurement designated in Table 33 09 12A – System Pipe Parameters, above 1-foot per second. Accuracy to assume at least three straight pipe diameters upstream of meter.

    b. Suitable for operation in ambient temperatures ranging from minus 20 to 140 degrees Fahrenheit.

    c. Flanged, cylindrical flow-tube with polyurethane liner, grounding rings and gaskets.

    d. Flanges:

        1) Meets requirements of AWWA C207, flat faced, Class D (for 12- and 36-inch flowmeters) and Class E (for 30-inch flowmeter).

        2) Carbon steel.

    e. Sensor Tubes:

        1) Stainless steel: Type 304.

        2) Fused platinum electrode material.

C. Remote Transmitters:

1. Same manufacturer as flowmeters.

2. One remote transmitter for each flowmeter. Each transmitter to provide the following characteristics:

    a. LCD display: 3/8-inch characters, 2-line, 16-character backlit alphanumeric to indicate flow units and total flow. Menu commands are visible on display.

    b. Minimum outputs: Analog 4-20 mA, two digital scaled pulse (totalizer), digital scaled frequency (flowrate), flow direction, fault, empty pipe detection with positive zero return, and digital port RS232.

    c. Non-volatile EPROM memory.

    d. Microprocessor based with integrated keypad.

    e. Display readout to simultaneously display flowrate and totalized flow.

    f. User selectable flow measurement units of ft^3/sec and gal/min for flowrate. Four-digit minimum display of flowrate in ft^3/sec with least significant digit in tenths of an ft^3/sec. Six-digit minimum display for flowrate in gal/min with least significant digit of one gal/min. Reverse flow direction shall indicate a minus sign in the display.

    g. Internal flow totalizer:

1) Programmed to totalize separately for forward and reverse flow (provide batch functions, if required for separate totalization).

2) Totalize volume (acre-feet) of water flow over time. Nine-digit minimum display of totalized volume in acre-foot with least significant digit in hundredths of an acre-foot. Totalizer retains totalized value upon loss of power.

h. Analog output: Isolated type output. Provide a minimum of one 4 to 20 mA output for flowrate linear to their respective flows.

i. Suitable for operation with 120-volt, single phase, 60-hertz power supply.

j. Remote (wall mounted) flowmeter transmitters in a NEMA 250, Type 4X enclosure, with visible display.

D. Provide cable between each flowmeter and their respective remote transmitter of the type specified by the flowmeter manufacturer that is suitable for pulling through conduit. Determine exact cable lengths and locations of conduit. Cable splicing not allowed.

E. Provide brackets, supports, and mounting hardware required to install equipment.

2.02 ELECTRICAL

A. Furnish electrical wiring and cable in accordance with Section 26 05 10 – Conductors and Cables.

B. Furnish power supplies, electrical boxes, and accessories that are required to install the remote signal transmitters in accordance with Section 26 05 02 – Basic Electrical Materials and Methods.

C. Furnish conduit required to install the flowmeters and signal cables in accordance with Section 26 05 33 – Raceways and Boxes.

PART 3 EXECUTION

3.01 INSTALLATION

A. Construct concrete vaults and lids in accordance with Section 03 30 00 – Cast-In-Place Concrete, Section 31 23 11 – Earthwork for Structures, and Section 05 50 00 – Metal Fabrications and drawings.

B. Install Flowmeters with Remote Transmitters:

1. In accordance with manufacturer’s instructions.

2. 30-Inch and 36-inch flowmeters in their respective pipeline located in flowmeter vault No. 1 as shown on drawing 1695-D-208.

3. 12-Inch flowmeter in the pipeline located in flowmeter vault No. 2 as shown on drawing 1695-D-216.

4. Remote transmitters to the wall of their respective flowmeter vault near the access hatch and ladder. Mount the transmitters to position the visible display at a height of approximately 60 inches above the floor.

C. Electrical:

1. Install electrical wiring, shielded telemetry cable, conduit, power supplies, electrical boxes, terminal blocks, and necessary accessories that are required to complete the installation in accordance with Division 26 – Electrical.

2. Make electrical connections between the flowmeters and their respective remote transmitters.

3. For connection and continuation of output signals between each transmitter to the Tohlakai Pumping Plant, see Division 26 - Electrical.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. General:

1. Perform after complete installation of the flowmeter systems.

2. Witnessed by the COR.

3. Make appropriate corrections and adjustments to equipment to correct deficiencies found during testing.

4. Retest until approved by the COR.

B. Simulated Test Procedure (for each flowmeter system):

1. Apply simulated flow signal inputs. Simulated signals to cover minimum and maximum flows over velocity range listed in Table 33 09 12A – System Pipe Parameters.

2. Check displays for correct readouts, and check each I/O (input/output) point for correct I/O signal.

3. Test each output connection for correct input conformance.

4. Verify that instrumentation and indication devices function properly. Test functions of each flowmeter transmitter for correct operations.

5. Submit field test reports with Final Data.

END OF SECTION

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SECTION 33 11 10

PIPELINE GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Line Pipe:

1. Measurement: Length along pipe centerline between ends of pipe in place. Continuous through fittings and outlets with no allowance for lap at joints.

    a. Stations shown on plan and profile drawings are break point between various bid items for furnishing and laying line pipe.

2. Payment: Applicable linear foot price offered in the schedule for various classes of line pipe.

    a. Includes cost of furnishing materials; manufacturing and laying pipe; furnishing and placing CLSM, furnishing and placing concrete in collars, encasements and blocking; filling, flushing and testing pipeline.

B. Filling and Testing Water:

1. Payment: Lump sum price offered in the schedule.

    a. Only water used for filling and testing as approved by the COR will be included.

C. Concrete Block at Station 12516 + 40 :

1. Payment: Lump sum price offered in the schedule.

    a. Concrete block for 36 inch pipe at Station 12516 + 40 may be eliminated if connecting pipe is installed before 36 pipe is installed. Price for concrete block will be removed from cost of project, if the block is not required.

D. Connection to Reach 12B:

1. Payment: Lump sum price offered in the schedule.

    a. Includes connection shown on Drawing 1695-D-311.

E. Connection to Reach 12.1:

1. Payment: Lump sum price offered in the schedule.

    a. Includes connection shown on Drawing 1695-D-311.

F. Repair Kit:

1. Payment: Lump sum price for repair kit offered in schedule.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A536 - 84(2009)	Ductile Iron Castings
2.	ASTM C150 / C150M - 12	Portland Cement
3.	ASTM D2000 - 12	Rubber Products in Automotive Applications

B. American Water Works Association (AWWA)

1.	ANSI/AWWA C111/A21.11-12	American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
2.	AWWA C219-11	Bolted, Sleeve-Type Couplings for Plain-End Pipe
3.	AWWA C600-10	Installation of Ductile Iron Water Mains and Their Appurtenances
4.	AWWA C604-11	Installation of Steel Water Pipe 4 in. (100mm) and Larger
5.	AWWA C605-05	Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
6.	AWWA C606-	
7.	AWWA C900-07	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution)
8.	AWWA C905-10	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1200 mm), for Water Transmission and Distribution)
9.	AWWA C906-07	Polyethylene (PE) Pressure Pipe Fittings, 4 In (100 mm). Through 63 In. (1,600 mm), for Water Transmission and Distribution)

C. Bureau of Reclamation (USBR)

1.	RSHS-2009	Reclamation Safety and Health Standards

D. International Organization of Standards (ISO)

1.	ISO 9001:2008	Quality Management Systems - Requirements

E. NSF International

1.	NSF 61-2011	Drinking Water System Components- Health Effects

1.03 DEFINITIONS

A. Pipe size and class symbols shown on drawings are for PVC pipe. Equivalent pipe size and class symbols for steel and ductile iron pipe are shown in Table 33 11 10A – Symbol Pipe Equivalents.

B. Pipe Sizes and Classes: Designated on plan and profile drawings by an alphanumeric symbol.

1. Steel Pipe:

a. Symbol identifies pipe as follows:

1) First number in the symbol designates the internal diameter of the pipe in inches.

2) Letters A, B, C, and D designate maximum allowable external loadings of earth over top of pipe of 5, 10, 15 and 20 feet, respectively.

3) Last number designates the hydrostatic head in feet measured to centerline of pipe.

4) A symbol of 12B50 means pipe of 12-inch diameter with a maximum allowable earth cover of 10 feet and 50 feet of allowable hydrostatic head.

2. Polyvinyl Chloride Pipe (PVC) and High Density Polyethylene Pipe (HDPE):

a. Symbol identifies pipe as follows:

1) First number in the symbol indicates nominal diameter in inches.

2) Alphanumeric indicates DR (dimension ratio) as defined in AWWA C900, C905 and C906.

3) Number in parenthesis is the hydrostatic head in feet measured to centerline of pipe.

4) Nominal diameter nomenclature IPS (iron pipe size) or CIOD (cast iron outside diameter).

5) Number in parenthesis is the hydrostatic head in feet measured to centerline of pipe.

6) A symbol of 12DR25 (75) means the pipe is 12 inches in diameter with a dimension ratio (DR) of 25, and a hydrostatic head of 75 feet.

3. Ductile iron pipe (DI):

a. Symbol identifies pipe as follows:

1) First number indicates nominal diameter in inches.

2) Nominal diameter nomenclature DIOD for ductile iron outside diameter.

3) Next number is the pipe pressure class in psi.

4) Number in parenthesis is the hydrostatic head in feet measured to centerline of pipe.

5) A symbol of 12DIOD150(25) means the nominal diameter of the pipe is 12 inches with a ductile iron outside diameter nomenclature, a pressure class of 150 psi, and a hydrostatic head of 25 feet.

4. Pipe designations shown on drawings and in these specifications establish minimum requirements for pipe types allowed under these specifications.

5. Pipe sizes and classes for the allowable pipe types allowed under these specifications are shown in Table 33 11 10A – Symbol Pipe Equivalents.

Table 33 11 10A- Symbol Pipe Equivalents

Steel	PVC	Ductile Iron	HDPE
12C75	12DR25 (75)	12DIOD350(75)	12DR21(75)
12C100	12DR25 (100)	12DIOD350(100)	12DR17(100)
12B125	12DR25 (125)	12DIOD350(125)	12DR13.5(125)
30B550	-	30DIOD250(550)	-
30C550	-	30DIOD250(550)	-
30C575	-	30DIOD250(575)	-
36C375	36DR25(375)	36DIOD200(375)	-
36D375	36DR25(375)	36DIOD200(375)	-
36B400	36DR21(400)	36DIOD200(400)	-
36C400	36DR21(400)	36DIOD200(400)	-

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 33 11 10-1, Qualifications:

1. Resumes and references of line pipe, lining, coating and specials manufacturers have at least 10 years of successful experience producing products as specified.

C. RSN 33 11 10-2, Pipelaying Diagrams:

1. Show position and marking of pipe sections.

2. Include centerline and invert stationing and elevations at horizontal and vertical changes in alignment, and subgrade elevation for each pipe fitting.

D. RSN 33 11 10-3, Use in a Public Water System Certification.

E. RSN 33 11 10-4, Floatation Prevention Plan:

1. Show location and describe method of preventing pipe from floating.

F. RSN 33 11 10-5, Safety Plan:

1. In accordance with RSHS 2009 and CFR 29 1910.146.
2. Method for ventilating pipe during procedures that require a person to enter the pipe.
3. Confined space entry and rescue plan in accordance with RSHS 2009 and NFPA 1670. Include on-site location of rescue equipment.
4. Certification of personnel performing confined space entry and rescue personal.

G. RSN 33 11 10-6, Filling and Testing and Inspection Plan:

1. Proposed rate, time, and procedure for:
   a. Cleaning.
   b. Filling.
   c. Field and pressure testing.
   d. Draining pipeline.
2. Method and equipment used to camera pipe.
3. Method of disposing of water drained from pipeline to enable repair of leaks and at conclusion of pressure test.

H. RSN 33 11 10-7, Field Examination Video:

1. DVD format with audio recording documenting video inspection of pipes.

I. RSN 33 11 10-8, Final Inspection Video:

1. DVD format with audio recording documenting video inspection of pipes.

1.05 REPAIR KIT

A. Furnish a repair kit for each type and size of pipe used.

B. Repair kit: One standard length of pipe and two couplings.

1. At the highest loading and pressure rating for each type of pipe used.

C. Place pipe in storage as directed by the COR. Within 150 miles from the site, as designated by the COR.

1.06 QUALIFICATIONS

A. Pipe manufactures shall be certified in accordance with ISO:9001 or similar nationally certified program as approved by COR.

B. Qualify welding procedures and welders in accordance with the code under which welding is specified to be accomplished.

C. Line pipe, lining, coating and specials manufacturers: At least 10 years of successful experience producing products as specified.

PART 2 PRODUCTS

2.01 PIPE OPTIONS

A. As listed in Table 33 11 10A-Symbol Pipe Equivalents and the following sections.

1. Steel line pipe and appurtenances in accordance with Section 33 11 11 – Steel Line Pipe.
2. PVC pressure line pipe and appurtenances in accordance with Section 33 11 12 - PVC Pressure Pipe.
3. Ductile Iron pipe and appurtenances in accordance with Section 33 11 13 – Ductile Iron Pipe.
4. HDPE pipe and appurtenances in accordance with Section 33 11 14 – HDPE Pipe.

B. All materials and chemicals that may come into contact with drinking water must be certified for use in a public water system. Certification is primarily accomplished through the National Sanitation Foundation (NSF).

C. Install one pipe type.

2.02 TWIN LAKES CONNECTION

A. Mega Coupling 3812, as manufactured by EBAA Iron, Incorporated, P.O. Box 857, Eastland, TX 76448, Website: www.ebaa.com. or equal, with the following essential characteristics:

1. Capable of connecting dissimilar pipes.
2. Corrosion resistant per manufacturer’s standard surface preparation and coating system.
3. Meets applicable requirements of AWWA 219, ASTM A 536, AWWA C111/A21.11, ASTM D 2000.

2.03 PIPE ACCESSORIES

A. Lubricants: NSF 61 compliant.

1. Deliver to the job site in closed containers

2.04 SOURCE QUALITY ASSURANCE

A. Approval for Shipment:

1. Pipe and fitting approval will be determined by inspection, during and after manufacture.
2. Notify the Technical Service Center, Attn: 86-68140, and COR at least 14 days before manufacturing pipe and fittings and 3 days before shipping pipe and fittings.
3. The Government will inspect pipe units and fittings and will approve for shipment those which have been manufactured and tested in accordance with these specifications, unless the Contractor is notified in writing.
4. Further inspection of pipe units and fittings will be in accordance with the clause entitled "Inspection of Construction."

PART 3 EXECUTION

3.01 GENERAL

A. Provide potable water for filling and testing pipeline.

1. Refer to Section 01 51 00 – Temporary Utilities.

B. Perform work in accordance with RSHS 2009.

C. Perform cleaning, filling and testing after backfill has been placed to finished grade or as approved by COR.

D. Disinfection is not required, unless pipe is flooded.

E. A professional land surveyor licensed in the State of New Mexico shall be on-site during excavation and pipelaying.

3.02 INSTALLATION

A. Install pipe in accordance with appropriate Section for pipe option installed.

B. Install warning tape over center of pipe at least 18 inches below ground and at least 18 inches above pipe.

C. Protect inside of pipe from contamination during construction and during storage on site.

1. Tightly close open ends of pipe with plastic wrap to prevent entrance of foreign materials prior to delivery.
    a. Plastic wrap:
        1) At least two thicknesses of 6-mil sheet polyethylene plastic.
        2) Remain on pipe until installation.
2. Keep openings to installed pipe closed with watertight plugs during work stoppage, including end of work day, breaks, work delays, etc.
3. Maintain only as much pipe at the work site as necessary, ensuring that pipe is quickly installed and not laying around the work site for long periods of time prior to installation.
4. Inspect 12-inch pipe at the end of each work day.
    a. Flush debris from pipe as approved by COR.
5. Clean each section of 30 and 36-inch pipe after it is installed and at the end of each work day.
    a. Remove debris and ponded water.
    b. Sweep dirt.
6. If the pipe is flooded during construction, it shall be cleared of the floodwater by draining and flushing with potable water, or other approved method, until the pipe is clean. Fill section exposed to the floodwater with chlorinated potable water that, at the end of a 24-hour holding period, shall have a free chlorine residual of not less than 25 mg/l.
7. Lubricant:
    a. Keep clean.
    b. Apply with dedicated, clean applicator brushes.

3.03 CONNECTIONS

A. City of Gallup:

1. City of Gallup may be present during connection to existing pipe. Do not touch existing pipe without approval from COR.
2. The existing pipe is unused and does not carry water.
3. Notify COR 7 days before making connection to existing pipe.
4. Remove concrete thrust block at the end of the existing pipe and dispose of in accordance with Section 01 74 00 – Cleaning and Waste Management.
5. Connect to existing pipe with a Mega Coupling in accordance with manufacturer's instructions.

B. Steel Manifold to Twin Lakes Turnout:

1. As shown on drawing 1695-D-216.
2. Connect at the vertical miter bend at edge of pumping plant yard.

C. Steel manifold to Reach 12B and Reach 12.1:

1. As shown on drawings 1695-D-210 and -211.
2. Connect at insulating flange joint.

3.04 FIELD EXAMINATION

A. Camera inside pipe condition for defects.

1. Repair defects in accordance with specifications and re-inspect (record).
2. COR will be present while pipe is videoed. Notify COR 7 days before videoing pipe.

B. Flush pipe before filling.

1. Remove debris and ponded water.
2. Sweep dirt and gravel.

3.05 FILLING PIPELINE

A. Pipeline Fill Rate, Maximum: Air valve capacity.

B. Maintain pipeline completely filled for at least 72 hours before testing.

3.06 CONTRACTOR FIELD QUALITY TESTING

A. COR shall approve of test results.

B. Leak Testing:

1. Notify the COR at least 7 days before applying pressure to pipeline.
2. Provide pumps, power, pressure gages, and flow meters for testing.
3. Test pipeline with hydrostatic pressures equal at a minimum to the lowest hydraulic grade line elevation shown on the profile.
    a. Prior to starting the test, maintain pressure in the pipe for 24 hours.
    b. Test for 96 hours or as approved by COR.
    c. Maintain pressure during test.
    d. Acceptance criteria:
        1) No observable leakage allowed.

2) Measured leakage shall not be greater than the test allowance prescribed in the AWWA installation standard for the pipe being used:

a) AWWA C600 for Ductile Iron Pipe.

b) AWWA C604 for Steel Pipe.

c) AWWA C605 for PVC.

e. If leakage is detected, halt test and identify and repair leaks in an approved manner.

f. Repeat test until leakage is not detected and measured leakage meets allowable rates.

C. Drain pipe completely using both gravity flow and sump pump at blowoff.

D. Repeat field examination as detailed above.

E. Seal openings to pipe as approved by COR.

END OF SECTION

SECTION 33 11 11

STEEL LINE PIPE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Measurement and Payment: In accordance with Section 33 11 10 – Pipeline General Requirements.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A139 / A139M - 04(2010)	Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
2.	ASTM A1011 / A1011M - 12b	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
3.	ASTM A1018 / A1018M - 10	Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
4.	ASTM E 165/E165M - 12	Liquid Penetrant Examination for General Industry

B. American Water Works Association (AWWA)

1.	AWWA C 200-12	Steel Water Pipe - 6 In. (150mm) and Larger
2.	AWWA C 205-12	Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. (100 mm) and Larger – Shop Applied
3.	AWWA C 206-11	Field Welding of Steel Water Pipe
4.	AWWA C 207-13	Steel Pipe Flanges for Waterworks Service – Sizes 4 in. Through 155 in. (100 mm Through 3,600 mm)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 33 11 11-1, Shop Drawings and Data:

1. Provide shop drawings showing major fitting dimensions and exact dimensions of joints and diameter of rubber gasket, including tolerances and other major dimensions or proposed restraint.
2. Include joint tolerances and closure sections and bolt torques.

1.04 DELIVERY, STORAGE, AND HANDLING

A. During loading, transporting, unloading, storing, and laying, prevent damage to steel pipe, linings, and coatings.

B. Tightly close open ends of shop-applied, cement-mortar-lined pipe with plastic wrap for protection of cement-mortar lining during shipment.

1. Plastic wrap:

a. At least two thicknesses of 6-mil sheet polyethylene plastic.

b. Remain on pipe until installation.

C. Transport coated pipe on padded bolsters curved to fit the outside of the pipe. Use heavy padding under ties.

D. Support and store pipe above ground surface. Do not allow bells and spigots to contact each other or the ground.

E. Government will inspect pipe once it is delivered.

F. Repair damage to lining or coating as directed if, in the opinion of the COR, a satisfactory repair can be made; otherwise, replace damaged section at the expense of the Contractor.

PART 2 PRODUCTS

2.01 STEEL LINE PIPE

A. Steel Line Pipe:

1. Electric-fusion- (arc-) welded helical-seam steel pipe: ASTM A 139, grade C, D, or E.
2. Fabricated in accordance with AWWA C 200:

a. Except, steel sheet shall be ASTM A 1011, designation SS, grade 40, 45, or 50; or ASTM A 1018, designation SS, grade 40.

B. Pipe Diameter: To inside of lining.

C. Minimum Steel Wall Thickness of Pipe:

1. As shown below or as otherwise shown on the drawings.

33 11 11A - Minimum Steel Wall Thickness for Symbol Pipe

Pipe Symbol	Minimum Steel Wall Thickness (Inches)
30C575	0.2188
30B550	0.2188
30C550	0.2188
36B400	0.1793
36C400	0.1793
36C375	0.1563
36D375	0.1563
12B125	0.0747
12C100	0.0747
12C75	0.0747

D. Prepare pipe ends for gasketed bell and spigot joints.

2.02 FITTINGS

A. Flanges:

1. Flange: AWWA C 207.

a. Class: Working pressure meets or exceeds head class of attached pipe.

B. Flange Gaskets:

1. Gylon Style 3000 manufactured by Garlock Sealing Technologies, 1666 Division Street, Palmyra, NY 14522; or equal with the following salient characteristics:

a. Suitable for cold water service.

b. Flat ring-type.

c. Suitable for AWWA C207 flanged joints.

C. Flange Insulation:

1. Linebacker Flange Isolation Kit, Manufactured by Pipeline Seal and Insulator, Incorporated, 6525 Goforth Street, Houston, TX 77021; Flange Isolation Kit with Trojan gasket, Advanced Products and Systems, P.O. Box 60399, Lafayette, LA 70596-0399; or equal with the following essential characteristics:

a. Full-faced, type E gaskets. The outside diameter of the gasket is the same as the outside diameter of the flange.

b. Retainer with integral Nitrile sealing element ("Linebacker" or "Trojan" type).

c. Retainer suitable for cold water service as recommended by gasket manufacturer.

d. One insulating sleeve and two insulating washers for each bolt. Suitable for cold water service as recommended by the gasket manufacturer.

2. Suitable for 200 psig cold water service.

3. Asbestos gaskets are not acceptable.

4. Gasket supplier to provide the required bolt torques, recommended bolt tightening sequence, and flange face finish for the insulating flanged joints.

5. Use between steel and ductile iron pipe.

D. Tapers (or Adaptors):

1. Lengths: As shown on drawings.

2. Ends: Fit type of joint in adjacent pipeline.

2.03 LININGS AND COATINGS

A. Coating and lining in accordance with Section 09 96 20 – Coatings.

B. Do not field apply mortar lining without COR approval.

2.04 CONCRETE

A. Concrete in encasements, blocking, and collars: Section 03 30 00 - Cast-In-Place Concrete.

2.05 CONTRACTOR SOURCE QUALITY TESTING

A. Steel Pipe and Fittings:

1. Hydrostatic test for pipe and fittings: Perform shop hydrostatic test on pipe which stresses steel to 75 percent of minimum yield point of the steel.

2. Hold pressure long enough to allow through inspection welded joints, or 15 minutes whichever is longer.

3. Repair leaks by rewelding and retesting of joints.

4. Hydrostatic test for pipe:

a. Test sections prior to forming bell and spigot joints.

b. Repair defects and retest section before applying lining and coating.

c. The Government may witness the hydrostatic testing and calibration of the pressure gauges. Notify the government 30 days prior to performing the hydrostatic test.

5. Hydrostatic test for fittings:

a. Fittings fabricated from tested steel pipe do not require hydrostatic testing if girth butt welds are complete penetration welds.

1) Girth weld test: Dye penetrant test in accordance with ASTM E 165 or Magnetic Particle in accordance with ASTM E 709.

b. Chip, flame gouge, or grind to sound metal defects in welds as disclosed by the dye penetrant or hydrostatic tests. Reweld and retest the resulting cavities.

B. Joint Test:

1. Assemble one joint for each pipe diameter to check the bell and spigot to check fit prior to coating or lining.

2.06 SOURCE QUALITY ASSURANCE

A. Basis for approval for shipment.

1. Pipe approval will be determined by inspection, during and after manufacturing, to determine whether the pipe conforms to these specifications, and ASTM A 139 or AWWA C 200.

2. Notify the Technical Service Center, Attn: 86-68140, and Construction Manager at least 14 days before manufacturing pipe and 72 hours before shipping pipe.

3. The Government will inspect pipe units and will approve for shipment those which have been manufactured and tested in accordance with these specifications, unless the Contractor is notified in writing.

4. Further inspection of pipe units will be in accordance with the clause entitled "Inspection of Construction."

PART 3 EXECUTION

A. Keep internal supports in place until the embedment material has been placed to a minimum height of 0.7 times the diameter and CLSM has reached 30 pounds per square inch.

3.02 LAYING PIPE

A. Keep pipe trenches free of water during pipelaying operations.

B. Excavate pipe trench in accordance with Section 31 23 22 - Pipe Trench Earthwork.

1. Grade pipe trenches to provide uniform slope along the bottom of pipe.

2. At joints involving bells or collars, excavate holes at the joint of ample size to prevent bells or collars from coming in contact with the subgrade.

3. Lower the pipe into the trench and place pipe in position such that no soil gets inside the pipe and pipe is not damaged.

C. On grades exceeding 10 percent, lay pipe uphill.

D. Joints for pipe with gasketed joints.

1. Before assembling pipe joints:

a. Clean gasket, bell, especially the groove, and the spigot with a rag, brush, or paper towel to remove any dirt or foreign material.

b. Use only gaskets which are designed for and supplied with the pipe.

c. Insert gaskets as recommended by the manufacturer.

1) Prior to placing the gasket in the spigot groove of the pipe, lubricate the gasket in accordance with pipe manufacturer's recommendations.

2) After rubber gasket is placed in the spigot groove, equalize rubber gasket cross section by inserting a tool or bar such as a large screwdriver under the rubber gasket and moving it around the periphery of the pipe spigot.

d. Lubricate spigot end of pipe as recommended by the manufacturer.

E. Joints for pipe with gasketed joints.

1. Before assembling pipe joints:

a. Clean gasket, bell, especially the groove, and the spigot with a rag, brush, or paper towel to remove any dirt or foreign material.

b. Use only gaskets which are designed for and supplied with the pipe.

c. Insert gaskets in accordance with AWWA C604 or as approved by COR.

d. Lubricate spigot end of pipe as recommended by the manufacturer.

2. Joining pipe:

a. In accordance with AWWA C604.

b. Verify inside joint gap meets manufacturer's tolerances as the work progresses.

F. Joints for pipe with welded joints.

1. In accordance with AWWA C 206.

G. Changes in alignment and grade.

1. Where shown on the drawings, make changes in alignment and grade with miter bends.
    a. Encase or block miter bends as shown on the drawings.
2. Make other changes in alignment and grade by providing small deflections between adjacent pipe. Do not exceed manufacturer's deflection tolerances.

H. Blocking and Anchors:

1. Block as shown on drawings.
    a. Other methods of restraint may be used as approved by the COR.

I. Connections at Structures and Encasements:

1. Where steel line pipe adjoins a concrete structure or is fully encased in concrete, except at concrete collars and air valve and blowoff encasements, provide a rubber gasket joint at or adjacent to the nearest face of such structure or encasement.
    a. Maximum distance from pipe joint to concrete face:
        1) One half pipe diameter.

J. Closure Sections: As approved.

K. After pipelaying and joining operations are completed, clean inside of pipe and remove debris. When pipelaying is not in progress, keep ends of pipelines closed.

L. Schedule work so that at no time will pipe remain in the trench more than 7 days before backfill is placed to original ground surface or to other specified backfill limits shown on the drawings.

3.03 TOLERANCES

A. Lay pipe to lines and grades shown on drawings or established by the COR to the following tolerances:

1. Departure from and return to established alignment and grade, maximum: 1/16-inch per foot of pipe.
2. Total departure from established alignment and grade, maximum: 1-inch.

3.04 JOINT LINING AND COATING

A. Field joints for pipe with shop applied cement-mortar lining:

1. Line field joints with cement-mortar in accordance with AWWA C205.
2. Coat exterior joints as specified in Section 09 96 20 – Coatings.
3. Do not backfill field joints until coating is approved by the COR.

B. Apply shrink sleeves to field joints in accordance with Section 09 96 20 – Coatings.

3.05 BACKFILL

A. Backfill pipe in accordance with Section 31 23 22 - Pipe Trench Earthwork.

1. Place backfill about pipe carefully to avoid lateral displacement of the pipe and damage to joints.
2. In certain pipeline reaches, where determined necessary by the COR to prevent the possibility of flotation, do not lay more than 300 linear feet of pipe ahead of backfilling operations.
3. If pipelaying operations are interrupted for more than 24 hours, cover pipe laid in the trench with backfill.

3.06 PIPE DEFLECTION

A. Allowable vertical pipe diameter deflection after backfilling is complete.

1. Decrease, maximum: 2 percent of nominal pipe diameter.
2. Elongation, maximum: 3 percent of nominal pipe diameter.

B. Within 2 weeks after backfilling is completed, take measurements of internal diameters.

C. Measurement Frequency:

1. One pipe unit out of three for the first 30 units laid and one pipe unit out of ten thereafter.
2. In areas of deep burial or where special problems are encountered, the frequency of measurements may be increased at the discretion of the COR.

D. Measurements:

1. Measure vertical and horizontal diameter at approximate midpoint of pipe unit.
2. Record pipe deflections and station where measurements were taken.
3. Mark inside of pipe so that future comparisons can be made.

E. If a pipe unit deflection exceeds the allowable.

1. Take measurements in adjacent pipe units to determine extent of excessive deflection.
2. Provide deflection data to the COR.
3. Additional direction will be provided to the Contractor after deflection data is analyzed.

END OF SECTION

SECTION 33 11 12

PVC PRESSURE PIPE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Measurement and Payment: In accordance with Section 33 11 10 – Pipeline General Requirements.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A36 / A36M - 12	Carbon Structural Steel
2.	ASTM A283 / A283M - 12	Low and Intermediate Tensile Strength Carbon Steel Plates
3.	ASTM E 165/E 165M - 12	Liquid Penetrant Examination for General Industry.
4.	ASTM E709-08	Magnetic Particle Testing

B. American Welding Society (AWS)

1.	AWS D1.1/D1.1M - 10	Structural Welding Code - Steel

C. American Water Works Association (AWWA)

1.	AWWA C104-08	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
2.	AWWA C110-12	Ductile-Iron and Gray-Iron Fittings for Water
3.	AWWA C153-11	Ductile-Iron Compact Fittings for Water Service
4.	AWWA C205-12	Cement-Mortar Protective Lining and Coating for Steel Water Pipe – 4 in. (100 mm) and Larger – Shop Applied
5.	AWWA C900-07	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. Through 12 in. (100 mm Through 300 mm), for Water Distribution
6.	AWWA C905-10	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 in. Through 48 in. (350 mm Through 1,200 mm), for Water Distribution

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 33 11 12-1, Shop Drawings:

1. Show fitting fabrication details.

2. Show exact dimensions of joints, and diameter of rubber gasket including tolerances, other major dimensions, proposed restraint.

1.04 QUALIFICATIONS

A. Qualify welding procedures and welders in accordance with AWS D1.1.

B. Pipelaying Workers: Skilled and experienced in laying pipe with type of joint being furnished.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prevent damage to PVC pipe during loading, transporting, unloading, storing, and laying.

B. Maintaining circularity of pipe.

1. Before shipping, install internal supports in pipe to maintain circularity.

2. Supports:

a. Two members at 90 degrees to each other.

b. Minimum member cross section: Nominal 2- by 4-inch.

3. Place supports at 5 feet from ends of each pipe section.

4. Orient support legs in same axis along pipe centerline.

C. Transport coated fittings with padded bolsters between the pipes. Use heavy padding under ties.

D. Provide sun protection for PVC pipe that is stored outside.

1. At a minimum, wrap pipe in an adequately fastened opaque covering.

a. In warm climates, allow air circulation through and around the pipe by puncturing or cutting the covering in the area of the pipe ends.

E. Support and store pipe above ground surface. Do not allow bells and spigots to contact each other or the ground.

F. Replace pipe that is damaged, at the Contractor's expense.

PART 2 PRODUCTS

2.01 PIPE

A. PVC Pressure Pipe: AWWA C900 and AWWA C905, elastomeric joint only.

1. Nominal laying length: 20 feet.

B. Rubber Gaskets: Manufactured and tested in accordance with AWWA C900 and AWWA C905.

1. Gasket and Lubricant: Approved for potable water use.

2.02 FITTINGS

A. Tees, crosses, adaptors, couplings, bends, and connections at structures and encasements: As shown on drawings, except that fusion-epoxy lining and coating may be used on steel fittings in lieu of mortar lining and coating shown on drawings.

B. Fittings:

1. Steel Fittings:

a. Steel for fittings: ASTM A 283, grade C or D or ASTM A 36.

b. Minimum steel wall thickness: 0.25 or thickness required to meet pipe classification shown on the plan and profile, whichever is greater.

c. Welding:

1) AWS D1.1.

2) Temporary or permanent welding for convenience of the Contractor: Not permitted on areas where welding will damage fusion-epoxy lining and coating.

3) Lifting eyes and other handling devices: Made part of fitting before lining and coating are applied.

d. Coatings and Linings: In accordance with Section 09 96 20 - Coatings.

2. Ductile iron fittings may be used if approved by COR.

a. Plan, profile and restraint system shown on drawings may require modification if ductile iron fittings are used.

b. AWWA C110 or AWWA C153.

c. Coatings and lining: Refer to Section 09 96 20 – Coatings.

3. Joints between steel or ductile iron fittings and PVC pressure pipe:

a. Joint dimensions and tolerances: Same as PVC pipe manufacturer's joint design.

2.03 CONCRETE

A. Concrete in encasements, blocking and collars: Section 03 30 00 - Cast-In-Place Concrete.

2.04 CONTRACTOR SOURCE QUALITY TESTING

A. Steel Fittings:

1. Testing:

a. Hydrostatic test fittings fabricated from steel plate.

1) Hydrostatic test for pipe and fittings: Perform shop hydrostatic test on pipe which stresses steel to 75 percent of minimum yield point of the steel.

2) Hold pressure long enough to allow through inspection welded joints.

3) Repair leaks by rewelding and retesting of joints.

b. Fittings fabricated from tested steel pipe do not require hydrostatic testing if girth butt welds are complete penetration welds.

1) Girth weld test: Dye penetrant test in accordance with ASTM E 165 or Magnetic Particle in accordance with ASTM E709.

2) Repair weld defect: Chip, flame gouge, or grind to sound metal; reweld resulting cavities; and retest.

B. Ductile Iron Fittings:

1. Test in accordance with AWWA C110, and AWWA C153.

2.05 SOURCE QUALITY ASSURANCE

A. Approval for Shipment:

1. Pipe approval will be determined by inspection, during and after manufacture, to determine whether pipe conforms to these specifications, AWWA C905.

2. Notify the Technical Service Center, Attn: 86-68140, at least 14 days before manufacturing pipe and 72 hours before shipping pipe.

3. The Government will inspect pipe units and will approve for shipment those which have been manufactured and tested in accordance with these specifications, unless the Contractor is notified in writing.

4. Further inspection of pipe units will be in accordance with the clause at FAR 52.246-12 "Inspection of Construction."

PART 3 EXECUTION

3.01 LAYING PIPE

A. Keep pipe trenches free of water during pipelaying operations.

B. Excavate pipe trench in accordance with Section 31 23 22 - Pipe Trench Earthwork.

1. Grade pipe trenches to provide uniform slope along bottom of pipe.
2. At joints involving bells or collars, provide holes at joint of ample size to prevent bells or collars from coming in contact with subgrade.
3. Lower pipe into the trench and place pipe in position such that no soil gets inside the pipe and pipe is not damaged.

C. On grades exceeding 10 percent, lay pipe uphill.

D. Before assembling pipe joints.

1. Clean gasket, bell or coupling interior, especially the groove, except when the gasket is permanently installed, and the spigot with a rag, brush, or paper towel to remove any dirt or foreign material.
2. When gaskets are separate, use only gaskets which are designed for and supplied with the pipe, and insert the gaskets as recommended by the manufacturer.
3. Apply lubricant as specified by pipe manufacturer:
    a. Use only lubricant supplied by the pipe manufacturer.
    b. Lubricate spigot end of pipe as recommended by the manufacturer.
    c. Do not lubricate either the gasket or the gasket groove in bells where gaskets are field installed.
    d. Lubricate factory-installed, nonremovable-type gaskets only if recommended by the pipe manufacturer.

E. Joining Pipe:

1. Join pipe in accordance with AWWA C605 or as directed by the COR.
2. Maintain circularity of pipe:
    a. Place pipe so that one support is approximately horizontal.
3. Align spigot to bell, and insert spigot into bell until spigot contacts gasket uniformly.
4. Apply firm, steady pressure either by hand or by using bar and block until spigot easily slips through gasket.
    a. Mechanical equipment such as come-alongs may also be used to join pipe.
    b. Do not damage pipe during joint assembly.
5. Push spigot until reference mark on spigot end is flush with bell end.
    a. Spigot end of pipe: Marked by manufacturer to indicate proper depth of insertion.

6. If adjustment of the position of a length of pipe is required after installation, remove and relay the length of pipe as for a new pipe.

F. Changes in Alignment and Grade:

1. Where shown as miter bends on drawings, make changes in alignment and grade with steel miter bends.

2. Encase or block miter bends as shown on drawings.

3. Do not encase rubber gasket joints in concrete.

4. Make other changes in alignment and grade by providing deflections at joints.

a. Maximum deflection: 1 degree or deflection recommended by pipe manufacturer, whichever is less.

5. Longitudinal bending of pipe to obtain deflection: Not permitted.

6. Other methods of providing curves in pipelines may be submitted; and if approved, use these methods to install curves at no additional cost to the Government.

a. Methods of providing curves in pipelines which incorporate rubber gasket joints encased in concrete will not be approved.

G. Connections at Structures and Encasements:

1. Where PVC line pipe adjoins a concrete structure or is fully encased in concrete, except at concrete collars and air valve and blowoff encasements, provide a rubber gasket mechanical joint at or adjacent to the nearest face of such structure or encasement.

a. Maximum distance from pipe joint to concrete face:

1) One-half pipe diameter.

H. Connections Between PVC Pressure Pipe and Other Types of Pipe:

1. Use rubber gasket mechanical joints to make connections between PVC pressure pipe and other types of pipe.

I. After pipelaying and joining operations are completed, clean inside of pipe and remove debris. When pipelaying is not in progress, keep ends of pipelines closed.

J. Schedule work so that at no time will pipe remain in the trench more than 7 days before backfill is placed to original ground surface or to other specified backfill limits shown on drawings.

K. Blocking:

1. Block as shown on drawings.

a. Other methods of restraint, as proposed by the contractor, may be used as approved by the COR. Address cathodic protection. Coat in accordance with 09 96 20 – Coatings.

L. Backfill pipe in accordance with Section 31 23 22- Pipe Trench Earthwork.

1. Place backfill about pipe carefully to avoid lateral displacement of the pipe and damage to joints.

2. In certain pipeline reaches, where determined necessary by the COR to prevent the possibility of flotation, do not lay more than 300 linear feet of pipe ahead of backfilling operations.

3. If pipelaying operations are interrupted for more than 24 hours, cover pipe laid in the trench with backfill.

3.02 TOLERANCES

A. Lay pipe to lines and grades shown on drawings or established by the COR to the following tolerances:

1. Departure from and return to established alignment and grade, maximum: 1/16-inch per foot of pipe.

2. Total departure from established alignment and grade, maximum: 1-inch.

END OF SECTION

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SECTION 33 11 13

DUCTILE IRON PIPE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Measurement and Payment: In accordance with Section 33 11 10 – Pipeline General Requirements.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME B 18.2.1-2010	Square, Hex, Heavy Hex, And Askew Head Bolts And Hex, Heavy Hex, Hex Flange, Lobed Head, And Lag Screws (Inch Series)

B. ASTM International (ASTM)

1.	ASTM A 36 / A 36M - 12	Carbon Structural Steel
2.	ASTM A 283 / A 283M-12	Low and Intermediate Tensile Strength Carbon Steel Plates
3.	ASTM E 165 /E 165M - 12	Liquid Penetrant Examination

C. American Welding Society (AWS)

1.	AWS D1.1/D1.1M - 10	Structural Welding Code - Steel

D. American Water Works Association (AWWA)

1.	AWWA C104-08	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
2.	AWWA C110-12	Ductile-Iron and Gray-Iron Fittings for Water
3.	AWWA C111-12	Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
4.	AWWA C151-09	Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
5.	AWWA C153-11	Ductile-Iron Compact Fittings for Water Service

E. Federal Specifications (FS):

1.	FS FF-N-836 E	Nut: Square, Hexagon, Cap, Slotted, Castle Knurled, Welding and Single Ball Seat

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

1. Required when ductile iron pipe used.

A. RSN 33 11 13-1, Shop Drawings:

1. Show fitting fabrication details.
2. Show exact dimensions of joints, and diameter of rubber gasket including tolerances, other major dimensions, proposed restraint.

1.02 QUALIFICATIONS

A. Qualify welding procedures and welders in accordance with AWS D1.1.

B. Pipelaying Workers: Skilled and experienced in laying pipe with type of joint being furnished.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Prevent damage to pipe and fittings during loading, transporting, unloading, storing, and laying.

B. Transport pipe and fittings on padded bolsters curved to fit the outside of the pipes. Use heavy padding under ties.

C. Support and store pipe above ground surface. Do not allow bells and spigots to contact each other or the ground.

D. Replace or repair, as approved by the COR, any pipe that is damaged during shipment, storage, or installation at the Contractor's expense.

PART 2 PRODUCTS

2.01 PIPE

A. Ductile Iron Pipe: AWWA C 151.

1. Nominal laying length: 20 feet.

B. For allowable pipe size and classes refer to Section 33 11 10 – Pipeline General Requirements.

C. Rubber Gaskets: AWWA C111.

1. Lubricant:
   a. Recommended by pipe manufacturer.
   b. Approved for potable water use.

D. Coatings and Linings in accordance with Section 09 96 20 - Coatings.

2.02 FITTINGS

A. Tees, bends, adapters, and connections at structures and encasements: As shown on drawings.

B. Fittings: Steel or ductile iron.

1. Steel Fittings:
    a. Steel for fittings: ASTM A 283, grade C or D or ASTM A 36.
    b. Minimum steel wall thickness: 0.25 or thickness required to meet pipe classification shown on the plan and profile, whichever is greater.
    c. Welding:
        1) AWS D1.1.
        2) Lifting eyes and other handling devices: Made part of fitting before lining and coating are applied.
    d. Bolts and nuts: ASME B 18.2.1 and FS FF-N-836.
    e. Coating and lining in accordance with Section 09 96 20 - Coatings.
    f. Joints between fittings and ductile iron pipe:
        1) Rubber gasket joints.
        2) Joint dimensions and tolerances: Same as pipe manufacturer's joint design.
    g. Miter Bends:
        1) Fabricate steel bends as shown on drawings.
    h. Closure Section Joints:
        1) Sleeve Coupling.
2. Ductile Iron Fittings:
    a. AWWA C110 or AWWA C153.
    b. Coatings and lining: Refer to Section 09 96 20 – Coatings.
    c. For straight fittings.
    d. Plan, profile and restraint system shown on drawings shall require modification if ductile iron fittings are used.
3. Joints between fittings and ductile iron pipe:
    a. Rubber gasket joints.
    b. Joint dimensions and tolerances: Same as pipe manufacturer's joint design.

2.03 CONCRETE

A. Concrete in encasements, blocking and collars: Section 03 30 00 - Cast-In-Place Concrete.

2.04 CONTRACTOR SOURCE QUALITY TESTING

A. Ductile Iron Pipe: AWWA C151.

B. Steel Fittings:

1. Testing:

a. Hydrostatic test fittings fabricated from steel plate.

1) Perform shop hydrostatic test on pipe which stresses steel to 75 percent of minimum yield point of the steel.

2) Hold pressure long enough to allow through inspection welded joints.

3) Repair leaks by rewelding and retesting of joints.

b. Fittings fabricated from tested steel pipe do not require hydrostatic testing if girth butt welds are complete penetration welds.

1) Girth weld test: Dye penetrant test in accordance with ASTM E 165 or Magnetic Particle in accordance with ASTM E 709.

2) Weld defect repair. Chip, flame gouge, or grind to sound metal; reweld; and test the repaired weld.

C. Ductile Iron Fittings:

1. Test in accordance with AWWA C110, and AWWA C153.

2.05 SOURCE QUALITY ASSURANCE

A. Approval for Shipment:

1. Pipe and fitting approval will be determined by inspection, during and after manufacture.

2. Notify the Technical Service Center, Attn: 86-68140, and COR at least 14 days before manufacturing pipe and fittings and 3 days before shipping pipe and fittings.

3. The Government will inspect pipe units and fittings and will approve for shipment those which have been manufactured and tested in accordance with these specifications, unless the Contractor is notified in writing.

4. Further inspection of pipe units and fittings will be in accordance with the clause entitled "Inspection of Construction."

PART 3 EXECUTION

3.01 LAYING PIPE

A. Excavate pipe trench in accordance with Section 31 23 22 - Pipe Trench Earthwork.

1. Grade pipe trenches to provide uniform slope along bottom of pipe.
2. At joints involving bells or collars, provide holes at joint of ample size to prevent bells or collars from coming in contact with subgrade.

B. Keep pipe trenches free of water during pipelaying operations.

C. Lower pipe into the trench and place pipe in position such that no soil gets inside the pipe and pipe is not damaged.

D. On grades exceeding 10 percent, lay pipe uphill.

E. When pipelaying is not in progress, keep ends of pipelines closed.

F. Joining Pipe:

1. Before assembling pipe joints, clean all parts with a rag, brush, or paper towel to remove any dirt or foreign material.
2. Assemble push-on or mechanical joints in accordance with AWWA C111 and the manufacturer's recommendations.
3. If adjustment of the position of a length of pipe is required after installation, remove and relay the length of pipe as for a new pipe.
4. Maintain pipe firmly in final position.

G. Changes in Alignment and Grade:

1. Where shown on drawings, make changes in alignment and grade with steel miter bend encased in concrete as shown on drawings, or
2. Make other changes in alignment and grade by providing deflections at joints.
    a. Maximum deflection angle between adjacent pipe sections as shown in Table 31 11 13B. – Maximum Deflection Angle Between Adjacent Pipe Sections.

Table 31 11 13B. – Maximum Deflection Angle Between Adjacent Pipe Sections

Push-on Joint	
Pipe Size, inches	Deflection Angle, degrees*
36	3
30	3
12	3

* Or manufacturers recommendation whichever is less.

H. Blocking and Anchors:

1. Block and anchor as shown on drawings.

a. Other methods of restraint, as proposed by the contractor, may be used as approved by the COR.

I. Connections at Structures and Encasements:

1. Where ductile iron pipe adjoins a concrete structure or is fully encased in concrete, except at concrete collars and air valve and blowoff encasements provide flexible joint.

2. Maximum distance from pipe joint to concrete face: D/2 inches.

J. Connections to Other Types of Pipe:

1. Use rubber gasket joints to make connections between ductile iron pipe and other types of pipe.

K. Backfill pipe in accordance with Section 31 23 22 - Pipe Trench Earthwork.

L. After pipelaying and joining operations are completed, clean inside of pipe and remove debris. When pipelaying is not in progress, keep ends of pipelines closed.

3.02 TOLERANCES

A. Lay pipe to lines and grades shown on drawings or established by the COR to the following tolerances:

1. Departure from and return to established alignment and grade, maximum: 1/16-inch per foot of pipe.

2. Total departure from established alignment and grade, maximum: 1-inch.

3.03 PIPE DEFLECTION

A. Allowable vertical pipe diameter deflection after backfilling is complete.

1. Decrease, maximum: 2 percent of nominal pipe diameter.
2. Elongation, maximum: 3 percent of nominal pipe diameter.

B. Within 2 weeks after backfilling is completed, take measurements of internal diameters.

C. Measurement Frequency:

1. One pipe unit out of three for the first 30 units laid and one pipe unit out of ten thereafter.
2. In areas of deep burial or where special problems are encountered, the frequency of measurements may be increased at the discretion of the COR.

D. Measurements:

1. Measure vertical and horizontal diameter at approximate midpoint of pipe unit.
2. Record pipe deflections and station where measurements were taken.
3. Mark inside of pipe so that future comparisons can be made.

E. If a pipe unit deflection exceeds the allowable.

1. Take measurements in adjacent pipe units to determine extent of excessive deflection.
2. Provide deflection data to the COR.
3. Additional direction will be provided to the Contractor after deflection data is analyzed.

END OF SECTION

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SECTION 33 11 14

HDPE PRESSURE PIPE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Measurement and Payment: In accordance with Section 33 11 10 – Pipeline General Requirements.

1.02 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME)

1.	ASME B 18.2.1-2010	Square, Hex, Heavy Hex, And Askew Head Boltsand Hex, Heavy Hex, Hex Flange, Lobed Head, And Lag Screws (Inch Series)

B. ASTM International (ASTM)

1.	ASTM A 36 / A 36M - 12	Carbon Structural Steel
2.	ASTM A 283 / A 283M - 03(2007)	Low and Intermediate Tensile Strength Carbon Steel Plates
3.	ASTM D 2657-07	Heat Fusion Joining of Polyolefin Pipe and Fittings
4.	ASTM D 3350-12	Polyethylene Plastics Pipe and Fittings Materials
5.	ASTM E 165/ E16M-12	Liquid Penetrant Examination for General Industry

C. American Water Works Association (AWWA)

1.	AWWA C110-12	Ductile-Iron and Gray-Iron Fittings for Water
2.	AWWA C153-11	Ductile-Iron Compact Fittings for Water Service
3.	AWWA C205-12	Cement-Mortar Protective Lining and Coating for Steel Water Pipe – 4 in. (100 mm) and Larger – Shop Applied
4.	AWWA C906-07	Polyethylene (PE) Pressure Pipe and Fittings, 4 in. (100mm) Through 63 in. (1,575 mm), For Water Distribution and Transmission
5.	AWWA C153-06	Ductile-Iron Compact Fittings for Water Service

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

1. Required when HDPE pressure pipe used.

B. RSN 33 11 14-1, Fitting Details:

1. Provide shop drawings showing major fitting dimensions.

C. RSN 33 11 14-2, Fusion Procedures:

1. Fusion temperature.
2. Interface pressure.
3. Cooling time.
4. Record of pipe size and DR being joined and each joints fusion temperature, interface pressure and cooling time.

1.04 QUALIFICATIONS

A. Operator of fusion machine: Trained and certified in operation of equipment used. Operated fusion machine on three similar projects.

B. Pipelaying Workers: Skilled and experienced in laying HDPE pipe. Laid pipe on three similar projects.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Prevent damage to pipe and fittings during loading, transporting, unloading, storing, and laying.

B. Transport pipe and fittings on padded bolsters curved to fit the outside of the pipes. Use heavy padding under ties.

C. Support and store pipe above ground surface. Do not allow bells and spigots to contact each other or the ground.

D. Replace or repair, as approved by the COR, any pipe that is damaged during shipment, storage, or installation at the Contractor's expense.

PART 2 PRODUCTS

2.01 PIPE

A. HDPE Pressure Pipe: AWWA C 906, except;

1. PE material:
   a. Standard PE code designation: PE 3408.
   b. Minimum cell Classification, ASTM D 3350: PE 345464C, or E.

B. For allowable pipe size and classes, see Table 33 11 10A – Symbol Pipe Nomenclature.

2.02 FITTINGS

A. Tees, tapers, adaptors, couplings, bends, and connections at structures and encasements at locations shown on drawings. Except:

B. Fittings:

1. HDPE fittings: In accordance with AWWA C906. Fittings shown on drawings are for steel fittings. Details may vary if other fittings are used.

a. Material: PE3408.

2.03 CONCRETE

A. Concrete in encasements, blocking and collars: Section 03 33 00 - Cast-In-Place Concrete.

2.04 SOURCE QUALITY CONTROL

A. HDPE Pipe, Miters and Fittings:

1. Test HDPE fittings in accordance with AWWA C906.

PART 3 EXECUTION

3.01 LAYING PIPE

A. Excavate pipe trench in accordance with Section 31 23 22 - Pipe Trench Earthwork.

1. Grade pipe trenches to provide uniform slope along bottom of pipe.
2. At joints involving flanges, provide holes at joint of ample size to prevent flanges from coming in contact with subgrade.
3. Lower pipe into the trench and place pipe in position such that no soil gets inside the pipe and pipe is not damaged.

B. Keep pipe trenches free of water during pipelaying operations.

C. Lower pipe into the trench and place pipe in position such that no soil gets inside the pipe and pipe is not damaged.

D. On grades exceeding 10 percent, lay pipe uphill.

E. When pipelaying is not in progress, keep ends of pipelines closed.

F. Joining Pipe:

1. Make heat fusion joint in accordance with recommendations of ASTM D 2657.

2. Pipe may be joined above ground and then lowered into position, provided pipe is supported and handled in a manner that prevents damage.

3. Connections between HDPE pressure pipe and other types of pipe: Flange joints

4. Saddle fittings: Fusion weld saddle fittings to pipe in accordance with ASTM D 2657.

G. Changes in Alignment and Grade:

1. Where shown on drawings, make changes in alignment and grade over 40 degrees with miter bends.

a. Encasement or blocking of fittings is not required for fused HDPE pipe or flanged connections except at 24+25.94 (after the casing pipe).

b. Use fabricated miter bend.

2. Make other changes in alignment and grade by bending pipe.

a. Minimum cold (field) bend radius shown in Table 33 14 11A – Minimum Cold Bending Radius.

Table 33 11 14A – Minimum Cold Bending Radius

Pipe DR	Minimum Cold Bending Radius
>21	30 times pipe OD
Filling or flange present or to be installed in bend	100 times pipe OD

H. Connections at Structures and Encasements:

1. Locate flange connection within 20 feet of the face of structure.

2. Suitably block flange connection to prevent pipe movement due to temperature changes.

I. Backfill pipe in accordance with Section 31 23 22 - Pipe Trench Earthwork.

J. After pipelaying and joining operations are completed, clean inside of pipe and remove debris. When pipelaying is not in progress, keep ends of pipelines closed.

3.02 TOLERANCES

A. Lay pipe to lines and grades shown on drawings or established by the COR to the following tolerances:

1. Departure from and return to established alignment and grade, maximum: 1/16-inch per foot of pipe.

2. Total departure from established alignment and grade, maximum: 1-inch.

END OF SECTION

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SECTION 33 11 16
SITE WATER UTILITY PIPING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Site Water Utility Distribution Piping:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A 240/A 240M-13a	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
2.	ASTM C 33/C 33M-13	Concrete Aggregates
3.	ASTM D 882-12	Tensile Properties of thin Plastic Sheeting
4.	ASTM D 1784-11	Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
5.	ASTM D 1785-12	Rigid Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80 and 120
6.	ASTM D 2103-10	Polyethylene Film and Sheeting
7.	ASTM D 2467-13	Rigid Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
8.	ASTM D 2564-12	Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
9.	ASTM D 2672-96a(2009)	Joints for IPS PVC Pipe Using Solvent Cement
10.	ASTM F 656-10	Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings

B. American Water Works Association (AWWA)

1.	AWWA C605-05	Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water

1.03 SYSTEM DESCRIPTION

A. This specification section covers three types of pipelines:

1. Sump pump discharge lines from the air chamber lift station, valve vaults, and flow meter vaults.
2. Water supply to Chlorine Feed Building.
3. Gravity drain from retaining wall gravel drain pipe.

B. The sump pump discharge lines convey water pumped from the air chamber sump lift station, valve vaults, and flow meter vaults to the site drainage channel through new 2-inch polyvinyl chloride (PVC) pipelines.

C. The water supply pipe conveys domestic water from the connection to the plant discharge manifolds located in the pumping plant building to the Chlorine Feed Building through a 2-inch PVC pipeline.

D. The retaining wall gravel drain conveys water collected behind the retaining wall to the site drainage channel through a 4-inch PVC pipeline.

E. Pipe connection locations are shown on the following drawings.

1. The Air chamber sump lift station: 1695-D-260.
2. Chlorine Injection Vault 1: 1695-D-168.
3. Valve Vault 1: 1695-D-168.
4. Flow Meter Vault No. 1: 1695-D-168.
5. Flow Meter Vault No. 2: 1695-D-168.
6. Water supply to the Chlorine Feed Building: 1695-D-264.
7. Retaining wall gravel drain: 1695-D-103.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 33 11 16-1, Pipe Layout Drawings:

1. Contractor’s Drawings of piping covered by this specification.
2. Plan view drawing showing dimensions and distances of all system components including pipe penetrations through structures.
3. Profile view drawing showing elevations, centerlines and depth of cover.

C. RSN 33 11 16-2, Product Approval Data:

1. Shipping, handling and installation procedures.
2. Manufacturers name, commercial products data and drawings, illustrations and dimensions for all pipe, fittings, and components.

D. RSN 33 11 16-3, Final Data:

1. As-built drawings.
2. Test reports:
    a. Pressure leak test.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle equipment and components in accordance with manufacturer's recommendations to prevent damage.

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS

A. Polyvinyl Chloride Pipe, Schedule 80, 4-inch and less.
    1. ASTM D 1785.
    2. End Style: Socket solvent cement.

B. PVC Extruded or Injection-Molded Pressure Fittings:
    1. ASTM D 2467.
    2. Pressure rating equal to pipe.

C. Solvent cement ASTM D 2564.

D. Primer ASTM F 656.

E. Metallic Warning Tape:
    1. Compliant with ASTM D 882 and ASTM D 2103.
    2. Standard 6-inch wide, commercial quality, detectable underground warning tape.
    3. Continuous tape with message "Caution Buried Waterline Below."
    4. Color: Blue.

2.02 COMPONENTS

A. Four-Way Expansion Joint:
    1. Model Redflex D-30 manufactured by Red Valve Company, Incorporated, 700 North Bell Avenue, Carnegie, PA, 15106; or equal, having the following essential characteristics:
        a. Compatible with the pipe material and fittings.
        b. Molded double arch design, neoprene elastomers or similar.
        c. Suitable for the line pressures up to 225 pounds per square inch (lb/in^2).
        d. Manufacturer's standard coating system.

2.03 OUTFALL SCREEN

A. Stainless Steel Wire Cloth:

1. Stainless steel, ASTM A 240, Type 304 or 316.
2. Mesh openings per linear inch: 4 by 4.
3. Wire diameter, minimum: .080 inches.

B. Bands for Screen:

1. Stainless steel: ASTM A 240, Type 304 or 316.
2. Thickness, minimum: 10 gauge.
3. Width, minimum: 1/2-inch.

2.04 PIPE BEDDING

A. ASTM C 33, coarse sand 100 percent passing 3/8-inch screen and 95 percent passing No. 4 screen.

2.05 PIPE TRENCH BACKFILL

A. Per Section 31 23 02 – Compacting Earth Materials.

PART 3 EXECUTION

3.01 INSTALLATION

A. Laying of Pipe:

1. Install water pipes in conformity to the approved design plan and in coordination with the COR.
2. Clean each section of pipe and each fitting before installation.
3. Lower pipe and fittings into the trench preventing damage to pipe. Use approved slings when required.
4. Lay pipe true and uniform to line and grade, with no visible change in alignment at any joint unless curved alignment is called for on the plans.
    a. If deflection is required, maximum deflection must not exceed the manufacturer's recommendation for the type of pipe and joint being used.
5. Whenever pipe laying is discontinued for an hour or more, close open ends of pipe with water-tight plugs.
6. Pipe shall not be laid when the condition of the trench or the weather is unsuitable or when there is the possibility of foreign material entering the pipe.

B. Joining Methods:

1. Solvent cement pipe sections in accordance with ASTM D 2467, ASTM D 2672, and ASTM D 3139.
2. PVC male threaded adapters for connections to metallic piping.

C. Slope sump pump discharge lines from structure to daylight above concrete liner of site drainage channel. Slope shall be 0.015 minimum.

D. Install water supply pipe with 42-inch minimum cover including gravel surfacing.

E. Slope solid PVC pipe from connection to perforated PVC pipe of retaining wall gravel drain to daylight above concrete liner of site drainage channel. Slope shall be 0.015 minimum.

F. Install sump discharge and gravity drain piping to discharge downward into the site drainage channel in the drainage flow direction.

G. Install stainless steel metal cloth on open ends of pipes at site drainage channel.

3.02 EARTHWORK AND TRENCHES

A. Pipe Bedding and Backfill:

1. Minimum 4 inches below pipe and 6 inches above.
2. Place initial fill in even layers not exceeding 4 inches in depth and hand tamped to the spring line of the pipe, before proceeding to next layer.
3. Place backfill in even layers not exceeding 6 inches in depth and compacted, before proceeding to next layer.

B. Metallic Detectable Warning Tape:

1. Lay continuous metallic warning tape above runs of nonmetallic pipe to facilitate locating the pipe at a later date.

3.03 COMPONENTS

A. Expansion Joint:

1. Install on Water Supply Pipeline within two feet of buildings.
2. Install on sump pump discharges within two feet of structure.

3.04 CONTRACTOR FIELD QUALITY TESTING

A. Test PVC pressure pipe 3 inches and less in diameter by the following:

1. Furnish testing equipment, as approved by COR, which provides observable and accurate measurements of leakage under specified conditions.
2. Maximum Filling Velocity: 0.25-foot per second calculated based on full area of pipe.

3. Expel air from piping system during filling.

4. Test pressure: 150 percent of system operating pressure based on pressure as measured at the lowest point on the line. Maximum test pressure not to exceed 225 pounds per square inch. Test pressure for some segments may be reduced, subject to COR approval.

5. Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.

6. Maintain hydrostatic test pressure continuously for 2 hours minimum.

7. Maximum Allowable Leakage: None.

3.05 DISINFECTION OF WATER SUPPLY LINE

A. Disinfect water supply line per Section 22 11 10 – Plant Auxiliary Water Systems.

END OF SECTION

SECTION 33 12 73

HORIZONTAL CENTRIFUGAL PUMPING UNITS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Two (2) - Horizontal Centrifugal Pumping Units:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American Bearing Manufacturers Association (ABMA)

1.	ABMA 9-1990 (R2008)	Load Ratings and Fatigue Life for Ball Bearings
2.	ABMA 11-1990 (R2008)	Load Ratings and Fatigue Life for Roller Bearings

B. American Society of Civil Engineers (ASCE)

1.	ASCE 7-10	Minimum Design Loads for Buildings and Other Structures

C. American Society of Mechanical Engineers (ASME)

1.	ASME BPVC-IX-2013	Boiler and Pressure Vessel Code - Section IX - Welding and Brazing Qualifications
2.	ASME B46.1-2009	Surface Texture

D. ASTM International (ASTM)

1.	ASTM A 29/A 29M-12	Steel Bar, Carbon and Alloy, Hot-Wrought General Requirements for
2.	ASTM A 108/A 108M-07	Steel Bar, Carbon and Alloy, Cold-Finished
3.	ASTM A 536-84 (R2009)	Ductile Iron Castings
4.	ASTM A 48/A 48M-03(2012)	Gray Iron Castings
5.	ASTM B 148-97(2009)	Aluminum-Bronze Sand Castings
6.	ASTM B 505/B 505M-12A	Copper Alloy Continuous Castings

E. American Welding Society (AWS)

1.	AWS D1.1/D1.1 M-10	Structural Welding Code - Steel

F. American Water Works Association (AWWA)

1. AWWA C207-13	Steel Pipe Flanges for Waterworks Service, Sizes 4 in. Through 144 in. (100 mm Through 3,600 mm)

G. Hydraulic Institute Standards (HI)

1. HI 1.1-1.2-2008	Rotodynamic (Centrifugal) Pumps - Nomenclature and Definitions
2. HI 1.3- 2009	Rotodynamic (Centrifugal) Pumps – Design and Application
3. HI 1.4-2010	Rotodynamic (Centrifugal) Pumps – Installation, Operation and Maintenance
4. HI 1.6-2000	Centrifugal Pump Tests
5. HI 9.6.4-2009	Centrifugal and Vertical Pumps – Vibration Measurements and Allowable Values
6. HI 9.8-2012	Intake Design for Rotodynamic Pumps

H. Institute of Electrical And Electronics Engineers (IEEE)

1. IEEE 43-2000	Recommended Practice for Testing Insulation Resistance of Rotating Machinery
2. IEEE 112-2004	Test Procedure for Polyphase Induction Motors and Generators

I. International Standard Organization (ISO)

1. ISO 1940/1-2003	Mechanical Vibration

J. Military Specifications (MIL)

1. MIL-PRF-907F	Anti-seize Thread Compound, High Temperature

K. National Electrical Manufacturers Association (NEMA)

1. NEMA MG 1-2011	Motors and Generators (Includes Errata 2012)

1.03 DEFINITIONS

A. Pumping unit: Pump and motor.

B. NPSHA: Net Positive Suction Head Available.

C. NPSHR: Net Positive Suction Head Required.

D. RTD: Resistance Temperature Device.

1.04 SYSTEM DESCRIPTION

A. Background:

1. Tohlakai Pumping Plant is part of a large project that will be expanded over the next 20 years. The pumps described in this specification are going to be part of the first of 3 phases for the project. The phases are shown in Table 31 12 73A – Pump Phases. These specifications only covers Phase 1 of the project.

Table 31 12 73A – Pump Phases

	Reach 12.1/12.2		Reach 12b/13	
	Pumps (1-3)	Total Flow	Pumps (4-7)	Total Flow
Phase 1: Interim Demand	Unit 1 – 2.00 cfs Unit 2 – 2.00 cfs	2.00 cfs	N/A	N/A (gravity)
Phase 2: 2020 Demand	Unit 1 – 2.00 cfs Unit 2 – 6.35 cfs	8.35 cfs	Unit 1 – 7.39 cfs Unit 2 – 7.39 cfs Unit 3 – 7.39 cfs Unit 4*	22.16 cfs
Phase 3: 2040 Demand	Unit 1 - 2.00 cfs Unit 2 – 6.35 cfs Unit 3 – 6.35 cfs	14.70 cfs	Unit 1 – 7.39 cfs Unit 2 – 7.39 cfs Unit 3 – 7.39 cfs Unit 4*	22.16 cfs

Notes: Unit 2 for phase 1 is a redundant pump which will be replaced in phase 2. The 12b/13 Unit 4 pump will be an installed spare.
*Unit 4 bay is for a future spare pump of equal size and capacity.

B. Design Requirements:

1. Horizontal-shaft, split-case, single-stage, double-suction centrifugal type pump, complete with accessories, piping, anchor bolt assemblies, tools, and spare parts, suitable for direct connection through a flexible coupling to a horizontal induction motor.

2. Design and construct pump in accordance with these specifications and HI 1.1 - 1.4, 9.4 and 9.8.

3. Mount pump and motor on a common baseplate supplied by the pump manufacturer.

4. Pump and motor assembled on common baseplate, shown on drawing 1695-D-218.

5. Weight of pump unit rotating parts, including unbalanced hydraulic thrust of impeller, carried by the pump bearing.

6. Direction of rotation of the pumping unit, when facing the motor end of the pump, to be as listed in Table 33 12 73B – Performance Requirements.

7. Pumping unit to be suitable for indoor operation at elevation of 6,694 feet and with an ambient temperature of 104 degrees Fahrenheit.

8. Design the pump to operate safely at maximum reverse runaway speed due to water returning through the pump when power to the motor is interrupted and the check valve fails to close. Determine maximum runaway speed using the maximum head listed in Table 33 12 73B - Performance Requirements.

9. Design the pump to ensure the natural frequency of vibration (reed frequency) of combined discharge head assembly and motor after installation is at least 10 percent greater than pump operating speed or maximum runaway speed, whichever is greater.

    a. If, after installation, the pumping unit does not meet this requirement, modify the discharge pipe support structure to meet this requirement.

    b. Plans for modification to be reviewed and approved by the Government before implementation.

    c. Use of frequency adjusting devices (such as washers and dampers) between the discharge head assembly and motor is not permitted.

10. Normal operating conditions:

    a. Soft starting of the unit will be controlled from a control device in the control cabinet.

    b. Design pump to start and stop against a closed discharge valve with discharge line full of water and to operate satisfactorily over the expected range of total heads. This is an unlikely operating scenario during start-up, but the design should be capable of operating at the full range of heads for shut-down.

    c. Under normal shutdown conditions, the butterfly discharge valve will close, at which time power to the pump motor will be interrupted after the discharge valve is fully closed.

    d. Under emergency shutdown or power failure conditions, power to the motor will be interrupted prior to closure of the butterfly valve and closure of the check valve will prevent reverse flow through the pump.

    e. Initial filling of the discharge line will be accomplished by using the filling line equipped with a butterfly valves and orifice plates.

11. Finish of pump parts not to exceed the following maximum surface roughness in accordance with ASME B46.1, “Surface Texture”:

    a. Impeller:

	1)	Outside, finish all over concentric with axis	125
	2)	Water passages	63
b.	Shafts:		
	1)	Exposed	63
	2)	Journal	32
c.	Wearing rings:		
	1)	Clearance surface	63
	2)	All other	125
d.	Split Face and Casing Flange		
	1)	All flange surfaces	125
e.	Grooves for O-rings:		
	1)	Stationary parts	125
	2)	Relative motion parts	63

12. Pumping units shall be seismically restrained to meet ASCE 7 Chapter 13 – *Seismic Design Requirements for Nonstructural Components*. Refer to seismic design criteria on drawings 1695-D-101 and 1695-D-102. Calculations should take into account all forces and loads including seismic that the pumping units will be subjected to.

C. Performance Requirements:

1. Refer to Table 33 12 73B - Performance Requirements.
2. Internal pump losses are not included in the “rated total head” column shown in Table 33 12 71B - Performance Requirements. Add internal pump losses to the total heads listed when computing capacity and efficiency.
3. Pump capacity at rated total head not to exceed 110 percent of required minimum capacity listed in Table 33 12 73B – Performance Requirements.
4. Overall efficiency of pumping unit when operating at rated total head shown in Table 33 12 73B - Performance Requirements not to be less than 74 percent for operating conditions.
5. Select pump with a head-capacity curve that has a continuously rising head with decreasing capacity over the expected range of total heads.
6. The pumping plant minimum net positive suction head available (NPSHA) of approximately 35 feet shall exceed the pump net positive suction head required (NPSHR) for the pump by the amount of margin specified in HI considering suction specific speed and the operating environment for the expected range of total operating heads listed in Table 33 12 73B - Performance Requirements.

Table 33 12 73B - Performance Requirements

Reach 12.1/12.2 Pumping Units	Direction of Rotation*	Unit minimum capacity at rated total head (cfs)	Rated total head (feet)	Expected range of total head (feet)	Unit suction/ discharge piping/valve size (inches)	Maximum allowable speed (rev/min)	Maximum head for reverse runaway speed (feet)
1	CCW	2.00	460	460-390	8	3600	393.3
2	CW	2.00	460	460-390	16	3600	393.3

* Viewed from driver side.

1.05 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 33 12 73-1, Pump Approval Data and Drawings:

1. Commercial products data, including complete identifying data giving manufacturer's name, type, model, size, and dimensions.
    a. Pumps.
    b. Pump and motor lubrication oil.
    c. Electrical terminal blocks.
    d. Motor bearing temperature relays.
    e. RTDs.
2. Drawings and data:
    a. Pumping unit outline drawings.
    b. Pedestal mounting details, which include the following:
        1) Baseplate drawings showing leveling bolt locations.
        2) Pedestal drawings.
        3) Anchor bolt drawing.
        4) Manufacturer's recommended tightening torques for the baseplate anchor bolts and pump and motor mounting bolts.
    c. Impeller dynamic balance data:
        1) Contractor's procedure, noting the standard referenced for dynamic balance criteria.
        2) Results of dynamic balance for each impeller.

d. Sectional assembly drawings with parts and materials lists, and component weights.

e. Typical pump performance curves that show efficiency, horsepower, total dynamic head, and NPSHR with reference to capacity and operating speed.

f. Pumping unit (pump and motor) flywheel effect (WR^2):

1) Pump unwatered.

2) Pump watered.

3) Motor.

g. Net weight and dimensions:

1) Complete pumping unit (pump and motor) and individual pump and motor weights.

2) Pumping unit baseplate.

h. Rate of flow of flushing water and supply pressure required for mechanical seals on pump.

3. Lifting beam drawings for pumping units, if applicable.

4. Test set-up drawing showing pumping unit assembly (pump and motor) and instrumentation set-up for pumping unit performance shop performance test.

5. Commercial products data for indicating and protective devices and associated components to be provided with the pump, including name of the manufacturer, type, size, scale range, electrical rating (where applicable), calibration curves (where applicable), etc.

6. Pumping unit installation, operation, and maintenance instructions, including:

a. Detailed procedures for leveling and grouting baseplate and for torqueing of bolts.

b. Detailed pump and motor field alignment procedures.

c. Pumping unit (pump and motor) installation millwright qualifications.

d. Pump operational field testing procedures.

7. Baseplate deflection analysis.

a. Deflection to be less than maximum shaft run-out of 0.015-inch per inch of shaft diameter.

8. Shaft coupling manufacturer's data.

C. RSN 33 12 73-2, Seismic Calculations:

1. Calculations and supporting data reviewed and stamped by a Registered Professional Structural Engineer in the State of New Mexico for the pumping units.

D. RSN 33 12 73-3, Motor Equipment Approval Data:

1. Catalog data, including complete identifying data giving manufacturer's name, type, model, size and dimensions for:

a. Induction motors.

b. Protective devices.

c. Accessories.

E. RSN 33 12 73-4, Motor Approval Data And Drawings:

1. Assembly and sectional drawings with parts and materials lists, and component weights.

2. Motor outline drawings including thrust bearings and dimensioned location of terminal boxes.

3. Schematic, and wiring diagrams:

a. Schematic diagrams:

1) Armature winding connection.

2) Indicating and Protective devices.

3) Space heaters.

b. Wiring diagrams:

1) Low-voltage terminal box.

4. Standard drawing 40-D-6032 completed for each size motor.

5. Description of motor insulation.

6. Idle (motor stopped) time required for motor to cool from rated load temperature to ambient temperature. Running time (motor fully loaded) after two successive cold starts before a third start of motor may be initiated.

7. Nameplate data.

8. Motor locked rotor current rating.

F. RSN 33 12 73-5, Pump Certified Shop Test Data And Reports:

1. Certified pumping unit performance test data with curves for each pump showing pump efficiency, horsepower, and total dynamic head with reference to capacity and operating speed.

2. Certified hydrostatic test reports for each pump casing.

G. RSN 33 12 73-6, Motor Factory Test Report:

1. Factory test reports.

H. RSN 33 12 73-7, Pump Final Data and Drawings:

1. Typed and bound service manual which includes:
    a. Material test certificates.
    b. Installation, operation, and maintenance instructions, including tools and accessories for assembly and disassembly of the pump and associated components.
    c. Pump storage/maintenance instructions.
    d. Mounting details including the pump manufacturer's recommended tightening torques for the base plate anchor bolts, pump mounting bolts, and pump/motor shaft coupling bolts.
    e. Special tools and accessories for assembly and disassembly of the pumping unit.
    f. Spare parts list.
    g. Maintenance schedule in tabular form.
    h. Recommended lubricants.

I. RSN 33 12 73-8, Motor Check Prints:
1. Schematic and wiring diagrams.

J. RSN 33 12 73-9, Motor Final Data And Drawings:
1. Half-size prints of:
    a. Assembly and sectional drawings with parts and materials lists, and component weights.
    b. Motor outline drawing including dimensioned location of terminal boxes.
    c. Mounting instructions and detail drawings including tightening torques for component assembly bolts.
    d. Motor nameplate drawings complete with nameplate data.
    e. Standard drawing 40-D-6032 completed for each size motor.
    f. "As-built" schematic and wiring diagrams for motor approval drawings.
2. Field test reports.
3. Installation, operation, and maintenance information including tools and accessories for assembly and disassembly of the motor.
    a. Mounting details including the motor manufacturer's recommended tightening torques for the motor mounting bolts.
    b. Spare parts list.
    c. Maintenance schedule in tabular form.
    d. Bill of materials.

e. Recommended Lubricants

4. Motor storage/maintenance instructions.

5. Motor bearing relay trip set points.

K. RSN 33 12 73-10, Resumes and Qualifications:

1. Pumping unit (pump and motor) Manufacturer's Installation Representative(s).

L. RSN 33 12 73-11, Pumping Unit Field Test Plan.

M. RSN 33 12 73-12, Pumping Unit Field Test Reports:

1. Vibration analysis, noise level, shaft alignment and runout measurements, and motor bearing temperatures, voltage, and amperage.

2. Typed 8 1/2- by 11-inch format bound together.

1.06 QUALITY ASSURANCE

A. Qualifications:

1. Welding procedures, welders, and welding operators:

a. Conform either to:

1) ASME BPVC-IX, or to the

2) Standard Qualification Procedure of AWS D1.1.

B. Certifications:

1. Certified pump performance test data and characteristic curves for each pump.

2. Certified hydrostatic test report for each pump casing.

1.07 SERVICES OF MANUFACTURER'S INSTALLATION REPRESENTATIVE

A. Provide separate Manufacturer's Installation Representatives for the pump and the motor.

B. Operational field testing of the pumping units shall be performed under the direction/oversight of the on-site Manufacturer's Installation Representatives.

C. No work shall be performed on pumps or motors without applicable Manufacturer's Installation Representative being on-site to direct/oversee the work. The applicable Manufacturer's Installation Representative(s) shall be on-site, at a minimum, for the following operations:

1. Baseplate installation, including setting, leveling, and grouting baseplate.

2. Setting of pump and installation to baseplate.

3. Alignment and coupling of pump to suction and discharge lines.

4. Alignment and coupling of motor to pump.

5. Motor field acceptance tests, including heat run.
6. Functional testing.
7. O&M training.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Prevent damage to pumping unit components and associated equipment during loading, transportation, unloading, and storage.

B. Repair damage to the pumping units and associated equipment as directed if, in the opinion of the COR, a satisfactory repair can be made; otherwise replace damaged pumping unit components and associated equipment.

C. Protect from corrosion, deformation and other types of damage.

1.09 PROJECT CONDITIONS

A. Water to be pumped is potable but may contain varying amounts of sand, silt and aquatic growth.

B. Pumping unit to be suitable for operation at an elevation of 6,694 feet and with an ambient temperature of 104 degrees Fahrenheit.

1.10 EXTRA MATERIALS

A. Spare Parts:

1. Provide spare parts that are “new” and not refurbished and properly packaged for long-term storage.
2. Furnish spare parts that are interchangeable with and of the same materials and workmanship as corresponding original pump and motor parts.
3. Clearly mark or tag each part to identify size and type of pumping unit it is intended. Specifically identify with part unit number and specific part number.
4. Furnish the one set of the following spare parts for each different size pumping unit at the Booster Pumping Plant:
    a. Pump bearings.
    b. Gaskets, seals, as applicable.
    c. Wearing rings.
    d. Motor bearings.
    e. Mechanical seal set for a pumping unit.
    f. Stainless steel shaft sleeves.

B. Special Tools:

1. Furnish one set of special tools required for assembly and disassembly of the pumping unit (pump and motor) and other appurtenances and accessories that may be required for assembling, installing, aligning, or dismantling part of the pumps and to make the unit complete and ready for operation. (Special tools are considered to be those tools, which because of their limited use, are not normally available but which are necessary for the particular equipment.)
2. Furnish tools of high-grade, forged alloy, tool steel.
3. Furnish a steel box for storage of the special tools.
4. Furnish major parts of the pumps with eyebolts, lugs, or lifting devices (i.e., lifting beam) to facilitate handling with a mobile crane. Lifting equipment to comply with performance standards.

1.11 DELIVERY, STORAGE, AND PROTECTION

A. Protect from corrosion, deformation, and other types of damage.

B. Store items indoors, free from contact with soil and weather.

C. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.01 HORIZONTAL CENTRIFUGAL PUMPING UNITS

A. Pump: Water being pumped contains varying amounts of sand, silt and aquatic growth. Material grade chemical composition of pump components not to exceed 0.03 percent Pb (lead) content.

1. Casing:
    a. Provide cast iron or ductile iron casing construction: ASTM A 48 or ASTM A 536.
    b. Double suction type.
    c. Design to produce smooth flow with gradual changes in velocity.
    d. Split on the horizontal centerline, with suction and discharge connections cast integral with the lower half and located as listed in Table 33 12 73B – Performance Requirements, when facing the motor end of the pump.
    e. Suction connection faced and drilled to conform to AWWA C207, ring type, Class D or E.
    f. Discharge connection faced and drilled to conform to AWWA C207, ring type, Class E.
    g. Casing minimum design pressure: 250 pound per square inch.
    h. Design for easy removal of impeller and bearings.

i. Provide with casing wearing ring of aluminum bronze material: ASTM B 505 (Brinell hardness not greater than 70 BHN). Finish of wearing ring surfaces as specified in System Description Article.

j. Provide suitable drilled and tapped holes for air release valve and drain connections.

1) Provide a standard NPT tapped hole at top of casing for installation of an air release valve.

2) Locate drains such that the casing can be completely unwatered.

k. Casing construction to permit pump to be readily assembled and dismantled.

l. Following cleaning as specified in Section 09 96 20 - Coatings, inspect castings thoroughly. Ensure that surfaces of vanes used to direct water flow through the suction case and pump bowl are as smooth as practicable and free of blow holes, chilled areas, slag, or foreign matter. Repair or reject defective castings.

2. Impeller:

a. Enclosed type and made in one piece entirely of aluminum bronze material: ASTM B 148.

b. Provide with impeller wearing rings of aluminum bronze material: ASTM B 505 (Brinell hardness not less than 170 BHN). Finish of wearing ring surfaces as specified in System Description Article.

c. Securely fastened to shaft in such a manner as to make it readily removable.

d. Wearing rings shrink-fit to the impeller, utilizing an interference fit of 0.0005-inch per inch of ring inside diameter.

e. Radial clearances between rotating and stationary wearing rings to be as small as possible consistent with safe operation and with the clearances required in the pump guide bearings.

f. Hand-finish impeller water passages to remove rough spots and excessive irregularities.

g. Finish of impeller surfaces as specified in System Description Article.

h. Statically and dynamically balance rotating parts to prevent whipping and vibration throughout operating range from shutoff head to run out.

i. Balance in accordance with ISO-1940/1-(E) to a balance quality grade of at least G6.3.

1) Balance to pump manufacturer's quality control standards provided the residual imbalance during operational field testing performed after installation at the job site does not exceed 1/2 the vibration limit established by HI 9.6.4.

j. Following cleaning as specified in Section 09 96 20 - Coatings, inspect castings thoroughly. Ensure that surfaces of hub and blades are as smooth as practicable and free of blow holes, chilled areas, slag, or foreign matter. Repair or reject defective castings.

3. Shaft:

a. Provide carbon steel shaft construction: ASTM A 29 or ASTM A 108, Grade 1045.

b. Provide a shaft of sufficient size to operate without objectionable distortion or vibration at maximum speed in both the forward and reverse directions.

1) Size shaft to prevent torsional and flexural deflection which could cause whipping and vibration under condition.

2) Shaft first critical speed to be at least 125 percent of operating speed.

c. Finish of shaft surfaces as specified in System Description.

d. Provide with removable and renewable shaft sleeves where it passes through the stuffing boxes and water passages.

1) Gasketed to prevent water being pumped from contacting shaft.

2) Secured in place for both directions of pump rotation.

3) Made of stainless steel.

e. Provide water deflectors on shaft to prevent water from passing along shaft and entering pump bearings.

4. Mechanical seal:

a. Design mechanical seal to prevent leakage and exclude air from the casing.

b. Provide a mechanical seal on each side of the pump:

1) Single, split seal type requiring no field assembly, other than assembly around the shaft and insertion into the pump.

2) Design to require minimum mechanical seal water injection at each mechanical seal to operate properly and provide pre-startup seal chamber filling. See Section 33 12 74 - Mechanical Seal Filtration and Booster System for further description.

3) Materials of construction to be able to withstand a 6-month shutdown, without benefit of lubrication, with no adhesion occurring which would cause a failure of part of the seal assembly on restart of the pump.

a) Gland and rotary holder made of stainless steel recommended for this service and application to provide superior corrosion protection.

b) Internal metal parts to be made of stainless steel.

c) Springs: Hastelloy C, Alloy 20, or AMS5876 (Elgiloy) or other alloy material that is not vulnerable to chloride stress corrosion as recommended for this service and application.

d) Stationary and rotary seal faces made of solid silicon carbide.

e) Elastomers: Fluorocarbon (Viton) material as recommended by the seal manufacturer for this service and application.

4) Type and size recommended for this service and application.

5) Suitable for maximum head listed in Table 33 12 73B – Performance Requirements.

6) Hydraulically balance and designed for the range of 28 inches mercury (vacuum) up to pump shutoff head at rated pump speed.

7) Stationary seal face mechanically loaded with multiple springs to ensure no leakage when pump is shut off.

8) Provide two mechanical seal water ports in gland with standard NPT tapped connections.

9) Minimal leakage to be no greater than 10 drops/min. List minimum call manufacturer.

10) Water will be supplied to each seal which is filtered with a strainer to allow particles no larger than 50 microns (See Section 33 12 74 – Mechanical Seal Filtration and Booster System).

5. Coupling and Guard:

a. Connect pump and motor shafts with a metal gear-type or disc-type, flexible coupling to compensate for parallel offset and angular misalignment.

b. Flexible coupling to be the heavy-duty type sized for 1.5 times the motor horsepower nameplate rating.

c. Provide an all metal OSHA-approved coupling guard that is removable and supported from the baseplate with stainless steel bolts and nuts.

6. Pump Bearings:

a. Support pump shaft by two bearings of suitable design with one located on each side of the pump.

b. Removable in the field without damage to the bearings or shaft.

1) Bearings requiring application of heat for removal not acceptable.

2) Provide detailed procedure for removal of bearings in installation, operation, and maintenance instructions.

c. One bearing to be of the thrust type designed to carry the unbalanced hydraulic thrust the pump might develop.

d. Bearings to be grease-lubricated, ball- or roller-bearing type.

e. Connections for grease-lubricated bearings to be button-head type.

f. Provide pump bearings with RTDs in accordance with Motor Article.

g. Bearings shall not require external cooling.

h. Design bearings for minimum L_{10} life of 5 years in accordance with ABMA 9 or 11.

i. Provide neoprene seals with the bearings to prevent loss of lubrication and entrance of moisture and dirt.

1) Labyrinth seals not acceptable.

7. Baseplate:

a. Provide pumping unit with a structural steel baseplate supplied by the pump manufacturer.

b. Mount pump and motor on a common baseplate with separate mounting plates attached to baseplate for the pump and the motor.

c. Provide with suitable lifting lugs properly located to maintain a balanced load when handling the pumps.

d. Sufficient size and rigidity to maintain the pump and motor in proper alignment and position without the benefit of epoxy grout, when subjected to the stresses imposed by normal operation or when pump dead headed or during reverse flow following emergency shutdown.

e. Machine contact surfaces between the pump and mounting plate on the baseplate and between the motor and mounting plate on the baseplate to within 0.002-inch of true flat, level to 0.002-inch per linear foot.

1) Elevation difference between each pump mounting plate to be machined and installed to 0.002-inch within plane of each other.

2) Elevation difference between each motor mounting plate to be machined and installed to 0.002-inch within plane of each other.

3) No welding after final machining.

f. Transmit the load due to pump shutoff head to the concrete structure. If provided with shear keys the area that the maximum bearing stress imposed on the epoxy grout from pump shutoff head is not to exceed 800 pounds per square inch.

g. Provide with standard NPT threaded drain connections and grout holes.

8. Piping and valves:

a. Submit in accordance with Section 35 21 94 - Steel Manifolds and Section 35 22 14 - Valves and Equipment.

9. Pressure gauges:

a. Submit in accordance with Section 35 22 14 - Valves and Equipment.

2.02 INDICATING AND PROTECTIVE DEVICES

A. General:

1. Determine scale range for the required operating conditions when scale range for instrument is not specified.

2. Pressure scales graduated in pounds per square inch.

3. Temperature scales graduated in degrees Fahrenheit.

4. Provide nameplates for each instrument, electrical control device, and alarm switch supplied under this paragraph.

5. Provide indicating meters in accordance with Section 26 18 39 - Medium-Voltage Motor Controllers and locate at the auxiliary control board.

B. Resistance Temperature Detectors (RTDs):

1. Provide each pump with two RTDs for producing a signal for remote indication of the temperature of each pump bearing at respective MCE and interface terminal cabinet.

2. Three-wire RTD, 100-ohm platinum type.

3. Furnish RTD complete with necessary fittings, connectors, conduit, terminal box, terminal board, and wiring from detector through the low-voltage motor terminal box to respective MCE. See drawings for wiring termination interface.

C. Nameplates:

1. Provide in accordance with standard drawing 40-D-6234.

2. Include in the nameplate captions, the device function number (where applicable) and the nameplate device description.

a. Nameplate captions can be changes by the COR at the time the nameplate list drawing is first submitted for approval at no change in contract price or delivery.

b. Device function numbers to be assigned at the time the drawings are first submitted for approval.

2.03 MOTOR

A. Type: Horizontal, induction squirrel-cage designed for duties specified.

B. Nameplate Ratings:

1. Voltage: 4000, 3-phase, 60-hertz.
2. Synchronous Speed: As listed in Table 33 12 71B – Performance Requirements.
3. Duty: Continuous.
4. Service factor: 1.0.

C. Service Conditions:

1. Altitude: 6694.00 feet.
2. Maximum ambient temperature: 40 degrees Celsius.
3. Minimum ambient temperature: 0 degrees Celsius.

D. Enclosure: Totally-enclosed, fan cooled (TEFC).

E. Horsepower Rating: Sufficient to carry continuously the maximum possible pump load developed under specified conditions without benefit of service factor. Horsepower rating to be value listed in NEMA MG 1.

F. Temperature Rise:

1. Armature winding: Not to exceed 80 degrees Celsius when measured by resistance.
2. Other motor parts: In accordance with NEMA MG 1.

G. Starting Method: Soft starters will be used with a closed butterfly valve and check valve on pump discharge, and pump discharge line full of water.

H. Starting Capability:

1. Number of starts: Two starts in succession (coasting to rest between starts) with motor initially at ambient temperature or one start with motor initially at a temperature not exceeding its rated load operating temperature.
2. Estimated maximum number of starts per day: 8.

I. Nameplate Marking: As listed in NEMA MG 1 for alternating-current polyphase squirrel-cage motors.

J. Conform to NEMA MG 1.

K. Stator:

1. Stranded copper conductors.

2. Insulation: Class F or H.

3. Coils completely sealed and moisture-tight.

4. Winding configuration: Manufacturer's standard wye or delta.

5. Completed winding subjected to two vacuum pressure impregnations in a solventless epoxy resin.

L. Rotor: Squirrel-cage windings of suitable impedance for starting under specified conditions. Rotor structure constructed in accordance with current industry practice

M. Bearings:

1. Provide manufacturer's standard anti-friction type.

2. Lubrication: Grease or oil.

3. Be self-cooled and sealed against loss of lubricant and entrance of dirt.

4. Provide means for removing the lubricant and relubricating the bearings without disturbing bearing housing.

N. Indicating and Protective Devices:

1. Resistance Temperature Detector (RTD): 100 ohm platinum, 3-wire.

2. Location:

a. Two RTD's per phase, located in stator slots between coil sides.

b. One RTD for each motor bearing.

3. Provide oil sight glass for oil lubricated bearings.

O. Main Lead Terminal Box:

1. Size: Oversized and suitable for terminating main leads with stress cones.

2. Provide clamp-type ground lug suitable for connecting conductor shields inside terminal box.

3. Manufacturer's standard cover with gasket.

P. Low-Voltage Terminal Box:

1. Size: Suitable for terminating leads from indicating and protective devices, and motor accessories.

2. Provide terminal blocks for terminating indicating and protective devices, and motor accessories.

3. Manufacturer's standard cover with gasket.

4. Provide with back panel for mounting terminal blocks.

Q. Accessories:

1. Space heaters:
    a. Provide space heaters to prevent condensation in the motor armature windings when the motor is shut-down for extended periods.
    b. Rating: 1-phase, 120-volt, 60-hertz.
    c. Thermostatically controlled when motor is de-energized.
2. Grounding Provisions: Provide pad with drilled and tapped bolt holes on motor enclosure. Pad to be machined flat and left unpainted.
3. Provide means for lifting the entire pumping unit and/or individual components. This will entail below-the-hook devices required to lift these components. Lifting eyes attached to motor housing that are suitable for attaching slings for lifting with a crane. Lifting hooks or similar devices are not acceptable.
4. Wire Markers:
    a. Type: Machine-printable, self-laminating label or tubular heat-shrink sleeve label.
    b. Color: White.

2.04 MOTOR FABRICATION

A. Stator Armature Winding and Armature Leads:
1. Seal armature lead insulation to be equal to armature coil insulation with regard to moisture resistance and voltage class.
2. Armature leads brought out of stator frame to motor lead conduit box for external connections. Terminate armature leads with individual bolted-type solderless connectors.

B. Wire Identification:
1. Provide computer-generated or labeling machine lettering.
2. Wire identification-refer to Division 26.

2.05 CONTRACTOR SOURCE QUALITY TESTING

A. Pump Shop Assembly and Test Requirements:
1. Assemble mating parts of pumping unit (pump and motor). Match-mark pump components before disassembly for shipment, unless shipped assembled, to ensure correct field assembly.
2. Prepare and submit certified pump performance curves showing overall efficiency, pump efficiency, horsepower input to the pump, and pump discharge at heads from the minimum head, specified in Table 33 12 73B - Performance Requirements, to pump shutoff head. Present test data at full-speed rating. The

portion of the curve above the maximum head specified to shutoff head may be plotted from previous shop test data.

3. Perform test with job pump and motor.

4. Government to witness pump test. Give a 14-day notice to the COR before the pump and motor are ready to be tested.

B. Motor Shop Test:

1. Assemble and test motor at the manufacturer's shop to establish that performance requirements of these specifications and warranties under this contract have been fulfilled.

2. Perform manufacturer's routine factory tests and the following routine tests required by Part 20 of NEMA MG 1.

a. Measurement of winding resistance.

b. No-load motoring readings of current, power, and nominal speed at rated voltage and frequency.

c. Alternating-current (AC) high-potential test. A direct-current (DC) high-potential test is not acceptable.

3. Perform tests in accordance with requirements of NEMA MG1 and IEEE 112.

2.06 ACCESSORIES

A. Lubricating Grease:

1. In accordance with pump and motor manufacturer's recommendations.

B. Anchor Bolt Assembly:

1. As shown on drawing 1695-D-218.

2.07 FINISHES

A. Shop paint in accordance with Section 09 96 20 - Coatings.

2.08 EPOXY GROUT

A. Epoxy Grout for Baseplate: Epoxy grout in accordance with Section 03 63 00 - Epoxy Grout.

PART 3 EXECUTION

3.01 FIELD INSTALLATION

A. Service each pumping unit before installing.

1. Servicing consists of complete lubricating, adjusting, and cleaning of the unit.

2. Lubricating grease furnished by the Contractor in accordance with the pump and the motor manufacturers' recommendations.

B. Responsible for correct assemble and alignment of parts of each pumping unit.

C. Apply an anti-seize compound meeting the requirements of Federal Specification TT-S-1732 (MIL-PRF-907E) to the shaft threads before assembling.

D. Furnish fine thread leveling bolts, anchor bolts as shown on drawing 1695-D-218, and other devices necessary to install the pumping unit. Set the base plate with leveling bolts not lead washers.

E. Apply a suitable lubricant to the pump baseplate leveling screws and pump baseplate anchor bolts to prevent bolt threads from seizing to the epoxy grout.

F. After servicing, install pumping by a qualified millwright, with 3 years of pumping unit installation and alignment experience, under the supervision of the Manufacturer's Installation Representatives from the pumping unit (pump and motor) manufacturers, and in accordance with HI 1.1 - 1.4 and manufacturer's installation instructions.

G. Tighten baseplate anchor bolts, pump mounting bolts, and motor mounting bolts to manufacturer's recommended torque, as submitted in the approval data, prior to beginning the field tests on each unit. At the conclusion of the field tests on each unit, check the respective bolt torques. If the bolts are insufficiently torqued, the COR may direct the tests be conducted again, at no additional cost to the Government.

H. Carefully handle equipment so that no part will be bent, broken, or otherwise damaged.

1. Repair damage caused by the Contractor, by and at the expense of the Contractor, as directed and approved by the COR.

2. Do not install damaged or defective parts.

I. Couplings and Flanges:

1. Thoroughly clean dirt and burrs from couplings, flange faces, and machined surfaces before connection to ensure tight fit and true alignment.

2. Coat finished surfaces of flanged joints with joint compound before bolting.

3. Make flanged joints with undamaged full face gaskets properly centered to the joint before bolting.

4. Tighten flange bolts several times at intervals until the initial stretch is taken up and it is positively ensured that there will be not leakage.

J. Pump Pedestal:

1. Furnish concrete pump pedestals to match pump suction and discharge pipe elevations shown on the drawings.

2. Install anchor bolts for the pumping units in the floor concrete and pedestals in accordance with drawing 1695-D-218. Use of lead washers and/or shims not permitted.

K. Baseplate and Pump/Motor Installation:

1. Remove pump and motor from baseplate before beginning baseplate installation.
2. Thoroughly clean the baseplate before installation to remove paint, dirt, rust, and other foreign matter.
3. Level and set the elevation of the baseplate by means of leveling bolts to within 0.002-inch per linear foot under each working component of the unit (0.002-inch per linear foot under the pump and 0.002-inch per linear foot under the motor).
4. Install baseplate assembly so that mating surfaces of the pump feet and motor feet to the mounting plates have 100 percent contact. No shims, wedges, or lead washers allowed.
5. Set pump on mounting plate of baseplate and align the pump and connect to the suction and discharge piping. Check baseplate level again as required.
6. Final installation of the pump to be at the elevation and position that lines up the suction and discharge piping with the pump and shall account for the offset between the centerline of the suction and discharge connections on the pump and respective connections on the intake and discharge manifolds.
7. Trim ends of suction and discharge piping to allow for the proper pipe end clearances at the location of each sleeve-type coupling installed between each thrust harness assembly.
8. Tighten each sleeve-type coupling and thrust harness assembly between pump and the suction and discharge piping only enough to prevent leakage. Do not fully tighten until the installation of the pump is completed.
9. Set motor on mounting plate of baseplate and align pump and motor. Secure baseplate by tightening the upper nuts on the embedded anchor bolts evenly and using the leveling bolts.
    a. Perform alignment using dial indicators or laser alignment to check both parallel and angular misalignments.
    b. Maximum allowable total angular run-out, with indicating point approximately 12 inches apart, is 0.003-inch.
    c. Maximum allowable total indicated parallel run-out is 0.004-inch.
10. Grout baseplate in place using epoxy grout as shown on the drawings and in accordance with Section 03 63 00 - Epoxy Grout.
11. Perform grout placement in a manner to ensure 100 percent contact between the baseplate and the concrete pad.

12. After epoxy grout has set, fully tighten upper nuts on the embedded anchor bolts and recheck alignment of the pump and motor.

    a. Loosen and remove sleeve-type couplings and thrust harness assembly between pump and suction and discharge piping before rechecking pump and piping alignment and baseplate leveling tolerance.

    b. Take corrective measures as required until alignment and leveling tolerances meet specification requirements.

13. Fully tighten nuts on embedded anchor bolts to manufacturer's recommended torque value.

14. Check level of baseplate and piping alignment after grouting and tightening nuts. Install the motor and align the motor shaft to the pump shaft.

15. After final alignment, dowel pump and motor to their respective mounting plates on the common baseplate.

16. Turn motor shaft and pump shaft by hand to ensure free rotation in their bearings.

17. After determining correction direction of rotation, connect water piping and make electrical connections.

18. Connect pump shaft and motor shaft and make necessary adjustments in accordance with manufacturer's instructions after electrical connections have been made and correct direction of rotation has been determined.

19. After installing completely, service each pumping unit.

    a. Completely lubricate, adjust, and clean each unit.

    b. Check lubricating devices and water piping systems for correct operation before thoroughly lubricating unit.

    c. Lubricating grease to be furnished by the Contractor in accordance with the pump and motor manufacturers' recommendations.

3.02 SERVICING AND FIELD TESTING

A. Submit operational field testing procedures for approval.

B. Before performing operational field tests, completely lubricate, adjust, and clean the pumping unit.

C. Check lubricating devices and water piping systems for correct operation before thoroughly lubricating unit.

D. Furnish lubricating devices and grease in accordance with the pump and motor manufacturers' recommendations.

E. Furnish and install temporary instruments, gauges, recording and sensing devices, and special brackets required for the operational field tests.

F. Calibrate permanent instruments, gauges, and recording and sensing devices and adjust equipment as required until operation is approved by the Government.

G. Clean up the testing area before and after each test.

H. Schedule construction work so that these tests can be conducted.

I. Have the necessary craftsman available to make necessary changes (either temporary or permanent).

J. Responsible for operating the units, recording the data, and enforcing safety procedures.

K. Schedule, conduct, and coordinate tests required to be witnessed by the Government.

L. Perform tests under the direction/oversight of the Manufacturer's Installation Representatives from the pumping unit (pump and motor) manufacturers, and in accordance with HI 1.6 and manufacturer's operational field testing procedures.

M. Clean internal surfaces of and system components to assure the effective removal of contaminants. Remove loose solid contaminants. Remove rust from all surfaces. Furnish materials, supplies, labor and equipment for cleaning the system components.

N. Check lubricating devices for correct operation. Furnish lubricating devices and grease in accordance with the pumping unit manufacturer's recommendations.

O. Without additional cost to the Government, unwater, sweep, and hose down complete pump area prior to initial startup of pumping unit to ensure that construction waste and accumulated debris have been removed.

1. Final cleaning of pump area to be witnessed by COR.
2. Correction of damage to the pumping units or related equipment during initial startup due to foreign objects left in the pump area to be performed by the Contractor at Contractor's expense.

P. Before making electrical connections and energizing the motor, perform the following checks and tests:

1. Successfully test all motor control, monitoring, and protective circuits in accordance with Section 26 05 90 – Wiring Checkout and Tests.
2. Insulation resistance test in accordance with IEEE 43.
3. AC high-potential test in accordance with NEMA MG 1 and IEEE 112.
    a. A DC high-potential test is not acceptable.
    b. If motor fails test, correct in accordance with manufacturer's recommendations.

Q. Terminate armature leads and external motor cables. Make terminations in accordance with manufacturer's instructions and recommendations using medium-voltage termination kits and stress cones.

R. Terminate leads for motor accessories and external control cables. Make terminations in accordance with manufacturer's instructions and recommendations.

S. Perform an operating test on each pumping unit under load for as long as the system will allow, as directed by COR, up to 8 hours.

1. Contractor shall provide a detailed pumping unit field test plan.

2. Contractor shall supply all testing equipment.

3. Test conducted by the Contractor and witnessed by the Government for each pump. Individual tests shall be performed for each pump. Do not test more than one pump at a time.

4. During the test, observe pumping unit operation and record noise level, vibration analysis, shaft alignment and run-out measurements, pump and motor bearing temperatures, motor voltage and amperage, and motor stator temperature.

   a. Take readings for as long as the system will allow, up to 8 hours:

      1) Once every 15 minutes for the first two hours; once every hour for the next 5 hours; and once every 15 minutes for the last hour.

      2) If testing for less than 8 hours; once every 10 minutes.

   b. Vibration analysis to be full spectrum analysis using a monitor that records and prints analysis results.

      1) Vibration levels not to exceed 1/2 the acceptable field vibration limits established by HI 9.6.4.

5. Provide a report of tests which shall include:

   a. Drawing showing specific locations of vibration probes and bearing temperature sensors.

   b. Vibration analysis, noise level, shaft alignment and run-out measurements, pump and motor bearing temperatures, motor voltage and amperage, and motor stator temperature.

   c. Presentation of vibration data in a summary form and as a comparison with specification requirements for allowable vibration limit.

   d. Observations and equipment adjustments performed during testing.

   e. Detailed discussion and summary of conclusions drawn from vibration, motor bearing and winding temperature, and motor voltage and amperage data that was recorded.

6. Without additional cost to the Government, Contractor shall make changes and correct errors for which the Contractor is responsible.

T. If the upstream infrastructure is not available to deliver flow to Storage Tank No. 1, then the pump testing requirements will be modified as follows:

1. Contractor shall provide potable water to fill Storage Tank No. 1 to test the pumping units and controls.
2. Contractor shall provide potable water to fill the suction and discharge manifolds, the pump unit piping and the pumping plant bypass for pump testing.
3. After pump testing, Storage Tank No. 1 shall be gravity drained and dried with forced air ventilation.
4. After pump testing suction manifold piping, discharge manifold piping, and pumping plant bypass piping will be pumped out and air dried with forced air ventilation.
5. Contractor shall dispose of all test water after pump testing. Disposal method shall meet all environmental regulations.
6. The Contractor shall prepare pumping plant equipment for sustained storage after pump testing in accordance to the manufacturer's recommendations.

U. If the downstream infrastructure is not available to receive pumping plant flows, then the pump testing will be modified as follows:

1. Pump Unit 12.1-1 test flows will be routed through the filling line for the time periods specified in 3.02.S, the discharge manifold and back to the suction manifold through the 12" Pumping Plant Bypass.
2. The set point of the 6" pressure sustaining valve in the filling line shall be adjusted to produce the rated conditions for the pump test.
3. Pump Unit 12.1-2 testing will be abbreviated to demonstrate proper pump, motor and control installation only. Sustained operation will not be performed since rated conditions in the discharge cannot be created with the installed equipment.
4. After pump testing, Storage Tank No. 1 shall be gravity drained and dried with forced air ventilation.
5. After pump testing suction manifold piping, discharge manifold piping, and pumping plant bypass piping will be pumped out and air dried with forced air ventilation.
6. Contractor shall dispose of all test water after pump testing. Disposal method shall meet all environmental regulations.
7. The Contractor shall prepare pumping plant equipment for sustained storage after pump testing in accordance to the manufacturer's recommendations.

END OF SECTION

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SECTION 33 12 74

MECHANICAL SEAL FILTRATION AND BOOSTER SYSTEM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Mechanical Seal Water Filtration and Booster System Equipment:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American National Standards Institute/Hydraulic Institute (ANSI/HI)

1.	HI 2.3-2008	American National Standard for Rotodynamic (Vertical) Pumps for Design and Application

B. American National Standards Institute /National Sanitation Foundation (ANSI/NSF)

1.	NSF 61-2012	Drinking Water System Components -- Health Effects

C. American Society Of Mechanical Engineers (ASME)

1.	ASME B16.5-2013	Pipe Flanges and Flange Fittings
2.	ASME B16.18-2012	Cast Copper Alloy Solder Joint Pressure Fittings
3.	ASME B16.22-2012	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
4.	ASME B40.100-2005	Pressure Gauges and Gauge Attachments

D. American Society of Sanitary Engineering (ASSE)

1.	ASSE-1003-2009	Performance Requirements for Water Pressure Reducing Valves

E. ASTM International (ASTM)

1.	ASTM A48-03	Standard Specification for Gray Iron Castings
2.	ASTM B32-08	Standard Specification for Solder Metal

F. Commercial Item Description (CID)

1.	CID-A-A-1923A-1995	Shield Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)

G. Manufacturers Standardization Society (MSS)

1.	MSS SP-73-2003	Brazing Joints for Copper Alloy Solder Pressure Fittings
2.	MSS SP-80-2013	Bronze Gate, Globe, Angle and Check Valves
3.	MSS SP-110-2010	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

H. National Electrical Manufacturer's Association (NEMA)

1.	NEMA-250-2008	Enclosures for Electrical Equipment

I. New Mexico Plumbing Code 2009

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals, and in accordance with the requirements of Section 01 33 26 – Electrical Drawings and Data.

B. RSN 33 12 74-1, Approval Data:

1. Commercial products data for all piping, fittings, valves, instrumentation, pumps, strainers and other appurtenances necessary for the complete mechanical seal cooling water filtration and booster system. Commercial product data shall include catalog illustrations, sizes, materials, pressure ratings and complete parts lists, as applicable.
2. Drawings showing complete mechanical seal cooling water filtration and booster system including plan view, elevations and pipe details.
3. NSF compliance for components, as required.
4. Mechanical seal cooling water booster pumps:
    a. Pump description and operating criteria.
    b. Outline and mounting detail drawings including equipment weights.
    c. Performance characteristics curves.
    d. Assembly drawings including parts and material lists.
    e. Motor nameplate data.
5. Automatic self-cleaning strainer:
    a. System description and operating criteria.
    b. Outline and mounting detail drawings including equipment weights.
    c. Performance characteristics curves including pressure drop.
    d. Assembly drawings including parts and material lists.
    e. Necessary calculations to support design and selection of system.
    f. Motor nameplate data.

6. List of special tools required for assembly and disassembly.

C. RSN 33 12 74-2, Check Prints.

D. RSN 33 12 74-3, Final Data:

1. Operation and Maintenance Manuals:

a. Submit complete installation, operation and maintenance manuals, including:

1) Maintenance data and schedules.

2) Description of operation and spare parts information.

3) All previously approved data, submitted under Approval Data submittal.

4) Half size (11- by 17-inch) drawings.

5) Any applicable test records or reports.

2. As-built Drawings:

a. Provide full size drawings on BOR title block.

b. Provide CDs in AutoCAD format.

E. RSN 33 12 74-4, Test Plan:

1. Detailed test plan including step by step instructions, time estimates, and list of required equipment in accordance with Section 01 80 15 - Commissioning.

1.04 SYSTEM DESCRIPTION

A. Furnish and install the mechanical seal cooling water filtration and booster system including all piping, valves, fittings, gauges, strainer and pumps.

B. The pumping plant is divided into two Reaches. Each Reach shall have an independent mechanical seal cooling water filtration and booster system.

1. Reach 12.1 contains three pumps, labeled 12.1-1, 12.1-2 and 12.1-3.

2. Reach 12.B contains four pumps, labeled 12.B-4, 12.B-5, 12.B-6 and 12.B-7.

C. The distribution system for each Reach includes two phases.

1. Phase 1 consists of the initial filling of the downstream pipeline and discharge tanks. The source for phase 1 water is the suction manifold for each Reach. A mechanical seal cooling water booster pump is employed for each Reach to send mechanical seal cooling water through the strainer. After filtration, the water is transported to the mechanical seals on the pumps used during phase 1, 12.1-1 and 12.B-4.

2. Phase 2 consists of normal pumping operation. A portion of the water in the discharge manifold for each Reach is used to supply the mechanical seal cooling water system. The mechanical seal cooling water is routed through the strainer and to the mechanical seals on the seven Reach pumps, as applicable, without the use of the mechanical seal cooling water booster pump.

D. The mechanical seal cooling water filtration and booster system is part of a potable water delivery system. All piping, fittings, valves, instrumentation, pumps, strainers, and appurtenances are to be lead free as required by NSF 61.

1.05 EXTRA MATERIALS

A. Spare parts: Furnish one extra set of any identified wear parts on the strainer stated to last 1,000 hours or less. Furnish spare parts to be interchangeable with, and of the same materials and workmanship as, the corresponding original parts of the equipment. Package spare parts in hermetically sealed containers labeled with manufacturer's name, part description and part number.

PART 2 PRODUCTS

2.01 PIPING AND APPURTENANCES

A. Pipe and Fittings:

1. Copper Tubing: ASTM B88 Type K:
   a. Buried pipe: annealed.
   b. Exposed pipe: rigid.
2. Tube Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
3. Solder joints:
   a. Provide for joints 2-inches and smaller.
   b. ASTM B32, solder, Grade 95-5 Tin Antimony.
4. Brazed joints:
   1) Provide for joints 2-1/2 inches and larger in conformance with MSS SP-73.
   2) Brazed joints made with flux are acceptable.
   3) Provide a lead-free brazing material.

B. Flexible Metal Hoses: Provide at each mechanical seal cooling water booster pump location.

1. Flexible seamless hose reinforced with stainless steel wire braid with threaded ends.
2. Same diameter as discharge piping with a length not less than 9 inches.
3. Suitable for pulsating service at a working pressure not less than 250 pounds per inch at a temperature of 100 degrees Fahrenheit.
4. Pressure rating: marked on outside of hose.

C. Valves:

1. Check valves:
   a. Conforming to MSS SP-80.
   b. Threaded ends.
   c. Capable of withstanding a maximum working pressure of 225 pounds per square inch.
   d. Brass or bronze body.
   e. Swing gate type.
2. Ball valves:
   a. Conforming to MSS SP-110.
   b. Brass or bronze body and ball.
   c. Full port design, 1/4 turn operation.
   d. Capable of withstanding a maximum working pressure of 225 pounds per square inch.
   e. Threaded ends.
3. Pressure reducing valves:
   a. Brass or bronze body.
   b. Threaded ends.
   c. Pressure drop no greater than 10 pounds per square inch.
   d. Capable of the following pressure reductions:
      1) Reach 12.1: 200 pounds per square inch maximum to 85 pounds per square inch.
      2) Reach 12B/13: 106 pounds per square inch maximum supply to 85 pounds per square inch.
   e. Conforming to ASSE 1003.
4. Solenoid valves:
   a. Normally closed.

b. Brass or bronze body.

c. 120 volts AC and 60-hertz.

d. Capable of withstanding a maximum working pressure of 225 pounds per square inch.

e. Threaded ends.

f. Cv value shall be greater than 10.

g. UL listed.

5. Globe valves:

a. Conforming to MSS SP-80.

b. Threaded ends.

c. Capable of withstanding a maximum working pressure of 225 pounds per square inch.

d. Brass or bronze body.

2.02 MECHANICAL SEAL COOLING WATER BOOSTER PUMP

A. Provide a booster pump for Phase 1 filling operations on each Reach, 12.1 and 12.B, with the following salient characteristics:

1. Pump type shall be a vertical multistage turbine pump. The number of stages shall be sufficient for the operating conditions listed.

2. Flanged connections shall be Class 150 per ASME B16.5.

3. Impeller shall be statically and dynamically balanced.

4. Bearings shall be permanently lubricated ball bearings.

5. Operating conditions:

a. Reach 12.1 rated condition:

1) Minimum flow of no less than 4 gallons per minute at 227 feet total dynamic head.

2) Net positive suction head available is 22 feet.

b. Reach 12.B rated condition:

1) Minimum flow of no less than 6 gallons per minute at 220 feet total dynamic head.

2) Net positive suction head available is 22 feet.

6. Materials:

a. Body shall be cast iron per ASTM A 48.

b. Seals shall be EPDM.

c. Impeller shall be stainless steel.

7. Motor:

a. Suitable for the duties specified.

b. Single speed.

c. Totally enclosed, non-ventilated or fan-cooled, squirrel cage-induction type.

d. Ratings: 208 volts, 3-phase, 60-hertz.

e. Enclosure shall be NEMA 4 rated.

f. Suitable for "across-the-line" starting.

g. Accessories- space heaters.

2.03 AUTOMATIC SELF CLEANING STRAINER

A. Provide a strainer for each Reach capable of automatic self-cleaning through an appropriate method. Supply all necessary components and accessories, including pumps, motors, differential pressure gages, additional piping and other instrumentation for a functional system ready for operation.

1. Strainer shall be electrically actuated with an integral control system.

2. The cleaning cycle shall be triggered by a differential pressure drop of no greater than 15 pounds per square inch as measured across the strainer. Cleaning cycle shall also be capable of timed operation with adjustable timer settings.

3. Capable of running at the following flow rate and inlet pressure.

a. Reach 12.1:

1) Phase 1 Initial Fill: 4 gallons per minute at 40 pounds per square inch.

2) Phase 2 Normal Operating: 16 gallons per minute at 85 pounds per square inch.

b. Reach 12.B:

1) Phase 1 Initial Fill: 6 gallons per minute at 40 pounds per square inch.

2) Phase 2 Normal Operating: 24 gallons per minute at 85 pounds per square inch.

4. Strainer shall be equipped with stainless steel media that filters all particles 50 microns and larger from the water.

5. Strainer shall be capable of providing continuous flow under all conditions, including during the cleaning process.

6. Strainer shall be equipped with drain plugs to fully empty the housing of water.

7. Flange connections shall be Class 150 per ASME B16.5.

8. Strainer body and cover shall have lifting lugs for ease of installation and removal.

9. Discharge line containing solids shall be piped to drains shown on the applicable drawing.

10. Materials:

    a. Strainer Body and Cover: Cast iron or stainless steel materials

    b. Strainer Shaft: Stainless with ceramic coating on surfaces in contact with bearings and packing.

11. Instrumentation, accessories and appurtenances:

    a. Furnish strainer with a control system which will initiate the automatic cleaning cycle.

        1) House control system in a NEMA 250, Type 4 enclosure.

        2) Automatic cleaning time interval shall be adjustable between 30 minutes and 8 hours.

        3) Set a differential pressure switch to a maximum 15 pounds per square inch pressure drop which will alarm and override the timer in the event of a sudden entrance of an abnormal amount of suspended particles into the strainer. Pressure switch shall reset automatically after cleaning cycle is complete.

    b. Supply duplex pressure gauges for visual confirmation of pressure differential across the strainer. Pressure gauges shall be submitted in accordance with Subsection 2.04.B of this section.

    c. Include with each strainer all lubricating devices, gaskets, packing for stuffing boxes, studs and bolts, and all other accessories and appurtenances required to make the strainer unit complete and ready for operation.

    d. Furnish an adjustable differential pressure switch that actuates upon a preset differential pressure in the self-cleaning strainer.

12. Motor used to actuate cleaning mechanism:

    a. Suitable for the duties specified.

    b. Single speed.

    c. Totally enclosed, non-ventilated or fan-cooled, squirrel cage-induction type.

    d. Rate motors at 120 volts AC.

    e. Enclosure shall be NEMA 4 rated.

    f. Suitable for "across-the-line" starting.

13. Filters and equipment shall be mounted on one or two skids not to exceed a combined total of 8 feet x 4 feet.

2.04 INSTRUMENTATION

A. Pressure Switch:

1. Mercury free.
2. 120 volts AC, 60-hertz.
3. Capable of sending signal to switch off Reach pumps when water pressure at mechanical seals is less than 35 pounds per square inch.
4. 1/4-inch or smaller NPT tap from main pipe.
5. UL listed.
6. Brass or bronze construction, otherwise use of dielectric pipe unions required.
7. Repeatability: ±2percent.
8. Suitable for operating pressure range of 20 pounds per square inch to 100 pounds per square inch.
9. Suitable for operating temperature range of 33 degrees Fahrenheit - 104 degrees Fahrenheit.

B. Pressure Gauge:

1. 1/4-inch or smaller NPT tap from main pipe.
2. 4 1/2-inch dials.
3. Bronze bourdon-tube, adjustable movement type.
4. Movement made of phosphor bronze, nickel, stainless steel, Monel steel, nitride steel, or any combination thereof.
    a. Bushings of any of the above-mentioned material but different composition or hardness than the shafts.
5. Case of brass or aluminum alloy.
6. Dust-proof and moisture-proof case.
7. Glycerin liquid filled.
8. Case and ring finished in black and dial in white with black markings.
9. Black indicating pointers.
10. Shatter resistant window.
11. Conformance to ASME B40.100.
    a. Grade A accuracy or better.
12. Furnished with shutoff cocks and pulsation dampeners.

13. Pressure range of 20 pounds per square inch to 100 pounds per square inch.

14. Suitable for operating temperature range of 33 degrees Fahrenheit - 104 degrees Fahrenheit.

C. Flow Indicator:

1. In line flow meter, calibrated for water.

2. Range from 0.5-5 gallons per minute.

3. Accuracy: ±5 percent.

4. NPT connections.

5. Pressure drop no greater than 11 pounds per square inch.

6. Brass or bronze construction.

7. Suitable for operating pressure range of 20 pounds per square inch to 100 pounds per square inch.

8. Suitable for operating temperature range of 33 degrees Fahrenheit - 104 degrees Fahrenheit.

9. Water delivered to flow meter will be filtered to 50 microns.

2.05 PIPE HANGERS AND SUPPORTS

A. Pipe Hangers for Copper Tube:

1. Hangers for tube sizes 1/2-inch to 1-1/2 inches: Carbon steel, adjustable tubing ring and malleable iron adjusting nut, both plated with copper-plated finish.

2. Hangers for tube sizes 2 inches to 4 inches: Carbon steel, adjustable clevis with copper-plated finish.

B. Pipe Supports:

1. Copper- plated carbon steel or malleable iron split tubing clamp.

C. Beam C-Clamps:

1. Use where piping is suspended from building steel.

2. Clamp type: Select on the basis of load supported and load configuration.

3. C-Clamps: Provide locknuts and cup point set screws.

4. Top flange C-clamps: use when attaching hanger rod to top flange of structural shapes.

D. Hanger Rods: Threaded on both ends or continuous threaded rods of circular cross section. No wire, chain, or perforated straps allowed.

E. Expansion Anchors:

1. Expansion anchors in accordance with CID A-A-1923A, type 4, stainless steel anchors with 3-1/2-inch minimum embedment bolt length.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. All installation shall occur in accordance with the New Mexico plumbing code.
2. Install all miscellaneous materials and appurtenances required for a complete installation including instrumentation and devices.
3. Make electrical connections in accordance with Division 26 - Electrical.
4. Provide dielectric connections wherever joining dissimilar metals. Locate unions in accessible places.
5. Make change in directions with pipe fittings.
6. Protection:
    a. Plug or cap open ends of pipe at end of each work day or other stopping point throughout construction.
    b. Tightly cover equipment.

B. Copper Tubing:

1. Clean outside surface of copper tubing that contacts fittings and inside surfaces of fittings with an abrasive material prior to making connections.
2. Use care to prevent annealing of the tube or fittings when making soldered or brazed connections.
3. When brazing connections of 2-1/2-inch and larger tubing, apply heat uniformly around the entire circumference of the tube and fittings with a multi-flame torch.
4. Wipe excess flux, solder, or brazing material off exterior of tubing and fittings before it hardens.
5. Avoid applying excess flux, solder, or brazing material to the inside surface of the tubes or fittings.
6. Cut tubes square and ream to remove burrs.

C. Fittings and Connections:

1. Bushings not permitted. Make changes in pipe sizes with fittings.
2. Provide dielectric connections wherever joining dissimilar metals, and locate in accessible places.

3. Install unions downstream of valves, equipment connections, or apparatus connections.

4. Escutcheons: Provide at finished surfaces where bare or insulated piping passes through floors, walls, or ceilings.

5. Provide sleeves for pipes passing through partitions, walls and floors.

D. Automatic Self-Cleaning Strainer:

1. Install the two self-cleaning strainer units in the piping system as shown on the drawings and in accordance with the manufacturer's instructions.

E. Mechanical Seal Cooling Water Booster Pumps:

1. Install the two booster pumps in the piping system as shown on the drawings, in accordance with standard drawing 40-D-5599 and in accordance with the manufacturer's instructions.

F. Anchors and Supports:

1. Maximum spacing between pipe hangers and supports is given in Table 35 12 74A - Maximum Spacing between Hangers and Supports for Hard Drawn Copper Tubing.

Table 35 12 74A – Maximum Spacing between Hangers and Supports for Hard Drawn Copper Tubing

Nominal Pipe Size (Inches)	Maximum Span (Feet)
1/2	5
3/4	6
1	6
1-1/4	7
1-1/2	8
2	8
2-1/2	9
3	10

G. Plastic Tape Pipe Markers:

1. Install appropriate plastic tape pipe markers for all exposed piping components, valves, and equipment.

2. Install identifying devices after completion of insulation, coverings, and painting.

3. Align with axis of piping. Install completely around pipe with markings in clear view.

4. Distance between identification: Not to exceed 20 feet on centers on straight runs, including risers and drops.

5. Provide adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

H. Nameplates:

1. Install nameplates indicating valve name or purpose indicated on drawings.

2. Chains may be provided if valve size or insulation interferes with nameplate installation.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Flush and disinfect the system per section 609.9 of the New Mexico Plumbing Code.

B. Site Tests:

1. Field test mechanical seal filtration equipment including pumping units by operating them continuously at rated flow and pressure conditions for a 4 hour period or as directed by COR to determine that they operate properly.

   a. Verify Reach pump mechanical seals are receiving proper flow at the required pressure.

   b. Test both phase 1 and phase 2 systems.

   c. Verify pumping unit vibration levels do not exceed 1/4 the acceptable vibration limits established by HI by utilizing a vibration monitor of the recordable type that records a full spectrum analysis.

   d. Record noise, vibration and motor bearing temperatures. Take readings every 15 minutes for the 1st hour, once an hour for the next 2 hours and every 15 minutes for the final hour.

2. Before initially energizing pump motors and filter assembly, successfully test all plant control monitoring and protective circuits. Include a complete check of the electrical wiring in accordance with Division 26 - Electrical.

3. Furnish all equipment and materials required for servicing and conducting operating tests including lubricating oil and grease and water needed for testing.

4. Test one seal unit assembly at a time.

5. Perform tests in presence of COR. Notify Government of test schedule at least 14 days before conducting tests.

END OF SECTION

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SECTION 33 16 14
AIR CHAMBERS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Air Chambers and Air Compressors:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American Society of Civil Engineers (ASCE)

1.	ASCE 7-05	Minimum Design Loads for Buildings and Other Structures

B. American Society of Mechanical Engineers (ASME)

2.	ASME B16.3-2011	Malleable Iron Threaded Fittings: Classes 150 and 300
3.	ASME B16.5-2009	Pipe Flanges and Flanged Fittings NPS ½ Through NPS 24
4.	ASME B16.9-2012	Factory-Made Wrought Buttwelding Fittings
5.	ASME B16.11-2011	Forged Steel Fittings, Socket-Welding and Threaded
6.	ASME B16.39-2009	Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300
7.	ASME Boiler and Pressure Vessel Code-2013	Section VIII, Rules for Construction of Pressure Vessels, Division 1
8.	ASME Boiler and Pressure Vessel Code-2013	Section IX, Welding and Brazing Qualifications

B. ASTM International (ASTM)

1.	ASTM A 36 / A 36M - 12	Carbon Structural Steel
2.	ASTM A 53 / A 53M - 12	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3.	ASTM A 139 / A 139M - 04(2010)	Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)

4.	ASTM A 516 / A 516M - 10	Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service

C. American Water Works Association (AWWA)

1.	AWWA C207-07	Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)

D. American Welding Society (AWS)

1.	AWS B2.1-2009	Specification for Welding Procedure and Performance Qualification

E. Manufacturers Standardization Society (MSS)

1.	MSS SP-85-2010	Gray Iron Globe & Angle Valves Flanged & Threaded Ends
2.	MSS SP-110-2010	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

F. National Electrical Manufactures Association (NEMA)

1.	NEMA ICS 2-2000 (2008)	Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 Volts
2.	NEMA ICS 5-2000 (2012)	Industrial Control and Systems Control-Circuit and Pilot Devices
3.	NEMA KS1-2006	Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
4.	NEMA MG1-2012	Motors and Generators
5.	NEMA 250-2008	Enclosures for Electrical Equipment (1000 Volts Maximum)
6.	IEEE 43	IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery

1.03 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 01 33 00 – Submittals, and in accordance with the requirements of Section 01 33 26 – Electrical Drawings and Data.

B. RSN 33 16 14-1, Qualifications.

C. RSN 33 16 14-2, Air Chambers Data and Drawings:

1. Checked, detailed shop drawings which include dimensions and tolerances, steel plate thicknesses, material data, joint details, ladder and platform, welding requirements; and all painting, lining, and coating requirements.

2. Design calculations, design considerations, and referenced publications and standards used in the design of the air chamber, supporting skirt, anchor bolts, and base plate.
3. Commercial products data for equipment associated with the air chamber.
4. Hydrostatic test results.

D. RSN 33 16 14-3, Air Compressors and Compressed Air Filtration System Data and Drawings:

1. Commercial products data.
2. Shop drawings or commercial products data which details the weather and sound attenuating enclosure.
3. Compressor sizing data and calculations showing the air compressor unit will deliver the minimum specified rate of air flow.
4. Performance data: Rate of flow (inlet cubic feet of free air per minute) of the air compressor unit at the normal operating pressure of 201 psig for Reach 12.1 and 111 psig for Reach 12B.
5. Assembly drawings.

E. RSN 33 16 14-4, Commercial Products Data:

1. Level indicating and switch module assembly.
2. Ball valves.
3. Globe valves.
4. Pressure safety valves.
5. Automatic drain valve.
6. Pressure gauges.
7. Check valves.
8. Safety rail for the ladder.
9. Compressed air filtration system components:
    a. Liquid separator and filter.
    b. Oil coalescing coarse filter.
    c. Oil coalescing fine filter.
    d. Oil vapor filter.
10. Oil water separator for air filtration drainage.

F. RSN 33 16 14-5, Service Manuals:

1. Air compressors.
2. Compressed air filtration system components:
    a. Liquid separator and filter.
    b. Oil coalescing coarse filter.
    c. Oil coalescing fine filter.
    d. Oil vapor filter.
3. Oil water separator for air filtration drainage.
4. Level indicating and switch module assembly.
5. Ball valves.
6. Globe Valves.
7. Pressure relief valves.
8. Automatic drain valve.
9. Pressure gauges.
10. Check valves.
11. Combination air valve.

G. RSN 33 16 14-6, Combination Air Valves:
    1. Commercial products data.
    2. Calculations that the valve will release an air rate minimum of 10 percentage greater than the air delivered by the air compressor at a pressure of 201 psig for Reach 12.1 and 111 pounds per square inch for Reach 12B.

H. RSN 33 16 14-7, Control Cabinet Equipment Layouts, Electrical Bill of Material, Nameplate Lists, Schematic Diagrams Approval Drawings:
    1. Provide separate schematic diagram drawings for air compressors showing entire control circuit, including devices mounted on air chamber.

I. RSN 33 16 14-8, Wiring Diagrams Approval Drawings:
    1. Provide wiring diagram drawings for each control cabinet.

J. RSN 33 16 14-9, Check Prints.

K. RSN 33 16 14-10, Final Drawings:
    1. Air compressor and air filtration system.
    2. Schematic diagrams.
    3. Wiring diagrams.

4. Air chamber drawings.

1.04 PERFORMANCE REQUIREMENTS

A. Design, furnish, and install 4 air chambers, 4 air compressors, 4 air filtration systems, and associated equipment.

B. Function of the Air Chambers:

1. Air chambers:

a. Provide surge protection to prevent formation of water column separation due to downsurge;

b. Maintain maximum pressure, due to the upsurge, below the design pressure limits of the pipe, fittings and valves.

2. Expected maximum internal pressure rise during the maximum upsurge, the waterhammer pressure, measured at the invert of the air chamber:

a. Reach 12.1: 224 psig (517 feet of water head).

b. Reach 12B: 145 psig (335 feet of water head).

3. During normal operations, the maximum internal pressure during normal operations measured at the invert of the air chamber are:

a. Reach 12.1: 201 psig (464 feet of water head).

b. Reach 12.B: 111 psig (256 feet of water head).

C. Structural Design Codes:

1. Design the air chambers in accordance with Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code.

2. Wind and earthquake loads: See drawing 1695-D-101.

D. Loading Conditions :

1. Wind loading during construction shall be considered if the air chamber is erected before the building is enclosed.

2. Water hammer pressure with the water level at EMERGENCY PUMPS OFF plus construction wind loading.

3. Normal operating pressure with the water level at EMERGENCY PUMPS OFF plus construction wind loading.

4. Normal operating pressure with the water level at EMERGENCY PUMPS OFF plus seismic loading.

5. Hydrostatic test condition plus construction wind loading.

6. Empty air chamber with construction wind loading.

7. Empty air chamber with seismic loading.

E. Determine steel plate thickness of the air chamber, supporting skirt, and base plate considering above conditions. A minimum thickness for the supporting skirt and base plate is shown on the drawings. Increase thicknesses if calculations show that a thicker material is needed.

F. Determine size and number of anchor bolts needed to fasten the air chamber and skirt to concrete foundation. Provide anchor bolt chairs similar to those shown on the drawings. Anchor bolt requirements:

1. Minimum anchor bolt diameter: 1.25-inch. A larger diameter bolt may be necessary.

2. Anchor bolts to be evenly spaced on the bolt circle diameter.

G. Level Transmitter and Level Indicating Assembly:

1. The switch modules and associated equipment control the automatic operation of the air compressor, air chamber emergency alarms, and pump shutdown:

a. EMERGENCY PUMPS OFF (Main pumps are locked out, alarm light on auxiliary control panel is lit, and pumping plant rotating alarm beacon is energized when the water in the air chamber reaches this level in the tank).

b. COMPRESSOR ON (Air compressor to start when the water in the air chamber reaches this level).

c. COMPRESSOR OFF (Air compressor to stop when the water in the air chamber reaches this level).

d. AIR RELEASE (Alarm light on auxiliary control panel is lit when the water in the air chamber reaches this level).

H. Air Release Valve:

1. Purpose: Maintain minimum water level in the air chamber in the event of an air compressor malfunction.

2. Locate at AIR RELEASE level as shown on the drawings.

3. Provide an air release valve with a minimum capacity 10 percent greater than amount being delivered by the air compressor.

1.05 QUALIFICATIONS

A. Welders and welding procedures: Qualified in accordance with Section IX of the ANSI/ASME Boiler and Pressure Vessel Code or under AWS B2.1, Specification for Welding Procedure and Performance Qualification. Provide the names of the welders and their experience.

B. Government may witness the welding of qualification test plates and physical testing of specimens taken from these plates. Government shall be provided 2 days of advance notice to witness the qualification test plate welding.

C. Certification of tests and results from a testing laboratory approved by the Government may be accepted in lieu of witnessing tests.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prevent damage to equipment during loading, transportation and unloading. Repair damage damaged equipment as directed by COR. Replace damaged equipment as directed by the COR.

1. Assemble and match mark to ensure correct fitting of parts in the manufacturer's shop.
2. Disassemble only as necessary for shipment.
3. Cover pipe connections with wood flange covers, pipe plugs, or other suitable means for protection and to prevent entrance of foreign matter during delivery, storage and handling.
4. Wrenches and tools:
    a. Furnish one set of special wrenches and special tools required to assemble and disassemble the air compressor and motor.

PART 2 PRODUCTS

2.01 EQUIPMENT AND MATERIALS

A. Steel Plate:

1. ASTM A 36 for tank skirts and other structural elements.
2. ASTM A 516, grade 70 with 4.1 additional tension test for pressure vessels.

B. Standard and Schedule Steel Pipe:

1. ASTM A 53, grade B.
    a. Pipe 4 inches in diameter and smaller: Galvanized.
    b. Pipe larger than 4 inches in diameter: painted in accordance with Section 09 96 20 - Coatings.

C. Electric-Fusion (Arc)-Welded, Spiral Seam Steel Pipe: ASTM A 139, Grade B or C.

D. Malleable Iron Threaded Fittings:

1. ASME B16.3.

2. Class 150 or 300, as shown on the drawings.

E. Malleable Iron Threaded Unions:

1. ASME B16.39.

2. Class 150 or 300, as shown on the drawings.

F. Welding Fittings:

1. ASME B16.9.

G. Flanges, Gaskets, Bolts, and Nuts:

1. AWWA C207.

2. Class D or E flanges as shown on the drawings, flat faced with finish suitable for flat gaskets.

3. Gasket:

a. Multi-Swell Style 3760-U as manufactured by Garlock, Website: www.garlock.com or equal with the following essential characteristics:

1) Dimensional requirements of AWWA C207.

2) NSF 61 listed.

3) Suitable for cold water service.

H. Manholes:

1. Designed by air chamber manufacturer.

2. Diameters of openings as shown on the drawings.

3. Provide a hinged manhole door.

4. Provide a handle on the door.

I. Flat Washers: SAE type. Provide flat washers under bolt heads and nuts.

J. Support Channels and Pipe Clamps:

1. P-1000 and P-115 respectively, as manufactured by Unistrut Service Company. 24400 Sperry Drive, Cleveland, OH 44145 or equal, with the following essential characteristics:

a. Minimum thickness: 12 gauge (0.1046 inch).

b. Galvanized-strip steel.

K. Level Indicating and Switch Module Assembly:

1. SureSite model as manufactured by Gems Sensors or equal, with the following essential characteristics:

a. Standard size, 2-1/2-inch diameter, 316 stainless steel material suitable for an operating pressure equal to 300 psig.

b. Provide length of level indicator as shown on drawings.

c. T8 top connection (top removal male connection) and B8 bottom connection (bottom removal male connection), as shown on the drawings.

d. Switch modules: Rated NEMA ICS 5: A600. Provide switch modules at the following levels where shown on the drawings:

1) EMERGENCY PUMPS OFF.

2) COMPRESSOR ON.

3) COMPRESSOR OFF.

4) AIR RELEASE.

L. Ladders with Safety Rail:

1. Safety rail: Saf-T-Climb as manufactured by Air Space Devices Norton Company, P.O. Box 197 Paramount, CA 90723 or approved equal; with the following essential characteristics:

a. Round cross section.

b. Allow sleeve to swing completely around when climber reaches the top platform, to allow the climber to step onto the top platform without disconnecting the sleeve.

c. Flat safety rail: Not acceptable.

d. Provide one sleeve and belt with tank.

M. Ball Valves:

1. MSS SP-110, stainless steel, full-ported, female screwed ends.

2. Cold-water pressure rating, minimum: 400 psig.

3. Bubble tight at rated pressure in either direction.

4. Suitable for operation after long periods of inactivity.

N. Pressure Safety Valves:

1. 900 series as manufactured by Kunkle Valve, 953 Old US Hwy 70 Black Mountain, NC 28711 or equal with the following essential characteristics:

a. Designed in accordance with requirements of ASME Section VIII, Division I.

b. Suitable for air service.

c. Bronze or iron body, stainless steel trim.

d. Threaded inlet and outlet.

e. Relief pressure setting for the air chamber valve equal to 258 psig for Reach 12.1 and 167 psig for Reach 12B.

O. Air Release Valves:

1. Pressure air release type.

2. Sized to allow air to be continuously and automatically released from the air chamber if the water level in the air chambers reaches the AIR RELEASE level during normal operation conditions.

3. Capacity, minimum: 10 percent greater than the standard free air rate discharge of the air compressor operating at a pressure = 201 psig for Reach 12.1 and 111 psig for Reach 12B.

4. Minimum orifice diameter: 3/16-inch.

5. Valve seat: Suitable for 300 psig for Reach 12.1 and 150 psig for Reach 12B.

6. The top of the valve to include the following features:

a. Steel balance pipe inlet that lets air flow out of the air chamber through the air discharge pipe if the water surface in the air chamber reaches the AIR RELEASE level.

b. Air discharge pipe as shown on the drawings.

7. Two petcocks:

a. One near top to permit checking effectiveness of air valve.

b. One at bottom to allow valve to be drained.

8. Internal parts, such as guides, bushings, and screws: Stainless steel or bronze.

9. Floats: Stainless steel.

10. Float-pivot supports: Brass, bronze, stainless steel, or cast iron.

11. Minimum cold-water pressure rating for all parts: 300 pounds per square inch for Reach 12.1 and 150 pounds per square inch for Reach 12B.

12. Internally threaded NPT or flanged connections as shown on the drawings.

P. Mufflers:

1. Standard High-Pressure Muffler manufactured by: Alwitco, 13805 Progress Parkway, North Royalton, OH 44133; or equal, having the following essential characteristics:

a. Vents air from the compressor discharge or from inside the air chamber to atmosphere.

b. Does not freeze under any atmospheric conditions at the air chamber.

c. Silences noise due to the motion of air across the pressure differential.

2. Calculate and provide adequate diameter of muffler.

Q. Globe Valves:

1. MSS SP-85.

2. Suitable for air service.

3. Suitable for throttling.

4. Suitable for use immediately upstream of muffler.

a. Valve diameter to match diameter of piping to muffler.

R. Check Valves:

1. Depend-A-Check valve manufactured by the Hoerbiger Corporation of America or equal, with the following essential characteristics:

a. Valve disks and springs: Constructed of stainless steel.

b. Pressure rating: 300 pounds per square inch for Reach 12.1 and 150 pounds per square inch for Reach 12B.

c. Specifically designed for air service, equal in size to the air compressor discharge.

d. For installation in the air compressor discharge line.

S. Anchor Bolts:

1. ASTM A193, Grade B7.

2. Size and number of anchor bolts for base of skirt: Determined by air chamber designer.

3. Embedded in the air chamber foundation similar to that shown on the drawings.

a. “J” or “L” shaped ends are not acceptable.

T. Air Compressor Unit:

1. Single motor-driven, air-compressor unit.

2. Rating:

a. Reach 12.1: Deliver between 55 and 60 inlet cubic feet per minute (minimum) of free air at 201 psig operating at elevation 6700 feet, 102 degrees Fahrenheit and 15 percent relative humidity. Two units are required at this rating

b. Reach 12B: Deliver between 25 and 30 inlet cubic feet per minute (minimum) of free air at 111 psig operating at elevation 6700 feet

102 degrees Fahrenheit and 15 percent relative humidity. Two units are required at this rating.

3. Base mounted.

4. Enclosed inside sound attenuating enclosure if needed to meet sound limits.

5. Suitable for installation in the space shown on the drawings and with sufficient access and working space to permit ready and safe operation and maintenance.

6. Complete with air compressor, motor, motor starter, automatic unloader, air filter, intake muffler, and necessary piping, valves, controls, and wiring.

7. A 1.25-inch diameter interconnection pipe with isolating ball valve shall be installed between the two Reach 12.1 air compressor discharge pipes. The interconnecting pipe and valve shall be installed so that either compressor can charge either Reach 12.1 air chamber when the air compressor system is operated in the manual mode.

8. A 1.25-inch diameter interconnection pipe with isolating ball valve shall be installed between the two Reach 12.B air compressor discharge pipes. The interconnecting pipe and valve shall be installed so that either compressor can charge either Reach 12.B air chamber when the air compressor system is operated in the manual mode.

U. Air Compressor:

1. Reciprocating piston type, single acting, two-stage, pressure lubricated, air cooled. Quincy compressor model D series or equal.

2. Main shaft bearings: Ball or adjustable roller-bearing type with heavy-load capacity.

3. Provisions shall be made for positive lubrication of all moving parts with food grade oil.

4. Food grade synthetic compressor oil shall have a minimum average life of 4,000 hours and shall be NSF H1 registered.

5. Include low-oil-level shutdown switch with indicating light.

6. Automatic unloading device: Unloads compressor whenever motor stops and maintains this condition until motor is operating at full speed.

7. Capable of continuous operation at specified discharge pressure and capacity without overheating.

V. Air Compressor Motors:

1. Designed for duties specified.

2. Horizontal squirrel-cage-induction type.

3. Conform to NEMA MG1, including characteristics, tests, and ratings, unless otherwise specified.
4. Lifting eyes or devices for slings: Provided on motor for lifting.
5. Totally enclosed fan cooled (TEFC) enclosure.
6. Designed for across-the-line, full voltage starting.
7. Coordinate motor torque with torque requirements of load, so that proper operation of the unit will be obtained during the sequence of starting, accelerating, and normal running.
8. Rated 3-phase, 600-hertz, 460 volts.
9. Horsepower rating: Motor will carry continuously the maximum possible compressor load developed under operating conditions specified, without exceeding nameplate rating, and without benefit of the service factor.
10. The motor will be operated in an ambient air temperature of up to 40 degrees Celsius at an elevation of 6,700 feet.
11. Maximum temperature rise of windings when motor is delivering rated output continuously at rated voltage and frequency: 80 degrees Celsius by resistance for class F, or H insulation.
12. Temperature rise of other parts of motor: In accordance with NEMA MG 1 for class B insulation.
13. Stators:
    a. Three main armature leads: Brought out of the stator frame to the terminal box, and each lead shall terminate in a bolted solderless connector.
    b. Armature lead insulation: Completely sealed so that it is equal to the armature coil insulation in regard to resistance to moisture and voltage class.
    c. Connection in terminal box to external leads: Taped.
14. Armature windings:
    a. Insulated with class F or H insulation.
    b. Insulation: Treated to prevent damage from temporary exposure to dampness.
15. Rotors:
    a. Rotor structure: Built up in accordance with modern practice and provided with squirrel-cage windings of suitable resistance for starting the motor and compressor with the required starting voltage.
16. Bearings:
    a. Antifriction bearings on each end of rotor.

b. Oil or grease lubricated.

c. Provided with facilities for draining lubricant and re-lubricating bearings without disturbing the bearing housing.

d. Self-cooled.

e. Sealed against loss of lubricant or entrance of dirt.

f. If a thrust load can occur in the motor, the bearings furnished shall be designed for the thrust load.

g. Designed so that in event of bearing failure the motor rotor cannot make contact with the stator core.

17. Motor: Painting and protective coating :

a. Paint exposed ferrous surfaces of motor in accordance with Section 09 96 20 - Coatings.

b. Internal ferrous surfaces of motor, including rotor: Finished with an applied protective covering of such composition as to effectively inhibit corrosion.

18. Controls: Provide following in addition to manufacturer's standard control devices:

a. NEMA Type 12 enclosure for motor and compressor controls with equipment designation nameplate.

b. Motor Starter:

1) Magnetic, full-voltage, NEMA type.

2) Thermal motor overload relay.

3) 120-volt, 60-hertz coil.

c. Mode Selector Switch:

1) HAND-OFF-AUTO. In AUTO position air compressor is controlled by signals from air chamber level control panel.

2) Oiltight, watertight.

3) NEMA ICS 5: A600 contact rating.

4) Provide manufacturer's standard nameplate.

d. Conform to NEMA 250, NEMA ICS 2, and NEMA ICS 5.

W. Drive:

1. Reciprocating piston type: V-belt drive with totally enclosed guard or flange mount motor.

X. Baseplates:

1. Mount air compressor and motor on a common rigid cast-iron or structural-steel baseplate.
2. Suitable for anchoring to a concrete pedestal.
3. Designed to suit the unit furnished.
4. Provide leveling bolts on bottom of the baseplate.
5. Paint exposed ferrous surfaces of motor in accordance with Section 09 96 20 – Coatings.

Y. Combination Air Intake Filter and Silencers:

1. Dry type.
2. Filter:
   a. Disposable elements.
   b. Micron rating as recommended by air compressor manufacturer.
3. If the compressor discharge has a blowoff for unloading the compressor, a silencer shall be furnished to keep the air discharge noise level within limits specified in the Field Quality Tests below.

Z. Unloaders:

1. Allows compressor motor to start and stop unloaded.
2. If a magnetic unloader is furnished: Suitable for use on a 120-volt, 60-hertz control circuit.
3. The pressure-regulating switch: Standard type, adjustable within an operating range of 80 to 110 percent of the pressure rating of its compressor.
4. Control equipment: Conform to the applicable standards of IEEE and NEMA.

AA. Appurtenances:

1. Furnish and install fasteners, lubricating devices, gaskets, and other appurtenances required to make the unit complete and ready for operation.

BB. Elapsed-time meter: On air compressor control panel.

CC. Safety Switch:

1. Provide safety switches at the air chamber air compressor. The safety switch shall serve as the in-sight disconnect for the 460-volt air compressor motor and controller.
2. Horsepower rated, 3-pole, heavy-duty, non-fusible type rated as follows:
   a. 30 amperes at 600 volts.

b. In accordance with latest edition of NEMA publication No. KS1.

3. Enclosure:

a. NEMA 250: Type 12.

b. Provided with knockouts or suitable for drilling to accommodate conduit installation shown on drawings.

c. Switch handle: Provision for locking in open or closed position with padlock.

d. Mount the enclosure on a rigid support anchored to the concrete pad adjacent to the air compressor, or may be integral with motor starter cabinet.

DD. Automatic Drain Valve:

1. Electronic Timer Drain Valve manufactured by Air Systems Products; or equal with the following essential characteristics:

a. Suitable for pressures up to 300 psig for Reach 12.1 and 150 psig for Reach 12B.

b. Automatically removes moisture.

EE. Protective Enclosure:

1. Enclose the air compressor and motor inside a sound attenuating protective enclosure if required to meet specified noise limits.

2. Steel materials.

3. Provide louvered inlet to allow adequate air flow into the air compressor.

4. Enclosure to be removable for access to the air compressor and motor.

5. Anchor enclosure to the concrete pad.

FF. Compressed Air Filtration System:

1. Each of the four air compressors shall be furnished with an air filtration system that filters the air to ISO 8573.1, Quality class 1.2.1 with the exception that an air dryer is not required if the particulate and oil quality requirements are met.

2. The maximum particulate size shall be 0.1 microns and the oil (liquid and gas) shall not exceed 0.008 parts per million in the filtered air.

GG. Compressed Air Filtration System Oil/Water Condensate Collection System and Separator:

1. A plumbing system (tubing with push to connect fittings) shall be provided to convey oil/water condensate from each filter element to an oil/water condensate separator.

2. A collection system and oil/water separator shall be provided for each air compressor.

3. The plumbing system will connect all filter drains to a Sch. 80 PVC condensate manifold.

4. The manifold will drain into the oil/water condensate separator.

5. The oil/water separator shall remove oil from the condensate so that the separated condensate can be conveyed to the plant drain without violation of federal, state and local environmental regulations.

6. Separated oil shall be held in a reservoir for proper disposal by the plant operators.

2.02 AIR CHAMBER FABRICATION

A. Fabricate in accordance with ASME of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code.

B. Stamp finished tank with official ASME code symbol.

C. Air Chamber Weld Tests:

1. The air chamber manufacturer shall maintain a quality-assurance program to ensure that minimum standards are met. It shall include an ASME Authorized Inspector to verify that welders and welding procedures are qualified, procedures are being followed within the limitations of testing, and quality assurance functions are being implemented.

2. Radiograph all longitudinal and girth butt welds. The Engineer will witness all weld tests.

3. Radiograph in accordance with requirements of the ASME Boiler and Pressure Vessel Code, unless otherwise provided for in these specifications.

4. Before radiographing weld, place suitable identification markers adjacent to weld. Paint, stamp, or fasten the markers to shell as directed by the Engineer. Do not remove the markers until all of the welds in one joint have been accepted.

5. In addition, provide temporary corresponding markers at each film location so that the images of these markers will appear on the radiographs.

6. Deliver radiographs to the Engineer.

7. The Authorized ASME Inspector will judge the acceptability of welded joints.

8. Repair defects in welds in accordance with requirements of the ASME Code.

9. Portions of welds that have been repaired are to be radiographed again.

PART 3 EXECUTION

3.01 INSTALLATION

A. Air Chambers:

1. Mount air chamber with supporting skirt on grout pad on concrete foundation.
2. Securely anchor with anchor bolts and chairs.
3. Terminate conduit and wiring for the level transmitter and level indicating assembly at the control board.

B. Air Compressors:

1. Clean, reassemble, align, shim, and anchor air compressor unit in its final position on a 1-inch thick grout pad on the concrete foundation in accordance with manufacturer's installation instructions and as shown on drawings.
2. Install control and unloading devices, piping connections from air compressor unit to air chamber, gauge, and electrical connections to the compressor, motor starter, and control panel.

3.02 CONTRACTOR FIELD QUALITY CONTROL

A. Air Chamber Hydrostatic Pressure Test:

1. Perform hydrostatic pressure test in the shop or in the field as necessary. Provide Government 30 days advance notice of shop test or 2 days advance notice for field test.
2. Test before cleaning and painting.
3. Welded attachments to be connected to the air chamber prior to testing.
4. Test pressure: Equal to that shown on the drawings.
5. Provide all temporary supports, bulkheads, air vents, dead weight tester, and other equipment necessary to perform the hydrostatic tests.
6. Remove temporary supports before final placement of the air chamber on its base.
7. Provide equipment necessary to complete test:
8. Provide a minimum of two calibrated pressure gauges.
    a. Upper limit of pressure gauges: 1.5 to 3 times required test pressure.
    b. Accuracy: To within 1 percent of full scale.
    c. One shall be recording type.
    d. Gauges shall be calibrated within 30 days prior to use.

e. Calibrate pressure gauges with a deadweight tester. The Engineer will witness calibration of pressure gauges.

9. Water for field test:

a. Obtain adequate supply of potable water, transport to the site, and dispose of the water after the test.

b. Temperature of test water, minimum: 45 degrees Fahrenheit.

10. Test procedure:

a. Fill air chamber with water.

b. Uniformly increase pressure until required test pressure is reached.

c. Make time - pressure record of the hydrostatic pressure test.

d. The Engineer will witness the hydrostatic test.

e. Apply and release test pressure three times.

f. Hold at required pressure each time until welded joints and seams can be examined. Hold time shall not be less than 15 minutes.

11. Repair defects, re-radiograph repairs, and retest air chamber.

12. No welding permitted on air chamber after hydrostatic test has been accepted.

B. Air Compressor Testing:

1. Before making electrical connections and energizing compressor motor perform motor insulation resistance test as follows:

a. Use 500 volt megger. Apply test voltage for 1-minute.

b. If no evidence of distress or insulation failure is observed and the insulation resistance reading is 5 megaohms or greater, the motor is considered to have passed the test.

c. Test in accordance with IEEE 43.

d. If the motor fails the test, correct in accordance with the manufacturer's recommendations subject to approval of the COTR.

2. After the air compressor unit and associated piping and control equipment have been installed, test in accordance with manufacturer's operating instruction to determine that it operates properly.

3. Run-in period:

a. Operate compressor without load for a period of not less than 1 hour.

b. During operation and after shutdown, observe to determine that parts are in proper alignment, are receiving correct lubrication, and there is no undue heating, as recommended by the manufacturer.

c. Test control system and make necessary adjustments to ensure proper operation of compressor.

d. Repair or replace wiring or equipment damaged during installation or in checkout process.

e. Set and test switch devices on level transmitter and level indicating assembly to start compressor when water level in air chamber is at COMPRESSOR ON level, and to stop compressor when water level in air chamber is at COMPRESSOR OFF level when operating under start stop (AUTO) control.

f. Without additional cost to the Government, make necessary adjustments until operation of the unit is approved.

4. Sound level test:

a. Test after compressor is installed and operating.

b. Noise level: Measured in accordance with CAGI-S5.1.

c. Maximum noise level, including unloader blowoff:

1) 80 dBA (decibels A).

d. Measure 10 feet from the outside of the air chamber enclosure in direction of highest sound level (A) scale reading (including within the pumping plant building).

5. If test readings show equipment exceeds specified noise level, install soundproofing enclosure on air compressors to lower noise level to specified limit.

3.03 PAINTING

A. Paint in accordance with Section 09 96 20 – Coatings.

END OF SECTION

SECTION 33 16 40
WATER STORAGE TANK

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Water Storage Tank:

1. Payment: Lump sum price offered in the schedule.

a. Includes:

1) Designing, furnishing, installing, testing tank and tank foundation, and associated equipment.

1.02 REFERENCE STANDARDS

A. American Concrete Institute (ACI)

1.	ACI 350-06	Code Requirements Of Environmental Engineering Concrete Structures and Commentary

B. American Society of Mechanical Engineers (ASME)

1.	ASME B16.9–2012	Factory-made Wrought Steel Buttwelding Fittings.
2.	ASME B16.11–2011	Forged Steel Fittings, Socket-welding and Threaded

C. ASTM International (ASTM)

1.	ASTM A 53/A 53M – 12	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded
2.	ASTM A 105/A 105M – 12	Carbon Steel Forgings for Piping Applications

D. American Water Works Association (AWWA)

1.	AWWA C200–12	Steel Water Pipe – 6 In. (150 mm) and Larger
2.	AWWA C207–07	Steel Pipe Flanges for Waterworks Service – Sizes 4 In. Through 144 In.
3.	AWWA C606–11	Grooved and Shouldered Joints
4.	AWWA C 652-11	Disinfection of Water Storage Facilities.

5.	AWWA D100–11	Welded Steel Tanks for Water Storage
6.	AWWA D110-04	Wire and Strand Wound, Circular, Prestressed Concrete Water Tanks
7.	AWWA D115-06	Tendon-Prestressed Concrete Water Tanks
8.	MSS SP-110-2010	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals.

B. RSN 33 16 40-1, Designer, Erection Engineer and Contractor Qualifications.

C. RSN 33 16 40-2, Commercial Products Data:

1. Data for the following:
    a. Grooved-end couplings.
    b. Pipe couplings.
    c. Safety rails for ladders.
    d. Valves.
    e. Liquid level indicator.
    f. Pressure transmitter.

D. RSN 33 16 40-3, Final Drawings:

1. In Government Format in accordance with Section 01 33 00 - Submittals.
2. Provide detailed drawings which clearly show the as-built conditions of the tank, and associated steel pipe. Include dimensions and tolerances, material data, joint details, painting, and welding.
3. Clearly mark drawings to show field modifications.
4. Operation and Maintenance Manuals.

1.04 DESIGN REQUIREMENTS

A. General:

1. Liquid volume: 1.1 MGAL.
2. Vent sized for an inlet rate of 38.41 cubic feet per second (cfs).
3. Vent sized for withdrawal rate of 38.41 cfs.
4. Refer to drawings for dimensions, elevations, tank venting, pipe penetrations, access hatches, and piping.

5. Account for openings and penetrations through tank elements.

6. Pressure transmitter and storage tank connection pipe heating system Provision for pipe and appurtenance supports shall be made as required. Design, furnish, and install pipe supports and brackets attached to the tank.

B. Foundation:

1. Coordinate design of tank and foundations

2. Design foundations with the centroids of superimposed loads at their actual locations.

3. Refer to Section 53 10 00 – Geological Investigations and Section 31 23 10 – Earthwork for foundation subgrade conditions.

4. The foundation shall be an on-grade structure. Bearing on subgrade as indicated on the drawings.

5. Support tank, equipment, accessories and overflow piping.

6. AWWA D110 and AWWA D115:

a. Minimum concrete thickness:

1) Footing: 12 inches.

2) Conventionally reinforced membrane floor: 6 inches.

3) Prestressed membrane floor: 5 inches.

4) Other Cast-in-Place Concrete elements: 8 inches or as required by ACI 350 if greater than 8 inches.

b. Minimum Concrete Cover: In accordance with ACI 350.

1) Top cover for membrane floors: 1-1/2-inch.

2) Bottom cover for membrane floors: 2-inch.

3) Conventionally reinforced concrete exposed to earth, weather, or liquid: 2-inch.

4) Pre-stressed or post-tensioned concrete exposed to earth, water, or liquid: 1-1/2-inch for floor and roof, 1-inch for walls.

c. Foundation:

1) Minimum reinforcement in each direction: 0.5 percent of the gross concrete area for non-prestressed membrane floors complying with ACI 350 relative to joint spacing.

2) Floors or portions of the foundation with active, flexural reinforcement shall be designed and have minimum reinforcement in accordance with ACI 350, based on distance between shrinkage-relieving joints.

3) Expansion joints in the foundation shall not be permitted, except at blockouts or penetrations.

4) Provide watertight joints with waterstops as detailed in Section 03 15 12 – PVC Waterstops.

1.05 WARRANTY

A. Warrant tank for extended period in accordance with the clause at FAR 52.246-21, Warranty of Construction.

1.06 QUALIFICATIONS

A. Tank and Foundation Designer Qualifications: Professional Structural Engineer registered in the State of New Mexico.

B. Erection Engineer:

1. Specializes in construction of applicable tank.
2. Minimum 3 years experience in the design, fabrication, and erection of regulating tank using the applicable AWWA, ASME, AWS, NSF/ANSI and OSHA standards.

C. Designer: Designed at least 5 similar projects.

D. Installer: Installed at least 5 similar tank projects.

E. Manufacturer: Manufactured at least 5 similar tank projects.

F. Contractor: Installed at least 5 water and or waste water tanks.

PART 2 PRODUCTS

2.01 TANK OPTIONS

A. In accordance with Table 33 16 40A – Tank Options.

Table 33 16 40A – Tank Options

Tank Designation	Options Allowed	Section
Steel	AWWA D100	33 16 50 – Steel Tank
Concrete Wire Wrapped	AWWA D110	33 16 51 – Concrete Wire Wrapped Tank
Concrete Prestressed	AWWA D115	33 16 52 – Concrete Prestressed Tank.

2.02 FITTINGS AND ACCESSORIES

A. Standard and Schedule Steel Pipe:

1. ASTM A 53, grade B:

a. Pipe 4 inches in diameter and smaller: Galvanized.

b. Pipe larger than 4 inches in diameter: painted in accordance with Section 09 96 20 - Coatings.

B. Welding Fittings:

1. ASME B 16.9 or ASTM A 105.

C. Threaded Fittings:

1. ASME B16.11 or ASTM A 105.

D. Flanges:

1. AWWA C 207, ring type, Class D.

E. Gasket:

1. Multi-Swell Style 3760-U as manufactured by Garlock, Website: www.garlock.com or equal with the following essential characteristics:

a. Dimensional requirements of AWWA C207.

b. NSF 61 listed.

c. Suitable for cold water service.

F. Flange Bolts:

1. AWWA C 207, grade A or B.

G. Pipe Couplings:

1. AWWA C606; Flexible joint type with rolled or cut grooves.

H. Pressure Transmitter: Rosemount Model 3051TG in-line pressure transmitters by Emerson Process Management, Rosemount Measurement, 8200 Market Boulevard, Chanhassen, MN 55317 or equal with the following essential characteristics:

1. Measurement range: 0 to 15 psig.

2. Isolating diaphragm: 316L stainless steel.

3. Sensor fill: Silicone oil.

4. Liquid Crystal Display with local operator interface.

5. Output: 4-20 milliamperes D. C.

6. Transmitter: Suitable for operation on 10 to 36 volt D.C. external power supply.
7. Adjustable offset (zero) and span.
8. Accuracy: Plus or minus 0.25 percent.
9. Vent/Drain valve.
10. Housing: Aluminum with 1/2-inch-14 NPT conduit entry size.
11. Enclosure: Insulated NEMA Type 4X with heater for outdoor installation in temperatures ranging down to -15 degrees Fahrenheit.
12. Process connection: 1/2-inch-14 NPT female.
13. Transmitter materials in contact with potable water shall be National Sanitation Foundation listed.
14. Heat trace and insulate piping and valves between water storage tank and pressure transmitter.
15. Transient Protector:
    a. Protects pressure transmitter from damage due to lightning and switching surges.
    b. Compatible with pressure transmitter output of 4 – 20 milliamperes.
    c. Be of same manufacturer as pressure transmitter.
    d. Mounting:
        1) As shown on the drawings.

I. Ball Valves:

1. MSS SP–110, stainless steel, full–port, female threaded ends.
2. Pressure rating: Minimum 200 psig cold–water.
3. Bubble tight at rated pressure in either direction
4. Suitable for operation after long periods of inactivity.

J. Liquid Level Indicator:

1. Model 92302, as manufactured by Shand & Jurs 5911 Butterfield Road, Hillside, IL 60162; Varec, Figure No. 6700, 5834 Peachtree Corners East Norcross (Atlanta), GA 30092; or equal, having following essential characteristics:
    a. Float-actuated level gauging system consisting of a target sliding vertically over an aluminum gauge board.
    b. Gauge board graduated in feet and inches with numerals at each foot.
    c. Type 316 stainless steel for float, cable, and guide wires.
    d. At least three gauge board support brackets to match tank material type

e. Liquid seal.

K. Safety Rail for Ladders:

1. Saf-T-Climb as manufactured by Air Space Devices of Norton Company, P.O. Box 197, Paramount, CA 90723; ; or equal, having following essential characteristics:

a. Round cross section.

b. Allow sleeve to swing completely around when climber reaches the top platform, to allow the climber to step onto top platform without disconnecting the sleeve.

c. Flat safety rail is not acceptable.

d. Provide one sleeve and belt for each tank.

L. Ladders:

1. Metal safety steps for ladders: "Tread-Grip" No. 11–gauge sheet steel ladder rungs, manufactured by Morton Manufacturing Company, P.O. Box 640, Libertyville, IL 60048; "One Diamond Ladder Rung" manufactured by GS Metals Corporation, P.O. Box 7, Pinckneyville, IL 62274; 1–inch–square "Mebac" solid ladder rungs, manufactured by IKG Industries, 270 Terminal Avenue, Clark, NJ 07066; or equal, having following essential characteristics:

a. Concentrated design load at center of rung of at least 200 pounds.

b. Raised button, serrated–edge, or metal bonded encapsulated grit surface.

2. Safety posts: "Ladder – Up" ladder extensions manufactured by The Bilco Company, P.O. Box 1203TR, New Haven, CT 06505; or equal, having following essential characteristics:

a. High–strength galvanized steel.

b. Tubular section that provides upward and downward movement and locks automatically when fully extended in up position.

c. Upward and downward movement controlled by stainless steel springs.

d. Operates in corrosive environment.

e. Attach ladder extensions securely to ladder rungs

f. Extend ladder extensions a minimum of 42 inches above walking surface.

M. Hinged, lockable, safety gate over the bottom of the ladder safety cage.

N. Lockable roof hatch with rubber sealing gasket.

O. Provide a safety platform as shown on drawing 1695-D-225 for steel tanks. Platform for concrete tanks shall be similar.

P. Pressure transmitter and storage tank connection pipe heating system

1. Pressure transmitter heating system shall prevent the pressure transmitter, connecting pipe to storage tank and isolation valve from freezing in temperatures as low as minus 15 degrees Fahrenheit.
2. Self-regulating heat tracing cable:A conductive-polymer heating matrix between two parallel bus connectors, with a copper grounding braid as a safety conductor to provide a continuous ground.
3. 120 volt, 60 hz hard wired power connection.
4. Ambient sensing thermostat.
5. Heat tracing end termination.
6. Heat rated attachment tape.
7. Fiberglass insulation, 1" minimum.
8. Stainless steel pipe jacket and stainless steel clamps.
9. Stainless steel valve box.
10. Weather proof construction suitable for outdoor environment.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install inlet, outlet, drain and overflow piping in accordance with drawings 1695-D-224 and 1695-D-226, Section 35 21 94 - Steel Manifolds and Section 35 22 14 – Valves and Equipment.

1. Furnish and install supports and bracing as required to hold the steel pipe in place and prevent distortion during erection, placing of concrete, and backfilling.
2. Furnish and install pressure transmitter and storage tank connection pipe heating system per manufacturer's design guidelines.

B. Install tank in accordance with appropriate section for proposed tank option.

C. Sterilize the completed tank using solution containing 200 ppm of chlorine following the criteria found in AWWA C652.

3.02 SERVICES OF ON–SITE ERECTION ENGINEER

A. Furnish the services of an on–site erection engineer to supervise and be responsible for erecting the storage tank. The erection engineer shall be onsite during all phases of installation of the storage tank.

B. Coordinate the work of the erection engineer with COR.

END OF SECTION

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SECTION 33 16 50

STEEL STORAGE TANK

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Measurement and Payment: In accordance with Section 33 16 40 – Water Storage Tank.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A 36/A 36M–12	Carbon Structural Steel
2.	ASTM A 193 / A 193M - 12b	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
3.	ASTM A 283/A 283M–12a	Low and Intermediate Tensile Strength Carbon Steel Plates
4.	ASTM A 1011/A 1011M-12b	Steel, Sheet and Strip, Hot–Rolled, Carbon Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength Steel

B. American Water Works Association (AWWA)

1.	AWWA D100–11	Welded Carbon Steel Tanks for Water Storage

C. American Welding Society (AWS)

1.	AWS D1.1/D1.1M-10	Structural Welding Code – Steel

1.03 DESIGN REQUIREMENTS

A. Tank Design Requirements:

1. Refer to Section 33 16 40 – Water Storage Tank.
2. In accordance with the requirements of sections 2, 3, and 7 through 13 of AWWA D100, these specifications and drawings 1695-D-207 through 1695-D-209.
3. Butt welds shall have complete penetration.
4. Design anchor bolts, roof, platforms, ladder, safety rail, and associated items in accordance with AWWA D100, Drawings and Section 33 16 40 - Water Storage Tank.

a. Anchor bolt:

1) Mechanical.

2) Design number and diameter.

3) Minimum diameter: 1-1/4 inches.

4) The diameter of the bolt circle shown on the drawings is the maximum size allowed for the tank.

5) Provide anchor bolt chairs for the anchor bolts.

5. Reinforced concrete foundation design requirements:

a. In accordance with AWWA D100 and as shown on the drawings (with grouted base ring and oiled sand cushion).

b. Concrete requirements: In accordance with Section 03 30 00 – Cast-In-Place Concrete.

c. Grout requirements: In accordance with Section 03 63 00 – Epoxy Grout.

1.04 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 01 33 00 – Submittals.

B. RSN 33 16 50–1, Shop Drawings, Design Calculations, and Design Data:

1. Design calculations for steel storage tank.

2. Provide checked, detailed shop drawings of steel storage tank which include dimensions and tolerances, material data, joint details, welding requirements; and painting, lining, and coating requirements.

3. Provide checked detailed design drawings of ringwall foundation showing concrete foundation layout, elevations and dimensions; typical sections through the ringwall foundation.

a. Show steel reinforcement details and sizes including bar lengths, location of construction joints and lap splices.

b. Include anchor bolt setting plan that shows size, location and projection of anchor bolts; base mounting detail that shows tank bottom, grout and sand cushion.

4. Design calculations for steel storage tank ringwall foundation.

a. List of loading criteria that includes load values, specific code references and load combinations.

b. Design data that shows magnitude and direction of steel regulating tank base reactions and anchor bolt loading.

c. Maximum bearing pressures.

5. Sign and seal by design engineer registered as a Professional Engineer in the State of New Mexico.

C. RSN 33 16 50–2, Welder Qualifications.

D. RSN 33 16 50–3, Nondestructive Weld Test Reports:

1. Nondestructive weld test reports for steel storage tank.

1.05 QUALIFICATIONS

A. Qualify welders in accordance with AWWA D100 using procedures, materials, and equipment of the type required for the work.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Steel Tank:

1. Steel plate:

a. ASTM A 283, grade C or D; or ASTM A 36.

2. Steel sheet:

a. ASTM A 1011, grade 40, 45, or 50.

B. Steel Structure Associated with Steel Tank:

1. Steel shapes, plates and bars.

a. ASTM A 36.

C. Anchor Bolts:

1. ASTM A 193, grade B7.

2. Studs with injection adhesive or capsule adhesive:

a. Parabond manufactured by Molly Division, Emhart Industries Incorporated, 504 Mount Laurel Avenue, Temple, PA 19560; the HVA Adhesive Anchor System or “HIT HY 150” manufactured by Hilti, P.O. Box 21148, Tulsa, OK 74121; or equal, having following essential characteristics:

1) The stud and epoxy combination to be furnished by the same manufacturer.

2) End of stud: Double cut point.

D. Support Channels and Pipe Clamps:

1. P–1000 and P–115 respectively, as manufactured by Unistrut Corporation, 4118 South Wayne Road, Wayne, MI 48184; or equal, having following essential characteristics:
   a. Minimum 12–gauge.
   b. Galvanized–strip steel.

2.02 TANK CUSHION

A. Provide an oiled sand cushion to support the steel storage tank bottom in accordance with AWWA D100.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install and hydrostatically test in accordance with AWWA D100 and Section 33 16 40 – Water Storage Tank.

B. Testing of Welds: AWS D1.1.
   1. Radiographic testing for welded-shell butt-joints.
   2. Air arc gouge testing where radiographic inspection is not feasible.
   3. Ultrasonic testing for all groove welds.

3.02 PAINTING

A. Refer to Section 09 96 20 – Coatings.

END OF SECTION

SECTION 33 16 51

CONCRETE WIRE WRAPPED TANK

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Measurement and Payment: In accordance with Section 33 16 40 – Water Storage Tank.

1.02 REFERENCE STANDARDS

A. America Concrete Institute (ACI)

1.	ACI 350-06	Building Code Requirements for Environmental Engineering Concrete Structures
2.	ACI 350.1-10	Tightness Testing of Environmental Engineering Concrete Containment Structures and Commentary
3.	ACI 350.3-06	Seismic Design of Liquid-Containing Concrete Structures and Commentary
4.	ACI 372-03	Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures
5.	ACI 506R-05	Guide to Shotcrete
6.	ACI 506.2-95	Shotcrete

B. American Society of Civil Engineers (ASCE)

1.	ASCE 7-05	Minimum Design Load for Buildings and Other Structures.

C. ASTM International (ASTM)

1.	ASTM A 185 /A 185M – 07	Steel Welded Wire Reinforcement, Plain, for Concrete
2.	ASTM A 227 /A 227M - 06(2011)	Steel Wire, Cold-Drawn for Mechanical Springs
3.	ASTM A 416 /A 416M - 12a	Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
4.	ASTM A 421 /A 421M - 10	Uncoated Stress-Relieved Steel Wire for Prestressed Concrete
5.	ASTM A 475-03(2009)	Zinc-Coated Steel Wire Strand.

6.	ASTM A 497 /A 497M - 07	Steel Welded Wire Reinforcement, Deformed, for Concrete
7.	ASTM A 586 - 04a(2009)	Zinc-Coated Parallel and Helical Steel Wire Structural Strand
8.	ASTM A 603 - 98(2009)	Zinc-Coated Steel Structural Wire Rope
9.	ASTM A 648 - 12	Steel Wire, Hard-Drawn for Prestressed Concrete Pipe.
10.	ASTM A 653 /A 653M - 11	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
11.	ASTM A 722 /A 722M - 12	Uncoated High-Strength Steel Bars for Prestressing Concrete
12.	ASTM A 821 /A 821M - 10	Steel Wire, Hard-Drawn for Prestressed Concrete Tanks
13.	ASTM A 882 /A 882M - 04a(2010)	Filled Epoxy-Coated Seven-Wire Prestressing Steel Strand
14.	ASTM C 881 /C 881M - 10	Epoxy-Resin-Base Bonding Systems for Concrete
15.	ASTM D 1056 - 07	Flexible Cellular Materials—Sponge or Expanded Rubber
16.	ASTM D 1752 - 04a(2008)	Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
17.	ASTM D 2000 - 12	Standard Classification System for Rubber Products in Automotive Applications.
18.	ASTM D 2240 - 05(2010)	Standard Test Method for Rubber Property - Durometer Hardness.

D. American Water Works Association (AWWA)

1.	AWWA D 110-04	Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks

E. International Building Code (IBC)

1.	IBC 2009	International Building Code (IBC).

F. Occupational, Health and Safety Administration (OSHA)

G. Post Tensioning Institute (PTI)

1.	PTI DC10.7-83	Post-Tensioned Commercial and Industrial Floors

2.	PTI TAB.1-06	Post-Tensioning Manual, Sixth Edition
3.	PTI DC20.8-04	Design of Post-Tensioned Slabs Using Unbonded Tendons
4.	PTI M10.2-00	Specification for Unbonded Single Strand Tendons
5.	PTI M10.3-00	Field Procedures Manual for Unbonded Single Strand Tendons
6.	PTI M50.3-12	Specification for Grouting of Post-Tensioned Structures
7.	PTI CRT20	Manual for Certification of Plants Producing Unbonded Single Strand Tendons, Sixth Edition.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 33 16 51-1, Approval Drawings and Data:

1. Shop drawings:
   a. Show all details that shall be used in the fabrication of tank components and tank construction.
2. Manufacturer’s installation instructions.
3. Tank surface finishes and coating materials.
4. Concrete design mixes, including shotcrete.
5. Structural design calculations or analyses, sealed by registered professional engineer.
6. Provide 2- by 2-foot area of shotcrete finishes to be used as the standard for acceptance of installed construction.

C. RSN 33 16 51-2, Test Reports:

1. Submit certified mill test reports indicating ultimate and yield strength of all reinforcing bars, prestressing and poste tensioning steel, and any other steel components.

D. RSN 33 16 51-3, Documentation:

1. Furnish applicable "Affidavits of Compliance" to building codes.

E. RSN 33 16 51-4, Final Drawings and Data:

1. Submit final drawings and data consisting of approved detailed shop drawings.
2. Submit Operation and Maintenance Manuals.

1.04 DESIGN REQUIREMENTS

A. Tank:

1. Refer to Section 33 16 40 – Water Storage Tank.
2. Design one of the following in accordance with ACI 350, and AWWA D110:
   a. Type I: Cast-In-Place Concrete with Vertical Prestressed Reinforcement.
   b. Type II: Shotcrete with a Steel Diaphragm.
   c. Type III: Precast Concrete with Steel Diaphragm.
3. Design floor and roof for single concrete placements, no joints are allowed.
4. Floor design shall take into account concentrated loads from the roof column supports.
5. The perimeter wall shall be wire-wound and vertically prestressed as applicable. If cast in place, full-height placements not to exceed 75 feet in length.
6. Design core wall for initial compressive forces applied by prestressing and other applicable loadings.

B. Earthquake resistance based on ACI 350.3 and the requirements of AWWA D110.

C. Base design on AWWA D110 and ACI 350 load combinations, with the basis for loadings as defined herein.

1. Load combinations for prestressed or post-tensioned items shall be in accordance with AWWA D110 and ACI 350.
2. Load combinations for non-prestressed/post-tensioned items shall be in accordance with ACI 350.
3. Snow load: See drawings for definitions of snow loads.

D. Wind Loads: (during construction and prior to backfilling):

1. See drawings for definition of wind loads.
2. Uniform live load over roof area: 20 psf. (non-reducible).

E. Design and detail wall, foundation and roof per ACI 350 and AWWA D110.

F. Design for lowest mean ambient temperature and for temperature differential required for project location.

G. Roof:

1. Conventionally reinforced construction: In accordance to ACI 350 relative to spacing between joints, minimum reinforcement ratios, and cracking serviceability (including serviceability load factors).
2. Prestressed/post-tensioned construction: in accordance with AWWA D110 and ACI 350.

H. Waterstops:

1. Adhesive waterstops are not permitted.
2. See Section 03 15 12 - PVC Waterstops.
3. For sliding joints, deflection data shall be submitted and summarized from the tank analysis for these locations.
4. Shear, load and deflection capabilities for the proposed waterstop shall be certified in writing by the waterstop manufacturer and shall be adequate for the movement indicated in the tank analysis.
5. Continuous waterstops shall be used at all wall/footing and roof/wall joints. These joints shall be specifically detailed to remain watertight.

1.05 QUALIFICATIONS

A. Prestressing, Post-tensioning Supplier/Installer:

1. In addition to qualifications listed in Section 33 16 40 – Water Storage Tank:
   a. Provide post-tensioning systems from a Post-Tensioning Institute (PTI) Certified Plant.
   b. Erection engineer shall be a full-time employee of the pre-stressing and post-tensioning and wire-winding supplier/installer.

PART 2 PRODUCTS

2.01 TANK

A. AWWA D110 Tank as manufactured by DN Tanks, Incorporated, 351 Cypress Lane, ElCajon, CA, 92020; The Crom Corporation, 250 SW 36th Ter, Gainsville, FL 32607, Preload, Incorporated, 49 Wireless Blvd #200, Hauppauge, NY 11788, Precon Tanks, 115 SW 140th Ter, Newberry, FL 32669, or equivalent with the following essential characteristics:

1. Materials:
   a. General requirements:
      1) Comply with AWWA D110, PTI TAB.1and ACI 350.
   b. Concrete:
      1) Wall, interior columns, and roof – 28-day compressive strength not less than 4,500 pounds per square inch (psi) and shall be air entrained.
      2) Floor – 28-day compressive strength not less than 4,500 psi and no air entrainment.
      3) Superplasticizer and water reducing admixture shall be incorporated into floor concrete.
   c. Shotcrete:

1) 28-day compressive strength not less than 4,500 psi.
2) Cement: Conform to Section 03 30 00.
3) Conform to ACI 506.2.

2. Prestress wire or strand for circumferential wrapping:

   a. Cold drawn, high-carbon wire shall conform to ASTM A 821, ASTM A 227, ASTM A 421, and A648 Class II, as applicable.

   b. Strand shall conform to ASTM A 416 or A475, as applicable.

   c. Where the tank surface is exposed to earth, weather, or liquid and less than 2 inches of concrete cover is provided, strand or wire shall be galvanized per the requirements ASTM A 586, Table 4, for a Class A coating.

3. Reinforcing bars, wire mesh:

   a. Reinforcing Bars: ASTM A 615, Grade 60.

   b. Wire Mesh: ASTM A 185 or ASTM A 497.

   c. Conform to Section 03 20 00 – Concrete Reinforcing.

4. Wedges:

   a. Wedge shall conform to PTI TAB.1. Wedge shall not break into separate pieces upon stressing.

   b. Designed to securely anchor the strand without significantly reducing ductility of the strand or tendon.

   c. Strand slip after anchoring shall not be permitted.

   d. Prevent breaking of individual strand wires in the wedges during stressing.

   e. Achieve dynamic fatigue and impact loading resistance without strand slippage or wire breakage.

5. Steel diaphragm (as applicable):

   a. Provide vertically ribbed steel sheets with adjacent and opposing channels that provide a mechanical bond to the concrete.

   b. Conform to ASTM A 653.

   c. Minimum thickness: 24 gauge.

   d. Galvanized with a minimum G90 coating per table 1 of ASTM A 653.

6. Elastomeric materials:

   a. Bearing pads conforming to ASTM D 2240 or ASTM D 2000.

   b. Sponge filler conforming to ASTM D 1056 or ASTM D 1752.

   c. Epoxy-ASTM C881 Type III, Grade I.

7. Strand for earthquake cables:

   a. Galvanized or epoxy coated with a fusion-bonded, grit-impregnated coating according to ASTM A 882.

b. ASTM A 416, grade 250 or 270 before galvanizing, ASTM A5 86, ASTM A 603, or ASTN A 475 after galvanizing. Only hot-dipped galvanizing shall be permitted for zinc coating.

8. Vertical/Roof/Floor prestressed reinforcement (as required):

a. Strand: ASTM A 416, grade 250 or 270.

b. Threadbar: ASTM A 722, grade 150 or 160.

c. Post-tensioning systems shall be produced by a PTI certified plant and tested to meet the requirements of ACI 350 for corrosion protection.

d. Post-tensioning systems shall be fully encapsulated.

e. Prestressed reinforcing left in ducts for more than 10 days prior to grouting shall be corrosion-protected in accordance with AWWA D110.

9. Ducts for bonded tendons:

a. Ducts for bonded tendons shall be manufactured from corrosion-resistant materials and shall comply with the PTI Guide Specification, "Acceptance Standards for Post-tensioning Systems."

10. Grout fitting:

a. Grout fittings shall conform to PTI M50.3.

b. Tendons shall have grout openings at stressing anchorages.

c. Provide grout vents or drain holes low and high points.

d. Prevent grout leakage at grout openings or vents.

11. Grout materials: PTI M50.3 and AWWA D110.

12. Couplings:

a. Couplings for bonded tendons shall not reduce the elongation of rupture below the requirements of the tendon itself.

b. Use where approved by Erection Engineer.

2.02 ACCESSORIES

A. Access Doors:

1. Materials:

a. Aluminum.

b. Stainless steel or aluminum bolts.

B. Interior Ladder:

1. Type 304 stainless steel.

2. Requirements for interior ladder: Comply with OSHA and the Building Code.

3. All supports on the tank interior shall be stainless steel.

C. Silt Stops:

1. Provide removable silt stop(s) at all discharge pipes and at other locations shown.

PART 3 EXECUTION

3.01 CONSTRUCTION

A. Comply with AWWA D110, ACI 372 and ACI 350.

B. Do not place concrete floor and foundation until subgrade approved by Erection Engineer.

C. Core Wall:

1. Provide continuous and full length steel diaphragm between tank contents and prestressing wires.
    a. With no horizontal joints.
    b. Mechanically seam vertical diaphragm joints except where located between wall panels, where either mechanical seaming or sealing with epoxy may be employed.
    c. Seal all vertical diaphragm joints to be full watertight.
    d. Piercing of the diaphragm is not permitted except by design.
    e. Do not allow form ties pierce the diaphragm.
2. Fabricate precast panels to the curvature of the tank radius.
    a. Tolerance in panel wall thickness: -0 to +1/4-inch.
    b. Place concrete for each panel in one continuous operation.
3. Locate bearing pads and hold them in position prior to erection of wall panels. Do not nail pads.
4. Properly secure sponge filler pads. Calk all voids around bearing pads and sponge with a non-toxic sealant to prevent mortar seepage.
5. Field-placed concrete or shotcrete shall be form and/or water cured until prestressing begins.

D. Horizontal Prestressing:

1. The term “wire” shall signify either wire or strand.
2. Place prestressing wire on the wall with a wire winding machine capable of consistently producing a stress in the wire within a range of 0 percent to ±2 percent of the stress required by the design.
    a. No circumferential movement of the wire along the tank wall will be permitted during or after stressing the wire.

3. Stressing may be accomplished by drawing the wire through a die or by other means that result in uninterrupted elongation, thus assuring uniform stress throughout its length and over the periphery of the tank.
4. Temporarily anchor each coil of prestressing wire at sufficient intervals to minimize the loss of prestress in case a wire breaks during wrapping.
5. Minimum spacing (center to center) of prestressing wires is 3/8-inch and a minimum clear space between wires of 5/16-inch or 1.5 wire diameters, whichever is greater.
    a. Respace any wires not meeting the spacing requirements.
    b. Do not place prestressing closer than 3-inch from the base of walls or floors where radial movement may occur.
6. Displace the band of prestressing normally required over the height of an opening into circumferential bands immediately above and below the opening to maintain the required prestressing force. Bundling of wires is prohibited.
7. Splicing of the wire shall be only permitted when completing the application of a full coil of wire, or when removing a defective section of wire.
    a. Join ends of individual coils by suitable steel splicing devices capable of developing the full strength of the wire.
8. Use a calibrated stress recording device, which can be recalibrated, in determining wire stress levels on the wall during and after the prestressing process.

E. Take at least one stress reading per foot or one stress reading for every roll of wire, whichever is greater, immediately after the wire has been applied on the wall.
1. Record readings referring to the applicable height and layer of wire for which the stress is being taken.
2. Contractor to keep a written record of stress readings and then deliver said record to the Owner.
3. Make stress readings on straight lengths of wire.
4. If applied stresses fall below the design stress in the steel, provide additional wire to bring the stress up to the required design stress.
5. If the stress in the steel is more than 7 percent over the required design stress, the wrapping operation should be discontinued and adjusted.

F. Floor:
1. No construction joints are permitted.
2. A minimum thickness of 8 in of concrete required over all pipe encasements in concrete floor (if applicable).
3. Reference Section 31 23 10 - Earthwork for subgrade conditions
4. Actively reinforced (structural) floors shall be a minimum 8-inch thick.

a. Apply not less than the minimum percentage of reinforcing steel to these thickened sections and extend a minimum of 2 feet into the adjacent floor.

5. Consolidate the floor slab so no air pockets or voids are present.

G. Shotcrete:

1. Weather limitations: Comply with AWWA D110.

2. Placement: Comply with ACI 506.2 and AWWA D110.

3. All shotcrete shall be applied by ACI certified nozzlemen.

4. Vertical screed wires shall be used to ensure uniform and correct thickness of shotcrete.

5. Test wall for hollow spots and repair any defective areas.

6. Each shotcrete layer shall be broomed prior to final set to effect satisfactory bonding for subsequent layer.

7. Do not apply shotcrete to reinforcing steel or diaphragm which is encrusted with overspray.

8. Coating of steel diaphragm:

a. Cover steel diaphragm with a layer of shotcrete at least 1-inch thick prior to prestressing.

b. Total minimum coating over the steel diaphragm: 3-inch including diaphragm cover, wire cover and finish covercoat.

9. Coating over prestressing wire:

a. Individually encase each prestress wire in shotcrete of a thickness sufficient to provide a clear cover over the wire of at least 1/2-inch.

b. Apply a finish coat of shotcrete as soon as practicable after the last application of wire coat.

1) Total thickness of shotcrete covercoat: Not less than 2-inch over the wire or strand.

c. Provide a natural gun finish.

H. Tolerances:

1. Out-of-plumb in total wall height: ±1/2-inch.

2. Out-of-round in diameter: ±1-inch.

I. Roof:

1. Cast-in-place or precast concrete free spanning dome roof

a. The dome roof shall have a rise to span ratio within the range of 1:8 to 1:14.

b. The minimum concrete thickness shall be 5 inches for both a precast dome and cast-in-place dome with a minimum 1-1/2 inches of cover to any reinforcement.

c. For a cast-in-place dome:

1) Do not remove any portion of formwork for the roof until the concrete is of sufficient strength. Refer to ACI 350.

2) Give roof soffit a form finish. Give exterior roof surface a floated finish.

d. The dome shall be fixed to the tank wall.

e. Columns or interior supports will not be permitted.

f. Dome designs shall be based on elastic spherical shell analysis.

2. Cast-in-place prestressed/post-tensioned concrete roof.

a. No construction joints are permitted.

b. Construct roof to be supported by perimeter walls and interior columns.

1) Locate and design interior columns and roof system to result in adequate strength and to limit deflections in accordance with ACI 350 and the IBC as applicable.

2) Minimum slope at top surface: 1.5 percent center to edge.

c. Do not remove any portion of formwork for the roof until the concrete is of sufficient strength and tendons have been fully tensioned (as applicable). Refer to ACI 350.

d. Give roof soffit a form finish. Give exterior roof surface a floated finish.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Test concrete in accordance with ACI 350.

B. Shotcrete:

1. Test in accordance with ACI 506.2.

2. Make tests from the shotcrete as it is being placed.

3. Sounding of the shotcrete covercoat as recommended in AWWA D110.

C. Watertightness Testing:

1. Tank supplier shall perform watertightness testing.

2. Upon completion of the tank, the tank supplier shall perform watertightness testing of the tank.

a. Watertightness testing shall be performed prior to application of water proofing, if applicable, to tank walls.

b. Water for watertightness testing shall be supplied by the Contractor.

c. The level for watertightness testing shall be the high water level as shown on the drawings.

d. The procedures and criteria for watertightness testing and acceptance shall be as defined in ACI 350.1. The maximum allowable loss shall be 0.0125 percent of the tank volume per day.

END OF SECTION

SECTION 33 16 52

CONCRETE PRESTRESSED TANK

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Measurement and Payment: In accordance with Section 33 16 40 – Water Storage Tank.

1.02 REFERENCE STANDARDS

A. America Concrete Institute (ACI)

1.	ACI 350-06	Building Code Requirements for Environmental Engineering Concrete Structures
2.	ACI 350.1-10	Tightness Testing of Environmental Engineering Concrete Containment Structures and Commentary
3.	ACI 350.3-06	Seismic Design of Liquid-Containing Concrete Structures and Commentary

B. ASTM International (ASTM)

1.	ASTM A185 / A185M – 07	Steel Welded Wire Reinforcement, Plain, for Concrete
2.	ASTM A416 / A416M - 12a	Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
3.	ASTM A497 / A497M - 07	Steel Welded Wire Reinforcement, Deformed, for Concrete
4.	ASTM A615 / A615M - 12	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
5.	ASTM A722 / A722M - 12	Uncoated High-Strength Steel Bars for Prestressing Concrete
6.	ASTM C881 / C881M - 10	Epoxy-Resin-Base Bonding Systems for Concrete
7.	ASTM D 1056 - 07	Flexible Cellular Materials - Sponge or Expanded Rubber.
8.	ASTM D 1752 - 04a(2008)	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
9.	ASTM D 2000 - 12	Standard Classification System for Rubber Products in Automotive Applications.

10.	ASTM D 2240 - 05(2010)	Standard Test Method for Rubber Property - Durometer Hardness.

C. American Water Works Association (AWWA)

1.	AWWA C 652-02	Disinfection of Water Storage Facilities.
2.	AWWA D 115-06	Tendon-Prestressed Concrete Water Tanks

D. American Welding Society (AWS)

1.	AWS D1.1/D1.1M 10	Structural Welding Code, Steel.
2.	AWS D1.3/D1.3M-08	Structural Welding Code, Sheet Metal.

E. International Building Code (IBC)

1.	IBC 2009	International Building Code (IBC).

F. Post Tensioning Institute (PTI)

1.	PTI DC10.7-83	Post-Tensioned Commercial and Industrial Floors
2.	PTI TAB.1-06	Post-Tensioning Manual, Sixth Edition
3.	PTI DC20.8-04	Design of Post-Tensioned Slabs Using Unbonded Tendons
4.	PTI M10.2-00	Specification for Unbonded Single Strand Tendons
5.	PTI M10.3-00	Field Procedures Manual for Unbonded Single Strand Tendons
6.	PTI M50.3-12	Specification for Grouting of Post-Tensioned Structures
7.	PTI CRT20	Manual for Certification of Plants Producing Unbonded Single Strand Tendons, Sixth Edition.

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 33 16 52-1, Approval Drawings and Data:

1. Shop drawings:
    a. Show all details that shall be used in the fabrication of tank components and tank construction.
2. Manufacturer’s installation instructions.
3. Tank surface finishes and coating materials.
4. Waterstop product information, samples, and certifications as requested by Contract Documents.
5. Concrete design mixes.

6. Structural design calculations or analyses, sealed by registered professional engineer, for record purposes only.

C. RSN 33 16 52-2, Test Reports:

1. Submit certified mill test reports indicating ultimate and yield strength of all reinforcing bars, prestressing and poste tensioning steel, and any other steel components.

D. RSN 33 16 52-3, Documentation:

1. Furnish applicable "Affidavits of Compliance" to building codes.

E. RSN 33 16 52-4, Final Drawings and Data:

1. Submit final drawings and data consisting of approved detailed shop drawings.

2. Submit Operation and Maintenance Manuals.

1.04 DESIGN REQUIREMENTS

A. Tank:

1. Refer to Section 33 16 40 – Water Storage Tank.

2. Design in conformance with ACI 350, and AWWA D115 and PTITAB.1.

a. Cast-In-Place Concrete with internal tendons.

3. Design the floor and roof for single concrete placements, no joints are allowed.

4. Floor design shall take into account concentrated loads from the roof column supports.

5. The perimeter wall shall be horizontally and vertically prestressed and cast in full-height placements.

a. Refer to 33 16 40 – Water Storage Tank for concrete thickness.

b. The thickness of the concrete wall shall be as required by AWWA D115, and applied loading, but shall not be less than 9 inches.

c. Backfill loads shall not be used in the design of the tank to counteract hydraulic loads or provide residual compression in the wall.

d. Tank analysis and design shall take into account all required openings and penetrations through tank elements.

e. Slope of floor: 1 percent center to edge.

B. Design for earthquake resistance based on ACI 350.3 and the requirements of AWWA D115.

C. Base design on AWWA D115 and ACI 350 load combinations, with the basis for loadings as defined herein.

1. Load combinations for prestressed or post-tensioned items shall be in accordance with AWWA D115 and ACI 350.
2. Load combinations for non-prestressed/post-tensioned items shall be in accordance with ACI 350.
3. Snow load: See Drawings for definitions of snow loads.
4. Uniform live load over roof area: 20 psf. (non-reducible).

D. Wind Loads: (during construction and prior to backfilling):

1. See Drawings for definition of wind loads.

E. Design for lowest mean ambient temperature and for temperature differential required for project location.

F. Roof Design Criteria:

1. Roof design for conventionally reinforced construction shall be in accordance with ACI 350 relative to spacing between joints, minimum reinforcement ratios, and cracking serviceability (including serviceability load factors).
2. Roof design for prestressed/post-tensioned construction shall be in accordance with AWWA D115 and ACI 350.

G. Waterstops:

1. Adhesive waterstops are not permitted.
2. See Section 03 15 12 – PVC Waterstops.
3. For sliding joints, deflection data shall be submitted and summarized from the tank analysis for these locations.
4. Shear, load and deflection capabilities for the proposed waterstop shall be certified in writing by the waterstop manufacturer and shall be adequate for the movement indicated in the tank analysis.
5. Continuous waterstops shall be used at all wall/footing and roof/wall joints. These joints shall be specifically detailed to remain watertight.

1.05 QUALIFICATIONS

A. In addition to qualifications listed in Section 33 16 40 – Water Storage Tank:

1. Post-tensioning components and systems shall be provided by a PTI CRT20-Certified Plant.
2. Superintendent shall be a full-time employee of the post tensioning supplier and shall be present during construction of tank.
    a. The superintendent shall be the holder of a current Certified Grouting Technician certificate from the American Segmental Bridge Institute

PART 2 PRODUCTS

2.01 MATERIALS

A. General Requirements:

1. Comply with AWWA D115, ACI 350, PTI TAB.1.

B. Concrete:

1. Wall, interior columns, and roof – 28-day compressive strength not less than 4,500 pounds per square inch (psi) and shall be air entrained.
2. Floor – 28-day compressive strength not less than 4,500 psi and no air entrainment.
3. Incorporate superplasticizer and water reducing admixture into floor concrete.

C. Prestress Strand for Circumferential Tendons:

1. Comply with ACI 350.
2. Strand shall conform to ASTM A416, A722, or ASTM A582.

D. Reinforcing Bars, Wire Mesh:

1. Reinforcing Bars: ASTM A615, Grade 60.
2. Wire Mesh: ASTM A185 or ASTM A497.

E. Wedges:

1. Wedge shall conform to PTI TAB.1. Wedge shall not break into separate pieces upon stressing.
2. Designed to securely anchor the strand without significantly reducing ductility of the strand or tendon.
3. Strand slip after anchoring shall not be permitted.
4. Prevent breaking of individual strand wires in the wedges during stressing.
5. Achieve dynamic fatigue and impact loading resistance without strand slippage or wire breakage.

F. Elastomeric Materials:

1. PVC waterstop: Section 03 15 12 – PVC Water Stops.
2. Bearing pads: ASTM D2240 or D2000.
3. Sponge filler: ASTM D1056 or D1752.
4. Epoxy: ASTM C881 Type III, Grade I.

G. Vertical/Roof Prestressed Reinforcement (as required):

1. Strand: ASTM A416, grade 250 or 270.

2. Threadbar: ASTM A722, grade 150 or 160.

3. Corrosion protect vertical prestressed reinforcing left in ducts for more than 21 days prior to grouting in accordance with AWWA D115.

H. Ducts for Bonded Tendons:

1. Ducts for bonded tendons shall be manufactured from corrosion-resistant materials and shall comply with the PTI Guide Specification, "Acceptance Standards for Post-tensioning Systems."

I. Grout Fitting:

1. Grout fittings shall conform to PTI M50.3.

2. Tendons shall have grout openings at stressing anchorages.

3. Provide grout vents or drain holes low and high points.

4. Prevent grout leakage at grout openings or vents.

J. Grout Materials: PTI M50.3 and AWWA D115.

K. Couplings:

1. Couplings for bonded tendons shall not reduce the elongation of rupture below the requirements of the tendon itself.

2. Used where approved by Erection Engineer.

L. Silt Stops:

1. Provide removable silt stop(s) at all discharge pipes and at other locations shown.

PART 3 EXECUTION

3.01 CONSTRUCTION

A. General:

1. In accordance with AWWA D115.

2. Do not place concrete floor and foundation until subgrade approved by Erection Engineer.

3. For wall base joints with bearing pads, locate bearing pads and hold them in proper position prior to erection of wall panels. Do not nail pads. Properly secure sponge filler pads. Calk all voids around bearing pads and sponge with a non-toxic sealant to prevent mortar seepage.

4. Field-placed concrete floors and roofs shall be form and/or water cured until prestressing begins.

B. Floor:

1. No construction joints are permitted.
2. A minimum thickness of 8-inch of concrete required over all pipe encasements in concrete floor (if applicable).
3. Actively reinforced (structural) floors shall be a minimum 8 inches thick.
4. Use at least the minimum percentage of reinforcing steel to these thickened sections and extend a minimum of 2 feet into the adjacent floor.

C. Refer ACI 350 for curing, hot and cold weather concreting, forming and troweled finish.

D. Consolidate the floor slab so no air pockets or voids are present.

E. Tolerances:

1. Out-of-plumb in total wall height: ±1/2-inch.
2. Out-of-round in diameter: ±1-inch.

F. Roof:

1. Support roof by perimeter walls and interior columns.
   a. No construction joints are permitted
   b. Locate and design interior columns and roof system to result in adequate strength and to limit deflections in accordance with ACI 350 and the IBC as applicable.
   c. Minimum slope at top surface: 1 percent center to edge.
   d. Design forms to resist all forces acting, including forces with respect to sloped surfaces.
2. Do not remove any portion of formwork for the roof until the concrete is of sufficient strength and tendons have been fully tensioned (as applicable).
3. Give roof soffit a form finish. Give exterior roof surface a floated finish.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Test concrete in accordance with ACI 350.

B. Watertightness Testing:

1. Tank supplier shall perform watertightness testing.
2. Upon completion of the tank, the tank supplier shall perform leak testing of the tank.
   a. Watertightness testing shall be performed prior to application of water proofing, if applicable, to tank walls.
   b. Water for watertightness testing shall be supplied by the Contractor.

c. The level for watertightness testing shall be the high water level as shown on the drawings.

d. The procedures and criteria for watertightness testing and acceptance shall be as defined in ACI 350.1. The maximum allowable loss shall be 0.0125 percent of the tank volume per day.

END OF SECTION

SECTION 33 42 30
CORRUGATED METAL PIPE CULVERT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. 24-Inch Diameter Corrugated Metal Pipe Culvert:

1. Measurement: Length along pipe centerline at pipe invert.
    a. From end to end of the pipe in place.
    b. No allowance for coupling bands and lap at joints.
2. Payment: Linear foot price offered in the schedule.
    a. Includes flared end sections and earthwork.

1.02 REFERENCE STANDARDS

A. ASTM International (ASTM)

1.	ASTM A 760/A 760M - 10	Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains

1.03 DELIVERY, STORAGE, AND HANDLING

A. Haul and handle pipe to avoid damage to the galvanized coating.

B. Do not use rope, cable, or chain slings for handling pipe.

PART 2 PRODUCTS

2.01 CORRUGATED METAL PIPE

A. Corrugations:

1. 2-2/3-inch by 1/2-inch unless otherwise indicated on drawings or in the schedule.
2. Annular or helical.

B. Sheet thickness: 0.064 inches.

C. Corrugated Steel Pipe, and Coupling Bands:

1. ASTM A 760, Type I.
2. Galvanized.
3. ASTM A 849.

D. Flared End Sections:

1. Prefabricated sections of standard manufacture.

2. Same metal as the pipe to which they are attached.

2.02 BACKFILL

A. Insofar as practicable, obtain backfill material from material moved in required excavations for pipe or from adjacent excavation. The type of material used for backfill is subject to approval.

B. Maximum Particle Size:

1. Backfill within 1-foot of pipe: 1-1/2 inches.

2. Compacted backfill in trench: 3 inches.

3. Uncompacted backfill in pipe trench: 3 inches.

PART 3 EXECUTION

3.01 CORRUGATED METAL PIPE

A. Furnish and lay corrugated metal pipe of the size and gauge shown on the drawings complete with coupling bands and joint materials.

B. Install flared end section on inlet and outlet end of each pipe.

3.02 EXCAVATION

A. Excavation for pipe trench: In accordance with Section 31 23 22 – Pipe Trench Earthwork.

3.03 LAYING CORRUGATED METAL PIPE

A. Lay corrugated metal pipe to lines and grades shown on drawings or established by the CO.

1. Laying tolerances:

a. Departure from and return to established alignment and grade, maximum: 1/8-inch per foot of pipe.

b. Total departure, maximum: 1-inch.

B. Place pipe carefully to be fully supported over bottom quarter of circumference.

C. Lay pipe with outside laps of circumferential joints pointing upstream and with longitudinal joints at the sides.

D. Coupling Bands:

1. Use where necessary to join sections of pipe.
2. Draw fastenings up tight.
3. Install to ensure tight joints.
4. Joints between sections approximately at the center of couplings.

E. Install flared end sections in accordance with the manufacturer's instructions.

3.04 BACKFILL

A. As each unit of pipe is laid, tamp backfill material about pipe to hold it rigidly in place until joints are completed.

B. After joints have been completed, place and compact backfill or CLSM in accordance with Sections 31 23 22 - Pipe Trench Earthwork and 31 23 70 – Controlled Low Strength Materials (CLSM).

C. Equipment travel over the pipe not permitted until backfill has been placed and compacted to depth recommended by pipe manufacturer, but not less than 3-foot above top of pipe. Provide adequate earth cover over pipe to prevent damage from construction equipment loads.

3.05 REPAIR

A. Repair damage to galvanized coatings including factory or field cut edges and welding in accordance with ASTM A 760.

END OF SECTION

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SECTION 33 82 23

OPTICAL FIBER COMMUNICATIONS DISTRIBUTION CABLING

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Fiber Optic Cable:

1. Measurement: Length of installed cable.
2. Payment: Price per linear foot offered in the schedule.
    a. Includes cost of all work and materials for cable.

B. Conduit:

1. Measurement: Length of installed conduit.
2. Payment: Price per linear foot offered in the schedule.
    a. Includes cost of all work and materials for conduit.

1.02 REFERENCE STANDARDS

A. Institute of Electrical and Electronic Engineers (IEEE)

1. IEEE C2-2012 National Electric Safety Code

B. National Fire Protection Association (NFPA)

1. NFPA 70-2011 National Electrical Code (NEC)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals and Section 01 33 26 - Electrical Drawings and Data.

B. RSN 33 82 23-1, Approval Data:

1. Manufacturer’s product data.

C. RSN 33 82 23-2, Approval Data:

1. Pre-installation test reports.
2. Test Reports to include:
    a. Electronic PDF and paper copy of each trace made during testing.

D. RSN 33 82 23-3, Approval Data:

1. Post-installation test reports.

2. Test Reports to include:

a. Electronic PDF and paper copy of each trace made during testing.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Handle and store fiber optic cable in accordance with manufacturer's instructions. Include copy of these instructions with equipment at time of shipment.

1.05 PROJECT CONDITIONS

A. Ambient Temperature Range: -30 degrees Celsius to 40 degrees Celsius.

B. Relative Humidity: 0 to 90 percent.

C. Altitude: 6,800 feet.

D. Wind:

1. Maximum sustained: 45 knots.
2. Maximum gust: 60 knots.

PART 2 PRODUCTS

2.01 SINGLE-MODE FIBER OPTIC CABLE

A. All Dielectric Fiber Optic Cable:

1. Cable type: Single-mode.
    a. Major cable components:
    b. Inner and outer polyethylene jackets.
    c. Inner and outer polyethylene jackets ripcords.
    d. Inner jacket, filled buffer tubes, and central member wrapped with water-swellable tape or filled with a non-hygroscopic jell.
    e. Optical fibers: 12.
    f. Water-swellable yarn.
    g. Dielectric strength member.
    h. Dielectric central member.
2. Outer jacket:
    a. Medium density polyethylene.
    b. Outer jacket label:
        1) Interval: regular for entire cable length in unbroken pattern.

2) Content:

a) Manufacturer's name.

b) Manufacturer's cable designation.

c) Words "fiber optic cable".

3. Strength members: With expansion and contraction characteristics similar to glass fibers.

4. Buffer tubes:

a. Protect each fiber in a buffer tube of loose-tube type construction.

b. Color coded.

5. Optical fibers:

a. Attenuation of 1310/1383/1550 nanometer wavelength light: Less than 0.5/0.5/0.4 decibels per kilometer.

b. Attenuation: Directly proportional to cable length for an arbitrary cable length section after steady-state conditions are reached.

c. Color coded.

6. Cable core: Symmetrically stranded buffer tubes around dielectric central member.

7. Cable tensile strength:

a. Long term (installed): 135 pounds.

b. Short term (during installation): 600 pounds.

8. Operating temperature range: -40 to 150 degrees Fahrenheit.

9. Age: 24 months old, maximum.

2.02 POLYETHYLENE WARNING TAPE

A. Width: 6 inches.

B. Color: Yellow.

C. Copy: Continuously imprinted with "CAUTION BURIED CABLE BELOW".

D. Suitable for direct burial.

2.03 TERMINATION/SPLICE PANEL

A. Type:

1. Rack-mounted in pumping plant.

2. Wallmount or panelmount at chlorine building and Twin Lakes pumping facility.

B. Metal housing with splice tray holder, splice tray, adaptor plates, and radius limiters.

C. Splice Trays:

1. Same manufacturer as termination/splice enclosure.
2. Fusion splice organizer to retain each splice and its shrink tubing.
3. Manufactured for loose tube type fiber optic cable.

D. Adaptor Plates:

1. Same manufacturer as termination/splice enclosure.
2. Mount at minimum 4 fibers.
3. Use ST connectors.
4. Each ST with 3 meters of single-mode fiber optic cable.

2.04 FIBER OPTIC PATCH CABLES

A. Type fiber: single-mode.

B. Length: As required.

C. Connectors:

1. ST on end connected to splice panel
2. As required to connect to fiber optic equipment.

D. Loss per connector: Less than 0.5 dB.

2.05 TWIN LAKES PUMPING FACILITY FIBER OPTIC MEDIA CONVERTER

A. Ethernet to Single-mode fiber.

B. ST connectors.

C. RJ-45 connector.

D. Operating temperature: -40 degrees Fahrenheit to 120 degrees Fahrenheit, minimum.

PART 3 EXECUTION

3.01 GENERAL FIBER OPTIC CABLE INSTALLATION

A. Comply with NFPA 70 and IEEE C2.

B. Conduit Installation:

1. Conduit shall be buried 30 inches deep as specified on drawing.

2. Clean and de-burr each conduit run prior to pulling in cable.
3. Pull a clean, dry tight-fitting rag through each conduit immediately before installing cable.
4. Do not cut or abrade cable insulation (outer jacket).
5. Do not kink cable.
6. Do not bend cable tighter than recommended bending radius, 15 to 20 diameters for fiber optic cable.

C. Install cable without exceeding allowable pulling tensions and sidewall pressures recommended by cable manufacturer.

D. Lubricant:
1. Use only as aid to pulling.
2. Use materials recommended by cable manufacturer.

E. Clamp cable entry with fiber type cable clamp.

F. Leave spare fibers in each termination/splice panel.

G. Leave 10 feet fiber to make connection to adaptor plate pigtail.

H. Retain fibers at each cable end equal in length to longest single fiber.

I. Tags:
1. Use: Outdoor.
2. Shape: Rectangular.
3. Color: White.
4. Tag fiber cables at each end.
5. Attach tag by self-locking cable ties.
6. Mark tags with cable designation:
   a. Computer generated lettering.
   b. As designated on approved drawings.

J. Block cable opening in conduits and sleeves with silicone-foam, fire-retardant material in accordance with NFPA 70.

3.02 FIBER OPTIC CABLE INSTALLATION SITE REQUIREMENTS

A. In accordance with drawings.

B. Pull fiber optic cable from power pole into Control Room within the Pumping Plant.

C. Install precast handhole pull box in accordance with Section 26 05 33 – Raceways and Boxes with the embossed logo "FIBER" on the surface instead of "ELECTRIC."

D. Install conduit from power pole to pull box EYE as specified on drawings 1695-D-308, 1695-D-307, and 1695-D-239.

1. Cable shall be installed a minimum of 30 inches below surface.

E. Run fiber in the conduit down from existing utility pole splice closure into the utility pull box.

F. Install fiber in electrical conduit to the Pumping Plant as specified on drawings 1695-D-239, 1695-D-240, and 1695-D-236.

G. Run fiber into Pumping Plant Control Room 19-inch rack splice panel inside the industrial server rack.

H. Installation in Control Room:

1. Furnish and install fiber optic transmitters, receivers and termination/splice panel inside Control Room.
2. Connectorize fiber cables and connect to termination/splice panel.
3. Furnish and install patch cords to connect all dielectric fiber cable to fiber optic equipment.

I. Install fiber in conduit from the Chlorination building fire panel enclosure as shown on drawings 1695-D-236, 1695-D-237, and 1695-D-238.

J. Installation at Chlorination Building:

1. Install PoE media converters as specified in section 27 30 01 – Telephone System, inside the Chlorination building fire panel enclosure.
2. Install fiber optic to PoE media converters as specified in section 27 30 01 – Telephone System.
3. Connectorize fiber cables and connect to media converter.

K. Installation at Twin Lakes Pumping Facility:

1. Run fiber-optic cable from pole designated by COR to programmable controller cabinet.
2. Furnish and install fiber-optic media converter, termination splice panel and fiber bypass unit at location designated by COR.
3. Connectorize fiber-optic cables and connect to termination splice panel.
4. Furnish and install patch cords to connect fiber-optic cable to fiber-optic equipment.

L. Do not splice fiber optic cables outside of termination/splice panels or splice closures.

M. Coil 5 feet of fiber cable inside each termination/splice panel.

3.03 SPLICING

A. Method: Arc-fusion.

B. Splices per set of Fusion Tips: 50.

C. Splice Loss: 0.1 dB, average bi-directional.

3.04 FIBER OPTIC CABLE TESTING

A. Test Fiber Optic Cable:

1. On reel, prior to installation.
2. After installation.

B. Government will witness tests.

1. Notify COR at least 20 days in advance of date and time of testing.
2. Test at a time which is mutually agreeable to Contractor and COR.

C. Test each fiber from the Control Building to the Utility splice panel using an Optical Time Domain Reflectometer (OTDR):

1. Purpose and intent of testing:
    a. Determine if installed cable is free from defects.
    b. Compare measured attenuation with cable manufacturer's specified attenuation of 0.4dB per kilometer for 1300 nanometer light.
    c. Compare measured bi-directional splice loss with specified splice loss of 0.1dB per splice.
    d. Compare measured connector loss with specified connector loss of 0.5dB.
    e. Verify cable length.
2. OTDR requirements:
    a. Fiber type: Single-Mode.
    b. Dynamic Range: 25 dB, minimum.
    c. Operating temperature: 30 to 90 degrees Fahrenheit.
    d. Resolution: Selectable 0.1 to 10 m.
    e. Pulse width: Selectable. One for all tests.
    f. Reflectance accuracy: ± 2dB.

g. Loss accuracy (Linearity): 0.02dB/dB.

3. Obtain an OTDR waveform for each fiber to:

a. Determine actual cable length.

b. Determine attenuation and splice loss.

c. Identify and locate splices and step discontinuities/possible fiber breaks.

D. Prepare Test Reports:

1. Generate a PDF copy and paper copy of each trace made during testing for inclusion in the report:

a. OTDR waveform for each fiber showing “A” and “B” range marks.

1) Do not move or change location of either mark.

2. Include an Analysis Summary Results Table for each fiber:

a. Indicate numerical values associated with each event.

b. Do not use question marks, dashes, or blanks.

3. Include following information for each trace:

a. Trace name.

b. Operator’s name.

c. Date and time.

d. Fiber type being tested.

e. Bundle color.

f. Fiber color.

g. Fiber number.

h. Launch reel length.

i. OTDR resolution.

j. Pulse width.

k. Wavelength.

l. Index of refraction.

m. Averaging number.

n. Receiver bandwidth.

o. Sampling point count.

p. End to end loss, dB.

q. Reflectance, dB.

r. Fiber Break, dB.

s. Backscatter.

4. Traces to be viewable and reproducible on a PC using Windows XP.

E. The Government will review test reports and determine if fiber cable is suitable for its intended purpose.

1. If defects are found (splices, connectors, discontinuities, etc.), the Contractor will be responsible for repairing and/or replacing the cable or fittings at no additional cost to the Government.

2. Repair or replace as directed by COR. Repeat testing.

END OF SECTION

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SECTION 34 71 10

W-BEAM GUARDRAILS FOR STRUCTURES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. W-Beam Guardrails:

1. Payment: Lump sum price offered in the schedule.

a. Includes cost of furnishing all steel and concrete parts and attaching guardrail terminal connectors; pipe handrail; furnishing all parts and attaching handrail to W-Beam guardrail.

1.02 REFERENCE STANDARDS

A. American Association of State Highway Officials (AASHTO)

1.	AASHTO M 180-00(2008)	Corrugated Sheet Steel Beams for Highway Guardrail
2.	AASHTO-AGC-ARTBA (1995)	Joint Committee, Subcommittee on New Highway Materials, Task Force 13 Report

B. American Society of Mechanical Engineers (ASME)

1.	ASME B 18.2.1-2010	Square, Hex, Heavy Hex, And Askew Head Bolts And Hex, Heavy Hex, Hex Flange, Lobed Head, And Lag Screws (Inch Series)

C. ASTM International (ASTM)

1.	ASTM A 36/A 36M-08	Carbon Structural Steel
2.	ASTM A 123/A 123M-12	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
3.	ASTM F 1554-07a	Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

1.03 DELIVERY, STORAGE, AND HANDLING

A. Mark each rail element in accordance with AASHTO M 180.

PART 2 PRODUCTS

2.01 METAL BEAM GUARD RAILING

A. Rail Elements and Backup Plates: AASHTO M 180, Type I, Class A, W-Beam.

B. Terminal Connectors: AASHTO M 180, Type I, Class A, W-Beam.

C. Steel Posts and Baseplates: ASTM A 36 steel, hot-dip zinc coated after fabrication in accordance with ASTM A 123.

D. Bolts, Nuts, and Other Fittings: Hot-dip zinc coated after fabrication in accordance with ASTM A 123.

1. Bolts, nuts and other fittings for rail elements: AASHTO M 180.

E. Anchor bolt assemblies for guardrail posts: Hot-dip zinc coated after fabrication in accordance with ASTM A 123.

1. Anchor bolts: ASTM F 1554, Grade 36.
   a. Galvanized.
   b. Provide length of bolt threads in accordance with ASME B18.2.1, Class 2, free-fit, American national coarse thread series.
2. Plates: ASTM A 36.
3. Nuts: ASTM A 563.
4. Washers: ASTM F 844.

2.02 PIPE HANDRAIL

A. Pipe rails, plates, and bolts: In accordance with Section 05 50 00 - Metal Fabrications.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install steel posts, rail elements, and anchor bolt assemblies in accordance with the details shown on the drawings.

B. Install pipe handrail in accordance with Section 05 50 00 - Metal Fabrications and the details shown on the drawings.

3.02 REPAIR

A. Repair abraded and damaged galvanized surfaces in accordance with 09 96 20 - Coatings.

END OF SECTION

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SECTION 35 21 94

STEEL MANIFOLDS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Steel Manifolds:

1. Payment: Lump sum price offered in the schedule.

B. Cost: Include earthwork in applicable price offered in schedule for Section 31 23 22 – Pipe Trench Earthwork.

1.02 REFERENCE STANDARDS

A. American National Standards Institute/NSF (ANSI/NSF)

1.	NSF/ANSI 61 – 2012	Drinking Water System Components - Health Effects

B. American Society of Mechanical Engineers (ASME)

1.	ASME B16.5-2009	Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
2.	ASME B16.9-2012	Factory-made Wrought Steel Buttwelding Fittings
3.	ASME Boiler and Pressure Vessel Code-2013	Section VIII, Rules for Construction of Pressure Vessels, Divisions 1 and 2

C. ASTM International (ASTM)

1.	ASTM A36/A36M-12	Carbon Structural Steel
2.	ASTM A53/A53M-12	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
3.	ASTM A139/A 139M-10	Electric-Fusion (Arc) - Welded Steel Pipe (Sizes 4 in. and over)
4.	ASTM A193 / A193M - 12b	Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
5.	ASTM A240/A240M-13a	Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

6.	ASTM A283 / A283M - 12a	Low and Intermediate Tensile Strength Carbon Steel Plates
7.	ASTM A312 / A312M - 13	Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
8.	ASTM A325 - 10	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
9.	ASTM A572/A572M-12a	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
10.	ASTM A588-10	High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance
11.	ASTM A1018/A 1018M-10	Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
12.	ASTM D2000 - 12	Rubber Products in Automotive Applications
13.	ASTM E165 / E165M - 12	Liquid Penetrant Examination for General Industry
14.	ASTM E709 - 08	Magnetic Particle Testing

D. American Welding Society (AWS)

1.	AWS D1.1/D1.1M - 10	Structural Welding Code
2.	AWS D1.6/D1.6M – 07	Structural Welding Code – Stainless Steel

E. American Water Works Association (AWWA)

1.	AWWA C200-12	Steel Water Pipe - 6 In (150 mm) and Larger
2.	AWWA C206-11	Field Welding of Steel Water Pipe
3.	AWWA C207-07	Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In.
4.	AWWA C606-11	Grooved And Shouldered Joints

F. Commercial Item Description (CID)

1.	CID A-A-1923A	Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)

1.03 SYSTEM DESCRIPTION

A. Details of the steel manifolds are shown on drawings 1695-D-205 through 1695-D-223.

1.04 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 01 33 00 – Submittals.

B. RSN 35 21 94-1, Shop Drawings:

1. Provide checked, detailed shop drawings which include dimensions and tolerances, material data, joint details, welding requirements; and painting, lining, and coating requirements.
2. When revised drawings and data are resubmitted, clearly identify changes from previous submittals.

C. RSN 35 21 94-2, Commercial Products Data:

1. Pipe couplings.
2. Installation procedures.

D. RSN 35 21 94-3, Final Drawings:

1. As-built drawings.
2. Provide detailed drawings which clearly show steel manifold sections after completion, including dimensions and tolerances, material data, joint details, painting, and welding.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Transport and handle in accordance with fabricator's instructions.

B. Prevent damage during loading, transporting, unloading, and at final storage location.

1. Provide padded bolsters curved to fit under the outside of the pipe.
2. Provide heavy padding under ties during transportation and storage.

C. Do not store directly on the ground.

D. Store so that lifting straps can be passed beneath pipe sections.

E. Provide space to allow personnel to move between pipe sections.

F. Cover with tarps and tie tarps down securely.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Steel Plate:

1. ASTM A 572, grades 42 or 50, or ASTM A 36.

B. Steel Coil:

1. ASTM A1018, grades listed in AWWA C200 Table 1 with minimum yield points equal to or greater 36,000 pounds per square inch (psi).

C. Stainless Steel Plate:

1. ASTM A 312, Type 316L.

D. Standard and Schedule Steel Pipe:

1. ASTM A 53, grade B.

a. Pipe 4 inches in diameter and smaller: Galvanized.

b. Pipe larger than 4 inches in diameter: painted in accordance with Section 09 96 20 - Coatings.

E. Stainless Steel Pipe:

1. ASTM A 312, Type 316L.

F. Electric-fusion- (arc-) Welded, Spiral-seam Steel Pipe:

1. ASTM A 139, grade B or C.

G. Flanges:

1. Slip-on ring type, flat faced: AWWA C207.

2. Provide the flat face with a finish suitable for flat gasket for flanged joints.

H. Gasket:

1. Multi-Swell Style 3760-U as manufactured by Garlock, Website: www.garlock.com or equal with the following essential characteristics:

a. Dimensional requirements of AWWA C207.

b. NSF 61 listed.

c. Suitable for cold water service.

I. Flange Bolts:

1. AWWA C207.

J. Butt-welded Steel Fittings:

1. ASME B16.9.

2. Furnish and install where shown on the drawings.

K. Pipe Couplings:

1. Depend-O-Lok couplings manufactured by Victaulic, P.O. Box 48776, Atlanta, GA 30362; or equal, having following essential characteristics:
    a. Steel material.
    b. Coupling housing: Arched, two or more segmented, sleeve-type which when closed compresses elastomeric O-ring gaskets beneath arches of sleeve to create radial seal around pipe ends joined inside of coupling.
    c. Gaskets: Isoprene, ASTM D 2000, suitable for cold-water service.
    d. Bolts and nuts: Carbon steel, ASTM A 325.
    e. Type E x E joint or F X F joint as indicated on drawings.
    f. Width:
        1) Pipe diameter 4-inch and smaller: 5 inches.
        2) Pipe diameter 5-inch and 6-inch: 7-1/2 inches.
        3) Pipe diameter 8-inch and greater: 12 or 14 inches.
    g. Suitable for pressure of 150 or 250 psig as indicated on drawings.
    h. Provide regular and electrically insulating type as shown on the drawings.
2. Restrained dismantling joints:
    a. Flange: AWWA Class D or E steel ring flange as required by drawings,
    b. Spool: ASTM A36 steel.
    c. End ring and body: ASTM A36 steel.
    d. Gaskets: Nitrile Buna Rubber (NBR) in accordance to ASTM D 2000.
    e. Bolts and nuts: ASTM A588 HSLA bolt material.
    f. Tie-Rods: High tensile steel per ASTM A193 Grade B7.
    g. Pressure rating: equal to the maximum rating of the adjacent flange.
    h. Assembly tolerance: Three inches flange face to flange face.

L. Grooved-end Pipe Couplings:
1. AWWA C606.
2. Flexible joint type with rolled or cut grooves.

M. Flange Insulation:
1. Manufactured by PSI, complete with the “Linebacker 61” type of gasket, Pipeline Seal and Insulator, Incorporated, 6525 Goforth Street, Houston , TX 77021; Advanced Products and Systems, complete with the “Trojan” type of gasket, P.O. Box 60399, Lafayette, LA 70596-0399; or equal with the following salient characteristics:

a. Provide full-faced, type E gaskets. The outside diameter of the gasket is the same as the outside diameter of the flange.

b. Provide retainer with integral Nitrile sealing element ("Linebacker" or "Trojan" type).

c. Retainer material to be suitable for cold potable water service as recommended by the gasket manufacturer.

d. One insulating sleeve and two insulating washers for each bolt. Material to be suitable for cold water service as recommended by the gasket manufacturer.

e. Asbestos gaskets are not acceptable.

f. To prevent damage to the gasket, the gasket supplier to provide the required bolt torques, recommended bolt tightening sequence, and flange face finish for the insulating flanged joints.

g. Suitable for 150 or 250 psig cold water service as indicated on drawings.

h. NSF 61 certified for contact with potable water.

N. Anchor Bolts:

1. Expansion anchors, anchor bolt chairs, or epoxy type anchor bolts with studs and epoxy capsule as shown on the drawings.

2. Expansion anchors:

a. CID A-A-1923A, type 4.

b. Stainless steel materials for components of the anchors.

3. Epoxy Anchors, Studs with injection adhesive or capsule adhesive shall be HVA Adhesive Anchor System or "HIT HY 150" manufactured by Hilti, P.O. Box 21148, Tulsa, OK 74121 or approved equal with the following essential characteristics:

a. ASTM A 193, grade B7 anchors or studs.

b. The stud and epoxy combination to be furnished by the same manufacturer.

c. End of stud: Double cut point.

O. Pipe Heads:

1. 2:1 ratio elliptical

2. ASME Boiler and Pressure Vessel Code.

2.02 FABRICATION

A. Fabricate steel manifolds in accordance drawings, and AWWA C200.

B. No rubber gasketed bell-and-spigot joints are allowed.

C. Longitudinal, girth, and spiral joints, other than field welds:

1. Single or double-welded butt joints with complete penetration.

2. Stagger longitudinal joints.

3. Longitudinal, girth, and spiral joints shall not intersect at outlet connections.

D. Cut the plates accurately to size and shape.

E. Bend or roll plates to true circular sections with curvature continuous from the edges of the plates.

F. Properly form the edges to be joined by welding to suit the type of welding and to allow complete penetration. Provide beveled ends for field welded butt-joints.

G. Tolerances, Inside Surface of the Pipe:

1. Inside surface of pipe: It shall not be possible to insert at any point a feeler gauge greater than 3/8-inch thickness between a template made to the nominal curvature of the inside surface extending over an arc of 30 degrees and the inside surface of the pipe.

2. Ends of straight pipe sections shall lie in a plane normal to the longitudinal axis of the section with a maximum deviation of 1/8-inch on either side of the plane.

H. Complete welding with a process that protects the molten metal from the atmosphere.

1. Where practicable, use automatic machines.

2. Where weld metal is deposited in successive layers, clean each layer thoroughly before the subsequent layer is deposited.

3. Take particular care in aligning and separating the edges of plates to be joined by butt welding so that complete penetration and fusion of the welds will be ensured.

4. After welding is completed, remove weld spatter.

I. Protect the work and the operator from the wind, rain, and snow during welding operations.

1. Welding of any kind is not permitted on wet surfaces or when the temperature of the steel is lower than 0 degrees Fahrenheit.

2. At temperatures between 0 and 32 degrees Fahrenheit, heat the surface of areas within 3 inches of the point where a weld is to be started to at least 60 degrees Fahrenheit.

J. Flanges and Flanged Connections:

1. During the attachment of flanges to their associated steel pipe, take adequate steps to ensure that the face of the flanges remains flat and perpendicular to the centerline of the attached piping.
2. Limit irregularities or warping in the face of flanges to 0.0015 of an inch measured from:
    a. A high point on the face of the flange at an inside diameter to a corresponding low point on the face of the flange at an outside diameter, along any radial line, (concave orientation of the flange is not permissible) and
    b. A high point on the face of the flange along a circumferential line at the centerline of the flange bolt holes, to a low point on the face of the flange along the same circumferential line, within a distance equal to the circumferential distance between every third bolt hole.
3. Remove by machining, initial, residual, or latent irregularities or warping that remains in the face of the flange after its attachment to the steel piping that exceeds the above.
4. After machining, the flange thickness shall not be reduced below the minimum thickness specified in AWWA C207, ASME B 16.5, or as shown on drawings.
5. Weld pipe flanges to the piping so that the bolt holes straddle the vertical centerline when in the installed position.
6. Provide all pipe flanges that connect to valve body flanges with the same number of bolt holes, bolt pattern, and bolt circle diameter as the valves with which they are connected.

K. Maintain the circularity of the pipe sections during coating, lining, transporting, and installing operations.
    1. Provide stulls or adjustable spiders.
    2. The measured thickness between the maximum and minimum diameters at stulls or spiders shall not exceed 0.5 percent of the nominal pipe diameter.

L. Continuously weld joints of flange supports and pipe supports.

M. Testing of Welds:
    1. Girth weld tests for miter bends:
        a. Test girth welds on miter bends by magnetic particle or liquid penetrant method in accordance with AWS D1.1.
        b. Repair defects and retest weld.
    2. Hydrostatic pressure testing:
        a. The Government shall witness the tests.

b. Provide a minimum of 14 days notice before the test is to be performed.

c. Provide the Government with documentation that shows that the pressure gauges have been recently calibrated.

d. Hydrostatically test each section of the steel manifolds.

e. Hydrostatic test pressures:

1) Manifold pipe from Reach 12A Pipeline Connection to Storage Tank No. 1: 35 psig.

2) Manifold pipe from Storage Tank No.1 to Tohlakai Pumps: 35 psig.

3) Tohlakai Reach 12.B pumps to yard fencing: 145 psig.

4) Tohlakai Reach 12.1 pumps to yard fencing: 225 psig.

5) Tohlakai Pumping Plant Bypass Pipeline: 225 psig.

6) Twin Lakes Turnout Pipeline: 35 psig.

f. Test sections of the steel manifolds with nozzle outlet connections ("nozzle outlet connections" includes any pump discharge outlets, tee outlets, manhole outlets, etc.) after the piping section has been completely fabricated with the nozzle outlet connections.

g. Straight sections of steel manifolds that will not have nozzle outlet connections and are manufactured and hydrostatically tested in accordance with ASTM A 53 or ASTM A 139 need not be retested.

h. If a flange is attached to a piping section after the piping section has been hydrostatically tested, the piping section will not require retesting.

i. Test the flange welds by the magnetic particle or liquid penetrant method in accordance with AWS D1.1. Any defects shall be repaired, and the weld retested.

j. Mitered bends need not be hydrostatically tested after they are fabricated if they are fabricated from straight sections that have been previously tested.

k. After the hydrostatic tests are completed, cut any sections for handling purposes on planes normal to the pipe axis.

l. The water temperature for the tests: greater than 45 degrees Fahrenheit.

m. Vent air from the test section.

n. Fill each section with water and uniformly increase the pressure until the required test pressure is reached.

1) Hold the test pressure for a minimum of 15 minutes.

2) Apply and release the test pressure three successive times.

3) After each application, hold the pressure to two-thirds of the required pressure until welded joints and seams can be examined.

4) Repair defects. After defects are repaired repeat the complete test procedure.

o. Use two or more pressure gauges with one being a recording type.

1) The upper limit of the pressure gauges shall be between 1.5 and 3 times the required test pressure. Calibrate the pressure gauges with a deadweight tester.

2) Gauges used for acceptance of the test, shall be calibrated within 30 days prior to use.

3) Make a time-pressure record of the hydrostatic pressure test.

p. Furnish temporary supports, bulkheads, air vents, dead weight tester, and other equipment necessary to perform the hydrostatic tests.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install the steel manifolds to line and grade as shown on drawings.

B. Refer to 31 23 22 – Pipe Trench Earthwork for excavation and backfill requirements.

C. Furnish and install supports and bracing as may be required to hold the steel manifolds in place and prevent distortion during erection and placing of concrete; however, the embedment of timber supports will not be permitted.

D. Contact between pipe and rebar will not be allowed.

E. Install pipe spools with flanged connections so that the bolt holes straddle the vertical centerline when in the installed position.

F. Install pipe couplings in accordance with manufacturer instructions.

G. Install anchor bolts in accordance with manufacturer instructions.

H. Field Joints:

1. Field joints shown on the drawings are required to facilitate lining or installation of the steel manifolds.

2. Welded field joints: in accordance with AWWA C206.

3. Allowable field joints for the manifolds:

a. Threaded couplings for pipe less than 4 inches in diameter.

b. Flanged for pipe from 4 up to 29 inches in diameter, inclusive. Flanges shall be suitable for the working pressure of the adjacent pipe.

c. Except as shown on drawings, field joints for pipe larger than 29 inches in diameter:

1) AWWA Class D, Class E or Class F flanged joints.

2) Full-penetration butt welds.

3) Double welded lap joints, or double welded butt strap joints.

I. Nondestructive Testing of Field Welds:

1. Test welds in accordance with AWWA C206 and this paragraph.

2. Complete inspections and tests as work progresses in presence of COR and in accordance with AWS D1.1.

3. When welds are found to be defective by the standards of AWS, repair welds in accordance with AWS D1.1 and reexamine welds to ensure the adequacy of repairs.

4. Visual Inspection: Visually inspect welds following procedures, techniques, and standards of AWS D1.1.

5. Testing of full penetration butt welded field joints:

a. Ultrasonic or radiograph methods in accordance with AWS D1.1.

6. Testing of partial penetration joint field welds and fillet field welds, including testing of double welded butt strap joints or double welded lap joints:

a. Magnetic particle or dye penetrant:

1) Technique and procedure for the magnetic particle test in accordance with ASTM E 709.

2) Technique and procedure for the dye penetrant in accordance with ASTM E 165.

3) Standards of acceptance for both types: AWS D1.1.

b. In addition, test the double welded butt strap joints and the double welded lap joints with an air test in accordance with AWWA C206.

3.02 PAINTING

A. Paint steel manifolds in accordance with Section 09 96 20 - Coatings.

END OF SECTION

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SECTION 35 22 14
VALVES AND EQUIPMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Valves and Equipment:

1. Payment: Applicable unit price offered in the schedule for the various types and sizes of valves.

B. Cost:

1. Include price of:

a. Equipment and Valves shown on drawing 1695-D-201 in price offered in the schedule for the Blowoff Assembly.

b. Other Equipment and Valves in the price of the offered in the schedule for the Steel Manifold.

1.02 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

1.	ANSI C2/NESC-2012	National Electric Safety Code

B. American National Standards Institute/NSF (ANSI/NSF)

1.	NSF/ANSI 61 – 2012	Drinking Water System Components - Health Effects

C. American Society of Mechanical Engineers (ASME)

1.	ASME B40.1-2005	Pressure Gauges and Gauge Attachments

D. American Water Works Association (AWWA)

1.	AWWA C207–07	Steel Pipe Flanges for Waterworks Service – Sizes 4 In. Through 144 In.
2.	AWWA C504–10	Rubber-Seated Butterfly Valves
3.	AWWA C507–11	Ball Valves, 6-In. Through 48-In

E. Institute of Electrical and Electronics Engineers (IEEE)

1.	IEEE C57.13-2008	Standard Requirements for Instrument Transformers

F. Manufacturers Standardization Society (MSS)

1. MSS SP–110–2010 Ball Valves Threaded, Socket–Welding, Solder Joint, Grooved, and Flared Ends

G. National Electrical Manufacturing Association Standards (NEMA)

1. NEMA ICS-5-2000 (R2005, R2010) Control Circuit and Pilot Devices

1.03 SUBMITTALS

A. Submit the following in accordance with the requirements of Section 01 33 00 – Submittals and 01 33 26 – Electrical Drawings and Data.

B. RSN 35 22 14–1, Commercial Products Data:

1. Data for the following:
   a. Pressure gauges.
   b. Pressure transmitters.
   c. Ball valves.
   d. Globe valves.
   e. Check valves.
   f. Air valves.
   g. Butterfly valves with manual actuators for exposed service.
   h. Butterfly valves for buried or submerged service.
   i. Valve boxes for buried valves.
   j. Pressure sustaining and check valves.
   k. Portable hydraulic valve operators.

C. RSN 35 22 14–2, Service Manuals:

1. Manuals for the following:
   a. Pressure gauges.
   b. Pressure transmitters.
   c. Ball valves.
   d. Globe valves.
   e. Check valves.
   f. Air valves.
   g. Butterfly valves with manual actuators for exposed service.
   h. Butterfly valves for buried or submerged service.
   i. Pressure sustaining and check valves.

j. Portable hydraulic valve operators.

D. RSN 35 22 14–3, Motor-Operated Butterfly Valve Data:

1. Commercial products (catalog) data including:
   a. Manufacturer's name.
   b. Model number.
   c. Bill of material.
   d. Name plate list.
   e. Settings for the limit switches and the torque switches.
2. Explicit torque calculations showing that the motor operator is of sufficient size to seat or unseat the valve and hold the disk at any intermediate position under the maximum unbalanced pressure conditions.
3. Certification for the following:
   a. The valves met the testing requirements of AWWA C504.
   b. The valves are capable of performing under the specified operating conditions without damage to valve body, valve seats, or motor operator.
4. Valve data:
   a. Maximum torque required (foot-pounds).
   b. Test data of rated flow coefficient (Cv). Provide data in graph or table format with data points at a maximum of 10 degree intervals, for disk angles of 10 degree through 90 degree.
5. Motor data:
   a. Locked rotor torque (foot-pounds).
   b. Full load torque (foot-pounds).
   c. Horsepower rating (horsepower).
   d. Voltage rating (volts).
   e. Locked rotor amps (amperes).
   f. Full load amps (amperes).
   g. Time rating (minutes).
   h. Assembly drawings.
   i. Schematic diagrams for each motor operated butterfly valve.
      1) Show schematic details for all portions of actual circuitry, regardless of whether circuitry is located within motor control center or elsewhere.

2) Show motor and switch terminals for the motor operated butterfly valves.

3) Clearly mark the interface for remote devices.

4) Show designations on device terminals and wire numbers.

5) Show spare contacts.

6) Show wire numbers including wire numbers for remote devices.

j. Wiring diagrams:

1) Submit actual wiring diagrams for this specific job.

2) Typical wiring diagrams will not be accepted.

k. Interconnection diagram.

E. RSN 35 22 14-4, Check Prints.

F. RSN 35 22 14-5, Motor-Operated Butterfly Valve Approval Drawings:

1. Schematic and wiring diagrams.

G. RSN 35 22 14-6, Motor-Operated Butterfly Valves Service Manuals:

1. Final "As-built" drawings, including:

a. Schematics diagrams.

b. Wiring diagrams.

2. Catalog data sheets for each device or item of equipment.

3. Manufacturer's fuse-size time-current curves.

4. Half-size prints of drawings including nameplate list and bill of material.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Prevent damage to valves and equipment during loading, transportation, unloading, storage, and laying to prevent damage to the valves and equipment. Repair damage to the valves and equipment as directed if, in the opinion of COR, a satisfactory repair can be made; otherwise replace damaged valves and equipment.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Gasket:

1. Multi-Swell Style 3760-U as manufactured by Garlock, Website: www.garlock.com or equal with the following essential characteristics:

a. Dimensional requirements of AWWA C207.

b. NSF 61 listed.

c. Suitable for cold water service.

B. Pressure Gauges:

1. Range displayed on the pressure gauges:

a. 0 to 25 psig.

b. 0 to 175 psig

c. 0 to 275 psig

2. Bronze bourdon-tube, adjustable–movement type.

3. Movement made of phosphor bronze, nylon, nickel, silver, stainless steel, Monel steel, nitrided steel, or any combination thereof.

4. Bushings of any of the above–mentioned material but different composition or hardness than the shafts.

5. Case of brass or aluminum alloy.

6. Dust–proof and moisture–proof case.

7. Glycerin liquid filled.

8. Four–inch diameter or larger dial.

9. Dial in white with black markings.

10. Black indicating pointer.

11. Shatter resistant window.

12. Conform to ASME B40.1, grade A accuracy or better.

13. Bottom connected with 0.25-inch diameter male pipe connections.

C. Six-Inch Diameter Pressure Sustaining/Pipe Filling Valve for Reach 12.1:

1. Model No. 100-01KO, manufactured by: Cla-Val Company, Newport Beach, CA 92663; or equal, having following essential characteristics:

a. Anti-cavitation trim suitable for pressure dissipation from 150 psig to atmosphere without damaging cavitation.

b. Suitable for bolting to AWWA Class E flanges.

c. Suitable for cold water pressures up to 225 psig.

d. Ductile iron, globe-style body.

e. Diaphragm operated.

f. Stainless steel trim.

g. Control system components to be manufactured by the same company as the main valve.

h. Pilot piping for the valves:

1) Hydraulic (water) operated control pilots.

2) Manual shut off valves.

3) Opening and closing speed control valves.

4) Pilot "Y" strainers.

i. Automatically sustain the pressure upstream of the valve to 185 psig.

j. Valve pressure sustaining settings shall be fully adjustable.

D. Ball Valves:

1. Bubble tight at the rated pressure in either direction and suitable for operation after long periods of inactivity.

2. MSS SP-72 or MSS SP–110.

3. Body - full ported, carbon steel, cast iron, ductile iron or stainless steel.

4. Ball – cast iron with fused Polytetrafluoroethylene (PTFE) or stainless steel.

5. Valve stem – stainless steel.

6. Packing follower – stainless steel.

7. Female threaded ends or flanged ends.

8. Flanges shall be flat faced and shall match the drilling dimensions and pattern of adjacent AWWA Class D or Class E flanges.

9. Cold – water pressure rating of not less than 150 psig or 250 psi as required to match adjacent piping.

10. Valves 6-inch diameter and larger shall be provided with geared operators.

11. Provide wheel handles for valves for blow off structures 4-inch diameter and smaller.

12. ANSI/NSF 61 listed for contact with potable water.

13. Valves shall be re-buildable.

E. Check Valves:

1. Series 9600 as manufactured by Val-Matic Valve and Manufacturing Company, 905 Riverside Drive, Elmhurst IL 60126; TD Series as manufactured by Crispin Valve, 600 Fowler Avenue, Berwick, PA 18603; Series 800B as manufactured by Valve and Primer Corporation., 1420 South Wright Boulevard, Schaumburg, IL 60196; or equal, having following essential characteristics:

a. Tilting-disc type.

b. Metal to metal seated or metal to resilient material seated.

c. ANSI Class 150 rated, suitable for pressures up to 250 psig, cold water service.

d. Suitable for use in a pipeline when the velocity of flow changes from approximately 16 feet per second to zero in 1 second.

e. Suitable for bolting to AWWA Class D and Class E steel pipe flanges.

f. The valve housing consists of two body sections bolted together at a central diagonal flange.

g. ASTM A536 Ductile iron valve body with integral flanges (not wafer style).

1) Provide spiral or concentric serrated grooved flange face gasket surface finishes that are suitable for flat gasket material.

h. Centrifugally cast bronze body seat.

i. Stainless steel pivot pin.

j. Seat and disk rings: Replaceable without machining in the field.

k. Provide a disc position indicator on the shaft.

l. Provide bottom mounted buffer.

m. Furnish check valves from the same manufacturer.

F. Globe Valves:

1. Forged steel.

2. ASME B16.34, Valves - Flanged, Threaded, and Welding End.

3. ASME Class 150.

4. Outside screw and yoke.

5. ASME B16.5 flanged ends.

6. Regular port.

7. Manually actuated.

8. Suitable for water service.

9. Suitable for use as a pipe filling valves to bypass the 24-inch butterfly isolation valves of Air Chambers for Reach 12.1 and 12.B as shown on the drawings.

10. Reach 12.1 globe valves shall have a design pressure not less than 250 psig.

11. Reach 12.B globe valves shall have a design pressure not less than 150 psig.

G. Air Valves:

1. General:

a. Provide combination air–inlet and air–release type or air and vacuum type actuated by a float, as shown on the drawings.

b. Remains open for filling the line until the water has displaced air at the point of attachment of the valve assembly after which it closes.

c. Opens whenever the pressure in the pipeline drops sufficiently to create a vacuum.

d. Furnish with two petcocks for the valve; one at the top to permit checking the effectiveness of air valve, and one at bottom to allow valve to be drained.

e. Stainless steel internal parts such as guides, bushings, and screws.

f. Stainless steel floats.

g. Float-pivot supports are brass, bronze, stainless steel, or cast iron.

h. Cold-water pressure rating for the body of the valve is at least 300 pounds per square inch.

i. Seat material suitable for 150 psig pressure for Reach 12.B, Twin Lakes Turnout and tank/pump suction manifold piping) and 250 psig pressure for Reach 12.1 manifold piping.

j. Inlet connection: internally threaded NPT or ANSI Class 150 or 250 flanged as indicated on the drawings.

k. Provide Low pressure seats for suction manifold and Twin Lakes Turnout air valves. Design pressure for low pressure seats is 15 psig.

2. Air release type: air release for clean water manufactured by Val-Matic Valve and Manufacturing Corporation, 8448 West 45th Street, Lyons, IL 60534; air release valve manufactured by APCO Valve and Primer Corporation, 1420 South Wright Boulevard, Schaumburg, IL 60193–4599; Crispin air release air valve manufactured by Crispin Air Valve, Multiplex Manufacturing Company, 600 Fowler Avenue, Berwick, PA 18603; or equal, having following essential characteristics:

a. Releases trapped air when the pipeline is under pressure.

b. Furnished with a discharge pipe that directs the released air downward as shown on the drawings.

3. Combination type: Bulletin 200 manufactured by Val-Matic Valve and Manufacturing Corporation, 8448 West 45th Street, Lyons, IL 60534; combination air valve manufactured by APCO Valve and Primer Corporation, 1420 South Wright Boulevard, Schaumburg, IL 60193–4599; Crispin Combination air valve manufactured by Crispin Air Valve, Multiplex Manufacturing Company, 600 Fowler Avenue, Berwick, PA 18603; or equal, having following essential characteristics:

a. Releases trapped air when the pipeline is under pressure.

b. Admits air into the pipeline in order to prevent a vacuum.

c. Releases air when pipeline is filled.

d. Furnished with a discharge pipe that directs the released air downward as shown on the drawings.

H. Manually Operated Butterfly Valves:

1. General:

a. AWWA C504.

b. Pressure class: 150B or 250B as indicated on the drawings.

c. Provide valves which are bubbletight at the rated pressure in either direction and suitable for operation after long periods of inactivity.

d. Install butterfly valves complete and lubricated in accordance with the manufacturer's instructions.

e. Axis of valve leaf: Horizontal when the valve is in the installed position, except where shown on the drawings.

f. Provide one extra set of seats for each size of butterfly valve.

g. Flanged ends shall connect to AWWA class D or E flanges as indicated on the drawings.

h. Valve seat: located either in the valve body mating with a stainless steel seating surface located on the valve disc; or in the valve disc mating with a stainless steel seating surface located in the valve body. No fully rubber lined bonded seat in body type seats are acceptable.

2. Manual operators for butterfly valves:

a. Equip manually-operated butterfly valves with a worm-gear traveling nut type manual operator in accordance with AWWA C504.

b. Provide operators that will open and close the valves under maximum unbalanced pressure conditions. Design for a maximum unbalanced pressure equal to 150 psig or 250 psi as indicated on the drawings.

c. Provide gears of the self-locking type, designed to hold the valve in position without fluttering or creeping.

d. Provide hand wheels for above ground valves. Ensure rim pull and component strength meet AWWA requirements.

e. Provide extension stems and floor stands where shown on drawings and in accordance with specifications. The extension shall not be attached with set screws; only use roll pins or bolt locking nut that extends through extension and valve shaft.

f. Pump suction piping valves:

1) Fit with limit switches.

2) Integral part of operator and furnished with necessary gearing.

3) Provide with minimum of 8 independent limit switches set to function as follows:

a) Two electrically independent contacts – Close at fully-open position.

b) Two electrically independent contacts – Open at fully-open position.

c) Two electrically independent contacts – Close at fully closed position.

d) Two electrically independent contacts – Open at fully closed position.

4) Heavy-duty type.

5) Adjustable to operate at any valve position.

6) Provide with A600 contact designation in accordance with NEMA ICS–5.

g. Air chambers isolation valves:

1) Fitted with limit switches.

2) Integral part of operator and furnished with necessary gearing.

3) Provide with minimum of 4 independent limit switches set to function as follows:

a) Two electrically independent contacts – Close at fully-open position.

b) Two electrically independent contacts – Open at fully-open position.

4) Heavy-duty type.

5) Adjustable to operate at any valve position.

6) Provide with A600 contact designation in accordance with NEMA ICS–5.

3. Buried and submerged butterfly valves: suitable for buried and submerged service and equipped with valve boxes.

a. Each buried butterfly valve shall be provided with a 2-inch square-nut operator.

b. Provide extension stems where required to raise the operating nut to within 6 inches of the ground surface or the top of the concrete sump where shown on the drawings.

c. Provide a total of 2 steel tee-handle wrenches, each with a length of 4 feet.

d. Equip valves with a worm-gear traveling nut type manual operator in accordance with AWWA C504.

e. Provide gears of the self-locking type, designed to hold the valve in position without fluttering or creeping.

f. Ensure rim pull and component strength meet AWWA requirements.

I. Valve Boxes:

1. Figure F-2454 manufactured by Clow Corporation, 1211 West 22nd Street, Oak Brook, IL 60521; 6850 series manufactured by Tyler Pipe, P.O. Box 2027, Tyler, TX 75710; Boxes as manufactured by Mueller Company, 500 West Eldorado Street, Decatur, IL 62525; or equal, having following essential characteristics:

a. Provide 5-1/4-inch minimum inside diameter cast iron valve boxes for valves 4 inches in diameter and larger.

b. Valve boxes shall be 2-piece or 3-piece and screw type.

c. Cast iron collar and lid with lid marked "WATER".

d. Provide base and adequate extension items to extend from the valve nut operator to the ground surface. Extension items shall be cast iron metal.

J. Motor Operated Butterfly Valves:

1. Butterfly valves: Manufactured by Val-Matic Valve and Manufacturing Company, 905 Riverside Drive, Elmhurst, IL 60126; DeZurik, Riverside Avenue, N. Sartell, MN 56377-1743; Henry Pratt Company, 401 South Highland Avenue, Aurora, IL 60506-5563; or equal with the following essential characteristics.

a. AWWA C504.

2. Valve seat: located either in the valve body mating with a stainless steel seating surface located on the valve disc; or in the valve disc mating with a stainless steel seating surface located in the valve body. No fully rubber lined bonded seat in body type seats are acceptable.

3. Provide valves which are bubbletight at the rated pressure in either direction and suitable for operation after long periods of inactivity.

4. The valves are required to operate from the fully opened to the fully closed position without damage to the seats, valve body, or motor under the operating conditions described below.

5. Provide actuators that will open and close the valves under maximum unbalanced pressure conditions. Design for a maximum unbalanced pressure = 150 or 250 psig as indicated on the Drawings.

6. Operating conditions:

a. The valve will open and close under unbalanced conditions.

b. The valves are to function as pump discharge valves.

c. They are located immediately downstream of the pumps.

1) During a pump start-up procedure, the valve will start to open simultaneously as the pump is started.

2) During a pump shut-down procedure, the valve will be closed while the pump is delivering water. Once the valve reaches its 100 percent closed position, the pump will shut-down.

d. Maximum pump shut-off inlet pressure: design for 150 psig for Reach 12.B valves; 250 psi for Reach 12.1 valves.

e. Maximum velocity through a fully opened valve: between 7 to 9 feet per second.

7. Provide valves which are suitable for operation with flow in either direction.

8. Mark the valve body with a flow arrow which indicates the manufacturer's recommended flow direction through the valve.

9. Install complete and lubricated in accordance with the manufacturer's instructions.

10. Flanged ends suitable for connection to AWWA Class D (Reach 12.B manifold pipe) or E (Reach 12.1 manifold pipe) flanges as indicated on the drawings.

11. Suitable for exposed service.

12. Motor operators for butterfly valves:

a. Provide actuators that will open and close the valves under maximum unbalanced pressure conditions. Design for a maximum unbalanced pressure = 150 psig for Reach 12.B valves; 250 psi for Reach 12.1 valves

b. The motor is to supply at least two times the torque required to open and close the valves under maximum full differential pressure.

c. Open and closing times:

1) 90 seconds.

d. Provide NEMA 250 4X enclosures for electrical equipment.

e. Motor operator: manufactured by EIM Company, Incorporated, 13840 Pike Road, Missouri City, TX 77459; or equal, having following essential characteristics:

1) Reduction gears.

2) Mechanical position indicator.

3) Electric motor:

a) Suitable for operation with ambient temperatures ranging from -10 degrees Celsius to 50 degrees Celsius.

b) Suitable for operation at an elevation of 6,700 feet.

4) Induction type rated 480 volts, 3 phase, 60 hertz, conforming to NEMA MG1 and designed for required service.

5) Enclosure: Totally-enclosed, fan-cooled (TEFC).

6) Minimum time rating: 15 minutes.

7) Designed for full-voltage starting and reversing duty.

8) Locked-rotor torque: Not less than 250 percent of full-load torque.

9) Insulation: Class F or H.

f. Integral motor starter:

1) Full-voltage, reversing type with mechanical and electrical interlocks.

2) Coils: 120 volts, 60-hertz.

3) Provide with thermal overload device. Thermal protector integral with motor may be used in lieu of motor starter overload device.

4) Control power transformer:

a) Voltage: 480-120 volt, 60 hertz.

b) Provide with primary and secondary fuses.

g. Torque switch mechanism:

1) Integral part of motor operator which functions to protect valve and motor operator in opening and closing directions.

2) Independently adjustable for both travel directions.

3) Provide with A600 contact designation in accordance with NEMA ICS–5.

h. Limit switches:

1) Integral part of motor operator and furnished with necessary gearing.

2) Provide with minimum of 8 independent limit switches set to function as follows:

a) Two electrically independent contacts – Close at fully-open position.

b) Two electrically independent contacts – Open at fully-open position.

c) Two electrically independent contacts – Close at fully-closed position.

d) Two electrically independent contacts – Open at fully-closed position.

3) Heavy-duty type.

4) Adjustable to operate at any valve position.

5) Provide with A600 contact designation in accordance with NEMA ICS–5.

a) Handwheel:

i. Provide a handwheel for manual operation that does not rotate during motor operation.

ii. Failure of the motor shall not prevent manual operation.

iii. Provide a declutching mechanism to engage the handwheel for manual operation.

b) Pushbuttons:

i. Momentary contact type.

ii. Provide for OPEN, CLOSE, and STOP functions.

iii. Operable from outside the enclosure.

i. Selector switch:

1) Two position type LOCAL-REMOTE.

2) Operable from outside the enclosure.

j. Provide strip space heater.

1) 120 volts, 60-hertz from discharge valve motor control transformer.

k. Provide terminal blocks for terminating external cables.

1) Suitable for connection to a future SCADA system.

l. Mounting options:

1) Mount the motor operators for the valves with the butterfly valve bodies.

2) The axis of the shafts for the valves shall be vertically orientated.

m. Digital Control Module (DCM):

1) Provide gate actuator with DCM to allow for remote monitoring and control of the actuator.

2) Microprocessor based electronics with control software stored in non-volatile EEPROM memory.

3) Watchdog timer to disconnect actuator from network and disable outputs upon microprocessor failure. Two serial communication ports, minimum.

4) Built in transient and lightning protection.

5) Perform self-diagnostics.

6) Provide valve position feedback in the form of 0 to 100 percent of valve opening.

7) Provide following status and alarms, minimum:

8) Valve in fully open position.

9) Valve in fully closed position.

10) Valve is moving in open direction in both electric and handwheel mode.

11) Valve is moving in closed direction in both electric and handwheel mode.

12) Selector switch in LOCAL position.

13) Selector switch in REMOTE position.

14) Torque switch tripped in the OPEN direction.

15) Torque switch tripped in the CLOSE direction.

16) Valve is not moving on command.

17) Loss of internal control voltage.

18) Actuator failed self-diagnostics or general alarm

19) Communication:

a) Communication protocol: Modbus RTU.

b) Communication method: Single RS-485 twisted pair, shielded wire network.

c) Communication topology: Redundant loop.

n. Integral disconnect switches:

1) Single throw switch.

2) Rating: 480V, 60 A.

3) Equip operator handles with means for padlocking operator in either open or closed position.

4) Position of disconnect switch shall be marked OPEN or CLOSED.

K. Flap Valves: A2540 series as manufactured by Troy Valve, www.pentroy.com, or equal with the following characteristics:

1. Cast iron body and cover.
2. Bronze seat and disc ring.
3. Stainless steel hinge pin and cotter pins.
4. Constructed with a 10-degree offset from vertical for positive closure.
5. The flange shall be flat faced and drilled to match an AWWA C207 Class D flange.

L. Resilient Seated Gate Valves:

1. Meet AWWA C515.
2. Cast ferrous valve components shall be made of ductile iron.
3. Non-rising stem.
4. Wrench nut operated.
5. Valve ends shall be flat faced flanges and shall match the drilling dimensions and pattern of AWWA C207 Class D flanges.
6. Wedges shall be fully encapsulated with EPDM rubber.
7. Operating nuts shall be 2" square and shall be ductile iron.
8. Cold water working pressure shall be 250 psig.
9. Valve shall be suitable for buried service.

M. Pressure Switches: B-series Type 400 by Aschcroft Inc., 250 East Main Street, Strafford, CT 06614 or equal with the following essential characteristics:

1. Reach 12.1 suction manifold pressure switches shall have a nominal pressure range of 0 to 15 psig with an approximate dead band of 0.1 to 0.35 psi. Set point shall be field set to actuate switch at 4.6 psig and less.
2. Reach 12.1 discharge manifold pressure switches shall have a nominal pressure range of 0 to 400 psig with an approximate dead band of 0.1 to 0.35 psi. Set point shall be field set to actuate switch at 212 psig and more.
3. Switch elements shall be general purpose, 15A, 125/250/480 Volt AC
4. Actuator seals: Buna-N.
5. Pressure switches shall be field adjustable from 15 to 100 percent of nominal pressure range.

N. Pressure Transmitters shall be Rosemount Model 3051TG in-line pressure transmitters by Emerson Process Management, Rosemount Measurement, 8200 Market Boulevard, Chanhassen, MN 55317 or equal with the following essential characteristics:

1. Reach 12.1 discharge manifold pressure transmitter shall measure pressure from -14.7 to 250 psig.

2. Reach 12.B discharge manifold pressure transmitter shall measure pressure from -14.7 to 150 psig.
3. Output shall be 4-20 milliamperes D. C.
4. Transmitter shall be suitable for operation on 10- to 36-volt D.C. external power supply.
5. Adjustable offset (zero) and span shall be provided.
6. Accuracy shall be plus or minus 0.25 percent.
7. Vent/Drain valve shall be provided.
8. Process connection shall be 1/2-inch-14 NPT female.
9. Isolating diaphragm shall be 316L stainless steel.
10. Sensor fill shall be silicone oil.
11. Housing shall be aluminum with 1/2-inch-14 NPT conduit entry size.
12. Transmitter materials in contact with potable water shall be National Sanitation Foundation listed.
13. Liquid Crystal Display with local operator interface shall be provided.

O. Portable Hydraulic Valve Operators shall be Pow-R Drive II by E.H. Wachs Company, 600 Knightsbridge Parkway, Lincolnshire, IL, 60069 or equal meeting the following essential characteristics:

1. Suitable for operating gate and butterfly valves from 6 to 60 inches.
2. Drive shall be lightweight aluminum gearbox with two stage reduction, planetary primary and bronze/steel secondary.
3. Hydraulic requirements shall be 8 gpm at 1800 psig.
4. Peak torque shall be 800 ft-lbs.
5. Finish shall be hard chrome plating.
6. Hydraulic motor control shall have an adjustable torque setting valve for 0 to 800 lb-ft control with torque indicating gauge, reversing valve and spring loaded self-centering automatic stop after release.
7. Revolution counter with built-in digital display and push button reset shall be provided. Counter increments shall be 1/10 revolutions and shall automatically register in the forward and reverse directions.
8. Glycerin filled hydraulic torque gage for 0 to 800 lb-ft measurement shall be provided.
9. Metal components shall be shop painted with the manufacturers standard coatings with the exception of handles and accessories which shall be nickel plated.

10. Two Telescopic valve keys shall be provided with 1" square solid bars and with adjustable lengths from 4 to 9 feet.

11. Two 2-inch square AWWA sockets shall be provided.

12. Two portable hydraulic valve operators with fitted, heavy duty storage cases shall be provided.

2.02 CONTRACTOR SOURCE QUALITY TESTING

A. Tests:

1. Submit certification showing valves meet the hydrostatic and leak testing requirements:

a. Butterfly valves:

1) Shop tests:

a) Test in accordance with AWWA C504.

2) Field pump tests:

a) Test the opening and closing during the field pump tests.

b) Valves shall open and close under the maximum full differential pressure.

c) Motor operated valves shall open and close with the pump operating at shut-off pressure.

d) Government to witness the pump field test. Provide the government 14 days of notice before performing the test.

b. Check valves:

1) Test in accordance with manufactures' requirements.

c. Pressure sustaining valves:

1) Test in accordance with manufactures' requirements.

B. Valve Body Flange Faces for Flanged Valves:

1. Valve manufacturers are responsible for providing the correct flange face gasket surface finish.

2. Provide spiral or concentric serrated grooved flange face gasket surface finishes that are suitable for the flat gasket material provided and for the operating pressures.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install the valves and equipment to line and grade as shown on drawings.

B. Install valves with flanged connections so that the bolt holes straddle the vertical centerline when in the installed position.

C. Install valves in accordance with the manufacturer's instructions.

D. After each valve has been completely installed, test the valve by opening and closing the valve through its full range of operation three times. Make any required changes or adjustments until the operation of the valve is approved by COR.

3.02 PAINTING

A. Paint the valves and equipment in accordance with Section 09 96 20 - Coatings.

END OF SECTION

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SECTION 41 22 20

OVERHEAD TRAVELING CRANE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Overhead Traveling Crane:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American Gear Manufacturers Association (AGMA)

1.	AGMA 2001 - D04 (R2010)	Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
2.	AGMA 6013 - A06 (R 2011)	Industrial Enclosed Gear Drives

B. American Institute of Steel Construction (AISC)

1.	AISC 325 - 2011	Steel Construction Manual

C. American Society of Mechanical Engineers (ASME)

1.	ASME B30.10 - 2009	Hooks
2.	ASME B30.11 - 2010	Monorails and Underhung Cranes
3.	ASME HST-1 - 2012	Performance Standard for Electric Chain Hoists

D. American Welding Society (AWS)

1.	AWS D1.1/D1.1M -10	Structural Welding Code - Steel
2.	AWS D14.1/D14.1M -05	Welding Industrial and Mill Cranes and Other Material Handling Equipment

E. Code of Federal Regulations (CFR)

1.	29 CFR Part 1910	Occupational Safety and Health Standards

F. Crane Manufacturers Association of America, Inc. (CMAA)

1.	CMAA 74 - 2010	Top Running and Under Running Single Girder Electric Traveling Cranes Utilizing Under Running Trolley Hoist

G. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250 - 2008	Enclosures for Electrical Equipment (1000 Volts Maximum)
2.	NEMA ICS 8 – 2011	Application Guide for Systems Crane and Hoist Controllers
3.	NEMA MG 1 – 2011	Motors and Generators

H. National Fire Protection Association (NFPA)

1.	NFPA 70 – 2011	National Electrical Code (NEC)

1.03 SUBMITTALS

A. In accordance with Section 01 33 00 – Submittals and Section 01 33 26 – Electrical Drawings and Data.

B. RSN 41 22 20-1, Approval Data:

1. Design and sizing calculations:

   a. Verify the choice of components for the overhead crane, including, but not limited to: hoist, trolley, end trucks and wheels, bridge beam, drive systems, brakes, motors, controls, and overcurrent protection of motors, controls, and branch circuits.

   b. Provide weights of components, maximum wheel loads, and rated speeds of trolley, bridge, and hoist when loaded to full capacity.

2. Drawings:

   a. General arrangement. Show complete layout and dimensions; weights of components; maximum wheel loads; hook limits, approaches and clearances; parts identification/bill of materials; assembly and details of the overhead crane components, including controls and control cabinets.

   b. Motor nameplate data.

   c. Electrical Schematics and Wiring Diagrams.

3. Commercial product data. Provide dimensional and rating data. Mark data sheets to indicate specific make, model number and features of equipment to be provided. Include data for:

   a. Electric motors (including motor horsepower and additional nameplate data per NEMA MG 1, output torque rating, torque versus speed (rpm) curves that indicate motor pullout torque, output torque ratings, and motor data shown on standard drawing. 40-D-6032).

   b. Gear reducers.

   c. Hook.

   d. Hoist.

   e. Trolley.

f. Bridge and end trucks.

g. Controls, control parameter settings, and pendant pushbutton station.

h. Electrification and festooning.

i. Brakes.

j. Overload Device.

k. Limit Switches.

C. RSN 41 22 20-2, Check Prints.

D. RSN 41 22 20-3, Final Data:

1. Service manual. Include:

a. As-built general arrangement, details, electrical schematics, and wiring diagrams.

b. Comprehensive list of parts.

c. Commercial product data for each component.

d. Adjustment and calibration instructions.

e. Preventative maintenance data, including recommended lubricants and lubrication schedules.

f. Detailed operating instructions.

g. Photographs:

1) 8- by 10-inch.

2) Front and end views of the crane, showing all the components, and close-up views of the hoist, trolley, and bridge, including motor nameplates.

h. Reports:

1) Certified copy of field quality test report.

2) Hook and hook nut magnetic-particle tests.

3) Load chain proof test.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment on site in shipping containers with labeling in place.

B. Protect equipment from damage, moisture, and dust.

1.05 FIELD MEASUREMENTS

A. Verify field measurements, building and site dimensions prior to fabrication. Coordinate and relate work to the building structure and work done by the various trades.

PART 2 PRODUCTS

2.01 OVERHEAD TRAVELING CRANE

A. Provide one overhead traveling bridge crane for servicing of pump units1 through 6 (and future unit 7) in the pumping plant, as shown on drawing 1695-D-257.

B. Design:

1. Comply with applicable sections of:
   a. CMAA 74, Class C, indoor service.
   b. ANSI B30.11.
   c. NFPA 70.
   d. AGMA 2001 and 6013.
   e. 29 CFR Part 1910.
2. Components suitable for indoor (industrial, non-hazardous environment) operation in ambient operating temperature range from 0 to 120 degrees Fahrenheit at approximate elevation 6700 feet above sea level.
3. Capacity: 5-Tons.
4. Operation: Electrically-operated, pushbutton pendant station-controlled hoist, trolley, and bridge.
5. Power supply: 480 Volts, 3-phase, 60 Hz, from the pumping plant panelboard DCA.
6. Protect crane with readily accessible enclosed-type circuit breaker.
7. Type: Top running, under-hung, single-girder, 4-wheel crane.
8. Span, runway length, and hoist lift: As shown on drawing.
9. Approximate speeds:
   a. Hoist:
      1) Low: 3-5 feet per minute (fpm).
      2) High: 15-20 fpm.
   b. Trolley:
      1) Low: 10-20 fpm.
      2) High: 50-75 fpm.
   c. Bridge:
      1) Low: 20-30 fpm.
      2) High: 75-100 fpm.
10. Checked, dated, and certified by a Registered Professional Engineer specializing in design of cranes and associated equipment.

C. Motors:

1. In accordance with requirements of NEMA MG 1.
2. Voltage: 460 Volt, 3-phase, 60-hertz.
3. Design:
   a. Two-speed, A.C. squirrel-cage induction type for hoist, bridge, and trolley drives.
   b. Reversing service and across-the-line starting at full voltage.
   c. Heavy-duty, totally-enclosed, fan-cooled.
   d. Duty rating: 60 minute.
   e. Maximum temperature rise when motor is at rated voltage, rated frequency, and is delivering rated output continuously:
      1) Windings: In accordance with NEMA MG 1 and not in excess of insulation rating.
      2) Other parts of motor: In accordance with NEMA standards for Class B insulation.
4. Bearings:
   a. Grease lubricated, antifriction type.
   b. Sealed against loss of the lubricant or entrance of dirt.
5. Windings insulation:
   a. Class F or Class H.
   b. Treated to prevent damage from temporary exposure to dampness.
6. Motor leads:
   a. Brought out of stator frame to terminal box.
   b. Insulation: Completely sealed to winding coil insulation so that connection is equal to stator or winding coil insulation in regard to voltage and resistance to moisture.
7. Terminal box:
   a. Sized to accept motor feeder wires, wires for space heater and motor brake, and a ground wire.
   b. Conduit openings: As required.
   c. Conductors: Terminate in a solderless connector.

D. Hoist:

1. Electric motor-driven, chain type, with low headroom configuration, in accordance with ASME HST-1, Class H3.
2. Hoist motor torque: NEMA MG 1, Design D.

3. Chain material: High-strength alloy steel, galvanized.
4. Chain container: Impact- and corrosion-resistant material.
5. Shafts, gears, load wheel materials: Heat-treated alloy steel.
6. Mounting: Top lug suspension.
7. Overload limit device required.
8. Limiting device required to prevent hook block from contacting upper sheave block (anti-two-blocking device).
9. Motor brake:
    a. Electro-mechanical, spring-set, disk-type, adequate to hold 131.25 percent of the rated hoist load.
    b. Provide with manual release.
10. Mechanical load brake: Adequate to hold 131.25 percent of the rated hoist load.
11. Unit casing: Steel.
12. Hook:
    a. In accordance with ASME B30.10.
    b. Material: Heat-treated alloy steel.
    c. Spring-return safety latch.
    d. 360-degree rotation.
    e. Provide with throat opening inspection marks.

E. Trolley:

1. Electric motor-driven.
2. Provide cross-shafts, suitable for hoist lug mounting.
3. Wheeled, suitable for mounting on bridge beam flange.
4. Bearings: Sealed, roller- or ball-type, permanently lubricated.
5. Provide with rubber bumpers.

F. Bridge:

1. Electric motor-driven.
2. Drive shaft geared to both end trucks to provide uniform travel at both sides of crane.
3. Bridge girder: Braced and welded to maintain squareness with the trucks.
4. End trucks:
    a. Frame: Steel, welded from structural shapes, designed to prevent distortion and mismatch of gears under maximum rated load.

b. Provided with restraining lugs to prevent truck drop of greater than one inch in the event of an axle or wheel failure.

c. Wheelbase: $1/8^{th}$ crane span, minimum.

d. Designed to run on upper surface of crane rail.

G. Bridge and Trolley Brakes: Electro-mechanical, capable of stopping the motion of the bridge or trolley as designated by CMAA 74.

H. Enclosures: In accordance with NEMA 250, Type 2.

I. Controls:

1. Two-speed magnetic-type for bridge, trolley, and hoist drives.

2. Coordinate timing of brake release and motor energization to prevent overhauling.

3. Provide separate banks of voltage reducing resistors or reactors with timing relays for starting, acceleration, and deceleration. Insert resistors or reactors into the motor high-speed leads prior to energization of the high-speed contactor on deceleration.

4. Feed control circuits from a single-phase, air-cooled, double-wound transformer, with a grounded metal screen between the primary and the secondary windings of the transformer.

5. Smooth acceleration and deceleration.

6. In accordance with NEMA ICS 8.

7. Pendant pushbutton station:

a. Arrange pushbuttons in accordance with ASME B30.11 recommendations. Clearly mark all controls to identify functions.

b. Provide:

1) ON/OFF button that removes power from the motors, brakes and control circuit.

2) 2-speed buttons for RAISE/LOWER hoist, EAST/WEST trolley, and NORTH/SOUTH bridge travel.

3) 3-position, keyed switch with positions for:

a) Bypass of the primary upper limit switch (for testing of the backup upper limit switch).

b) Bypass of the backup limit switch in the LOWER direction only.

4) Directional contacts with both mechanical and electrical interlocks.

c. Suspend from independent festooned messenger track system, operating the length of the bridge.

d. Extend control pendant so top of station hangs to level approximately 4 feet above the finished floor of the pumping plant building.

J. Limit Switches:

1. Adjustable primary upper and lower geared limit switches, allowing reversing direction to back out of the limit without resetting.

2. Backup mechanical hook block-activated upper limit switch, requiring resetting prior to operation of the hoist.

K. Hour Meter:

1. Non-resettable.

2. Connected across main-line contactor.

3. Readable from exterior of main control panel.

4. Indicating elapsed number of hours the crane is energized.

L. Electrification:

1. Bridge: Festooned-type. Flat cable with terminal box, multi-conductor cord, and all support accessories, stops, channels, and trolleys for hoist and trolley power.

2. Runway: Enclosed, safety bar-type, with redundant, dual-shoe power collectors.

M. Runways and crane rails: In accordance with CMAA 74 and Section 05 12 10 – Structural Steel.

N. Stops:

1. Provide trolley stops at each end of the bridge beam, located to permit maximum possible trolley travel.

2. Provide bridge stops at each end of the runway beams, located to permit maximum possible bridge travel.

O. Labeling:

1. Mark the rated crane load capacity, in tons, on each side of the crane bridge so that it is legible from a position holding the control pendant station on the operating floor.

2. Mark the rated load capacity of the hoist, in tons, on both sides of the hoist lower block and the hoist body.

3. Mark the underside of the bridge and the trolley with direction arrows that coincide with those indicated on the control pendant station.

4. Identification plates: Provide permanently attached, non-corrosive metal plates for crane components identifying manufacturer, model number, size, serial number, capacity, and any other essential information.

P. Warning Devices:

1. Warning horn, operable from pendant pushbutton station.
2. Warning strobe or rotating beacon, illuminated during movement of the hoist, trolley, or bridge.

Q. Floodlights:

1. Evenly spaced along bridge, providing an illumination level of 40 lumens at 3 feet above the finished floor.
2. Lights: Vibration resistant, designed to prevent material from falling from fixture.
3. ON/OFF switching provided on the pendant pushbutton station.

R. Lubricants:

1. Suitable for air temperatures ranging from 0 to 120 degrees Fahrenheit.
2. Grade and type meeting the manufacturer's recommendations.

S. Coatings: Manufacturer's standard finishes, unless otherwise indicated, in accordance with Section 09 96 20 – Coatings.

2.02 FABRICATION

A. Structural Steel: In accordance with these specifications and AISC 325.

B. Fabricate all load bearing components, couplings, shafts, and gears in the hoist drive trains from rolled or forged steel. Brake drums may be fabricated from ductile iron.

C. Welding:

1. In accordance with qualified procedures per AWS D14.1/D14.1M.
2. Welding operators: Capable of meeting qualification tests for operators as outlined in AWS D1.1. COR may require test specimens by welding operator in accordance with AWS D1.1 appendix.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install runways and rails straight, parallel, level, at same elevation, and aligned in accordance with CMAA 74 tolerances. Fully torque all nuts, bolts, and anchors.

B. Perform work in accordance with manufacturer(s) installation instructions. Ensure all components are fully lubricated and ready for operation upon installation.

C. Install crane on crane rails, adjust and calibrate equipment as required.

D. Conduct a full joint inspection of the installed crane with the COR, prior to testing. Visually inspect all steel castings and subject to non-destructive testing, if required. Verify the crane is ready for testing.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Notify COR at least five days prior to testing of crane.

B. Record test data on standard report form and submit with the final data service manual.

1. Record operating and startup current (and corresponding loads) data for the motors and verify that they meet the manufacturer's recommended values.

2. Record hoist, trolley, and bridge speeds during each test cycle.

3. Measure hook throat dimension at inspection markings prior to loading to establish a baseline measurement and again after load tests to confirm the throat opening has not increased.

4. Record the length of 11 chain pitches, using a caliper gauge, prior to loading the chain. Measure the same number of pitches during the load test and record the stretched length for future comparison.

5. No-load tests:

   a. Raise and lower hook through full range of travel at various speeds and verify hook limit switch and anti-two-block device operation and that there are no obstructions.

   b. Operate trolley and bridge through full travel in each direction through entire speed range and verify operation of stops and brakes and that there are no obstructions.

6. Load tests: Provide a sling for and a test weight of 125 percent rated load capacity of crane.

   a. Position test weight below the trolley at the center of the bridge span.

   b. Attach test weight to hoist and verify load cell readout is accurate and that overload limit device operates satisfactorily.

   c. Override/adjust/disable overload limit device to allow test using test weight.

   d. Raise the test weight approximately 1 foot off the floor and hold the load for 10 minutes. Manually rotate the load to check that the block bearing operates freely. Verify that the brake holds the load without lowering or that the structural elements do not exceed the deflections allowed by CMAA 74.

   e. Operate hoist, trolley, and bridge through their full range of motions and speeds and check for abnormal temperature, noise, binding, distortion, or vibration. Verify free and easy operation and proper brake action while moving the load in all directions.

7. Loss of power tests: For the trolley and bridge, with 100 percent of rated load test weight attached to hook, positioned as far from obstacles as possible, attain slow speed then disconnect the main power. Verify that the trolley/bridge brake engage and measure the stopping distance required.

8. Correct all deficiencies and improper adjustments encountered during testing. Perform any adjustments or repairs in accordance with standard practice or manufacturer's recommendations.

9. If required, retest crane operation to the satisfaction of the COR.

10. Reset the overload limit device for rated crane capacity.

C. After testing, transport the test weight(s) and sling to a designated storage area, at the direction of the COR.

END OF SECTION

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SECTION 41 22 23
MONORAIL CRANE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Monorail Crane:

1. Payment: Lump sum price offered in the schedule.

1.02 REFERENCE STANDARDS

A. American Gear Manufacturers Association (AGMA)

1.	AGMA 2001 - D04 (R2010)	Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
2.	AGMA 6013 - A06 (R2011)	Industrial Enclosed Gear Drives

B. American Institute of Steel Construction (AISC)

1.	AISC 325 - 2005	Steel Construction Manual

C. American Society of Mechanical Engineers (ASME)

1.	ASME B30.10 - 2009	Hooks
2.	ASME B30.11-2010	Monorails and Underhung Cranes
3.	ASME 30.16 - 2007	Overhead Hoists (Underhung)
4.	ASME HST-1 - 2012	Performance Standard for Electric Chain Hoists

D. American Welding Society (AWS)

1.	AWS D1.1/D1.1M - 10	Structural Welding Code - Steel
2.	AWS D14.1/D14.1M - 05	Specification for Welding Industrial and Mill Cranes and Other Material Handling Equipment

E. Code of Federal Regulations (CFR)

1.	29 CFR Part 1910	Occupational Safety and Health Standards

F. Crane Manufacturers Association of America, Inc. (CMAA)

1.	CMAA 74 - 10	Top Running and Under Running Single Girder Electric Overhead Cranes, Utilizing Under Running Trolley Hoist

G. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250 - 2008	Enclosures for Electrical Equipment (1000 Volts Maximum)
2.	NEMA ICS 8 - 2011	Application Guide for Systems Crane and Hoist Controllers
3.	NEMA MG 1 - 2011	Motors and Generators

H. National Fire Protection Association (NFPA)

1.	NFPA 70 - 2011	National Electric Code

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittals and Section 01 33 26 – Electrical Drawings and Data.

B. RSN 41 22 23-1, Approval Data:

1. Design and sizing calculations: Verify the choice of components for the monorail crane, including, but not limited to: hoist, trolley, drive systems, brakes, motors, controls, and overcurrent protection of motors, controls, and branch circuits. Provide weights of components, maximum wheel loads, and speeds of trolley and hoist when loaded to full rated capacity.
2. Drawings:
    a. General arrangement. Show complete layout and dimensions; weights of components; maximum wheel loads; hook limits, approaches and clearances; parts identification/bill of materials; assembly and details of the overhead crane components, including controls and enclosures.
    b. Motor nameplate data.
    c. Electrical Schematics and Wiring Diagrams.
3. Commercial product data. Provide dimensional and rating data. Mark data sheets to indicate specific make, model number and features of equipment to be provided. Include data for:
    a. Electric motors (including motor horsepower and additional nameplate data per NEMA MG 1, torque versus speed (rpm) curves that indicate motor pullout torque, output torque ratings, and motor data shown on standard drawing 40-D-6032).
    b. Gear reducers.
    c. Hook.
    d. Hoist.
    e. Trolley.
    f. Controls, control parameter settings, and pendant pushbutton station.

g. Electrification and festooning.

h. Brakes.

i. Overload Device.

j. Limit Switches.

C. RSN 41 22 23-2, Final Data:

1. Service manual. Include:

a. As-built drawings for general arrangement, details, electrical schematics, and wiring diagrams.

b. Comprehensive list of parts.

c. Commercial product data for each component.

d. Adjustment and calibration instructions.

e. Preventative maintenance data, including recommended lubricants and lubrication schedules.

f. Detailed operating instructions.

g. Photographs:

1) 8- by 10-inch

2) Front and end views of the crane, showing all the components, and close-up views of the hoist and trolley, including motor nameplates.

h. Reports:

1) Certified copy of field quality test report.

2) Hook and hook nut magnetic-particle tests.

3) Load chain proof test.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment on site in shipping containers with labeling in place.

B. Protect equipment from damage, moisture, and dust.

1.05 FIELD MEASUREMENTS

A. Verify field measurements and all building and site dimensions prior to fabrication. Coordinate and relate all work to the building structure and work done by the various trades.

PART 2 PRODUCTS

2.01 MONORAIL CRANE

A. Description: Provide one overhead monorail crane for transport of 1 Ton cylinder chlorine tanks at the Chlorine Storage Area and the Chlorine Feed Room, with the following characteristics:

1. Design:
    a. Comply with applicable sections of:
        1) CMAA 74, Class C, outdoor service.
        2) ASME B30.10, B30.11, and B30.16.
        3) NFPA 70.
        4) AGMA standards.
        5) 29 CFR Part 1910.
    b. All components suitable for outdoor, industrial environment operation in ambient operating temperature range from 0 to 120 degrees Fahrenheit at approximate elevation 6700 feet above sea level.
    c. Checked, dated, and certified by a Registered Professional Engineer specializing in design of cranes and associated equipment.
2. Capacity: 2-Ton.
3. Operation: Electrically-operated, pushbutton pendant station-controlled hoist and trolley.
4. Power supply: 208 Volts, 3-phase, 60 Hz, from the chlorine feed room distribution panelboard.
5. Protect crane with readily accessible enclosed-type circuit breaker.
6. Type: Under-hung trolley chain hoist, suitable for mounting on S18 by 70 monorail beam.
7. Monorail beam length: As shown on drawing 1695-D-167.
8. Hoist lift: Approximately 10 feet, sufficient to lower chlorine container onto storage chalks and raise containers on and off flatbed delivery truck.
9. Approximate speeds:
    a. Hoist: 5-10 feet per minute (fpm).
    b. Trolley: 25-50 fpm.

B. Motors:

1. In accordance with requirements of NEMA MG 1.
2. Voltage: 200-Volt, 3-phase, 60-hertz.

3. Design:
    a. Single-speed, A.C. squirrel-cage induction type for hoist and trolley drives.
    b. Reversing service and across-the-line starting at full voltage.
    c. Heavy-duty, totally-enclosed, fan-cooled.
    d. Duty rating: 60 minute.
    e. Maximum temperature rise when motor is at rated voltage, rated frequency, and is delivering rated output continuously:
        1) Windings: In accordance with NEMA MG 1 and not in excess of insulation rating.
        2) Other parts of motor: In accordance with NEMA standards for Class B insulation.
4. Bearings:
    a. Grease lubricated, antifriction type.
    b. Sealed against loss of the lubricant or entrance of dirt.
5. Windings insulation:
    a. Class F or Class H.
    b. Treated to prevent damage from temporary exposure to dampness.
6. Motor leads:
    a. Brought out of stator frame to terminal box.
    b. Insulation: Completely sealed to winding coil insulation so that connection is equal to stator or winding coil insulation in regard to voltage and resistance to moisture.
7. Terminal box:
    a. Sized to accept motor feeder wires, wires for space heater and motor brake, and a ground wire.
    b. Conduit openings: As required.
    c. Conductors: Terminate in a solderless connector.

C. Hoist:
1. Electric motor-driven, chain type, with low headroom configuration, in accordance with ASME HST-1, Class H3.
2. Hoist motor torque: NEMA MG 1, Design D.
3. Chain material: High-strength alloy steel, galvanized.
4. Chain container: Impact- and corrosion-resistant material.
5. Shafts, gears, load wheel materials: Heat-treated alloy steel.

6. Mounting: Top lug suspension.
7. Overload limit device required.
8. Motor brake:
    a. Electro-mechanical, spring-set, disk-type, adequate to hold 131.25 percent of the rated hoist load.
    b. Provide with manual release.
9. Mechanical load brake: Adequate to hold 131.25 percent of the rated hoist load.
10. Unit casing: Steel.
11. Hook:
    a. In compliance with ASME B30.10.
    b. Material: Heat-treated alloy steel.
    c. Spring-return safety latch.
    d. 360-degree rotation.
    e. Provide with throat opening inspection marks.

D. Trolley:
1. Electric motor-driven.
2. Provide cross-shafts, suitable for hoist lug mounting.
3. Wheeled, suitable for mounting on the monorail beam lower flange. Provide safety (drop) lugs or equivalent on the frame to prevent derailment in the event of a wheel failure.
4. Bearings: Sealed, roller- or ball-type, permanently lubricated.
5. Brake: Electro-mechanical, capable of stopping the motion of the trolley as designated by CMAA 74.
6. Provide with rubber bumpers.

E. Enclosures: In accordance with NEMA 250, Type 4.

F. Controls:
1. Single-speed magnetic-type for trolley and hoist drives.
2. Coordinate timing of brake release and motor energization to prevent overhauling.
3. Provide separate banks of voltage reducing resistors or reactors with timing relays for starting, acceleration, and deceleration.
4. Feed control circuits from a single-phase, air-cooled, double-wound transformer, with a grounded metal screen between the primary and the secondary windings of the transformer.
5. Smooth acceleration and deceleration.

6. In accordance with NEMA ICS 8.

7. Pendant pushbutton station:

   a. Arrange pushbuttons in accordance with ASME B30.11 recommendations. Clearly mark all controls to identify functions.

   b. Provide:

      1) ON/OFF button that removes power from the motors, brakes and control circuit.

      2) Buttons for RAISE/LOWER hoist and NORTH/SOUTH trolley travel.

      3) Directional contactors with both mechanical and electrical interlocks.

   c. Extend control pendant so top of station hangs to level approximately 4 feet above the finished floor of the Chlorine Storage Area and the Chlorine Feed Room.

G. Limit Switches: Adjustable limit stops to prevent over travel in raise and lower directions.

H. Electrification: Flat-cable festooning with terminal box, multi-conductor cord, and all support accessories, stops, channels, and trolleys for hoist and trolley power.

I. Monorail Beam: In accordance with CMAA 74, Section 05 12 10 – Structural Steel, and as shown on drawing 1695-D-167.

J. Stops: Provide for trolley at each end of the monorail beam and locate to permit maximum possible travel.

K. Lifting Bar: Model C-262, manufactured by Chlorine Specialties, Incorporated, 1027 California Drive, Burlingame, CA 94010-3630; or equal, having the following essential characteristics:

1. Designed for safely hoisting and handling one fully-filled, horizontally-stored, 80-82-inch long, 1-ton chlorine cylinder.

2. Low profile.

3. Designed to receive crane hook that is provided with the monorail crane at center span.

4. Provided with hooks at each end that may be rotated into place, profiled to grasp the rolled ends of the cylinder.

5. Galvanized steel structural member construction. Hooks cut from 1" wrought steel plate.

L. Labeling:

1. Mark the rated load capacity of the hoist, in tons, on both sides of the hoist body.

2. Identification plates: Provide permanently attached, non-corrosive metal plates for crane components identifying manufacturer, model number, size, serial number, capacity, and any other essential information.

M. Lubricants:

1. Suitable for air temperatures ranging from 0 to 120 degrees Fahrenheit.

2. Grade and type meeting the manufacturer's recommendations.

N. Coatings: Manufacturer's standard finishes, unless otherwise indicated, in accordance with Section 09 96 20 – Coatings.

PART 3 EXECUTION

3.01 FABRICATION

A. Structural Steel: In accordance with these specifications and AISC 325.

B. Welding:

1. In accordance with qualified procedures per AWS D14.1/D14.1M.

2. Welding operators: Capable of meeting qualification tests for operators as outlined in AWS D1.1. COR shall have the right to call for making of test specimens by any welding operator in accordance with AWS D1.1 appendix.

3.02 INSTALLATION

A. Install monorail beam straight, level, and aligned in accordance with CMAA 74 tolerances. Fully torque all nuts, bolts, and anchors.

B. Perform work in accordance with manufacturer(s) installation instructions. Ensure all components are fully lubricated and ready for operation upon installation.

C. Install hoist and trolley on monorail beam, including the festoon track supports. Adjust and calibrate equipment as required.

D. Conduct a full joint inspection of the installed crane with the COR, prior to testing. Visually inspect all steel castings and subject to non-destructive testing, if required. Verify the crane is ready for testing.

3.03 CONTRACTOR FIELD QUALITY TESTING

A. Notify COR at least five days prior to testing of monorail crane.

B. Record test data on standard report form and submit with the final data service manual:

1. Record operating and startup current (and corresponding loads) data for the motors and verify that they meet the manufacturer's recommended values.

2. Record hoist and trolley speeds during each test cycle.

3. Measure hook throat dimension at inspection markings prior to loading to establish a baseline measurement and again after load tests to confirm the throat opening has not increased.

4. Record the length of 11 chain pitches, using a caliper gauge, prior to loading the chain. Measure the same number of pitches during the load test and record the stretched length for future comparison.

5. No-load test:

   a. Raise and lower hook through full range of travel. Verify hook limit switch operation, proper festoon operation, and that there are no obstructions.

   b. Operate trolley through full travel in each direction and verify operation of stops and brakes and that there are no obstructions.

6. Load test:

   a. Attach crane hook to lifting bar, then attach bar to fully-filled one-ton chlorine container on flat-bed delivery truck.

   b. Raise container to clear truck obstructions, transport along length of monorail beam until container is positioned above storage chalks, then lower container onto chalks, and disconnect bar from container.

   c. Reattach bar to container, then raise container off chalks to clear obstructions in storage area, transport along monorail into Chlorine Feed Room until container is over the south loading assembly. Lower container onto assembly and disconnect lifting bar. Reverse this process to simulate loading empty containers from the loading assemblies onto truck.

7. Static brake load test: Raise the chlorine container approximately 1 foot off the floor, at mid-span between beam supports, and hold the load for 10 minutes. Verify that the brake holds the load without lowering or that the structural elements do not exceed the deflections allowed by CMAA 74.

C. While operating crane through full travel and speed ranges, check for abnormal temperatures, noise, binding, distortion, or vibration. Verify free and easy operation and proper brake action while moving the load in all directions.

D. Correct deficiencies and improper adjustments encountered during testing. Perform any adjustments or repairs in accordance with standard practice or manufacturer's recommendations.

E. If required, retest crane operation to the satisfaction of the COR.

END OF SECTION

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SECTION 46 31 10

CHLORINE DISINFECTION SYSTEM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Chlorine Disinfection System:

1. Payment: Lump sum price offered in the schedule.

a. Chlorine Disinfection System as shown on drawings 1695-D-173 through 1695-D-181 and 1695-D-193.

b. Includes:

1) Chlorine feed equipment.

2) Residual sampling system.

3) Gas containment.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 46 31 11

CHLORINE FEED EQUIPMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in lump sum price offered in the schedule for Chlorine Disinfection System.

1.02 REFERENCE STANDARDS

A. APA – The Engineered Wood Association (APA)

1.	APA PS 1-09	Structural Plywood

B. ASME International (ASME)

1.	ASME B16.1-10	Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
2.	ASME B16.5-13	Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
3.	ASME B16.11-11	Forged Fittings, Socket-Welding and Threaded
4.	ASME B16.3-11	Malleable Iron Threaded Fittings, Classes 150 and 300
5.	ASME B16.42-11	Ductile Iron Pipe Flanges & Flanged Fittings Classes 150 and 300

C. ASTM International (ASTM)

1.	ASTM A53 / A53M - 12	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
2.	ASTM A760/A760M - 10	Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
3.	ASTM D882 - 12	Standard Test Method for Tensile Properties of Thin Plastic Sheeting
4.	ASTM D1784-11	Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
5.	ASTM D1785 - 12	Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
6.	ASTM D2103 - 10	Polyethylene Film and Sheeting

7.	ASTM D2467 - 13	Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
8.	ASTM D2672 - 96a(2009)	Joints for IPS PVC Pipe Using Solvent Cement
9.	ASTM D3139 - 98(2011)	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
10.	ASTM F441 / F441M - 12	Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

D. Chlorine Institute (CI)

1.	CI Pamphlet 1-08	Chlorine Basics, Edition 7
2.	CI Pamphlet 6-05	Piping Systems for Dry Chlorine, Edition 15
3.	CI Pamphlet 164-07	Reactivity and Compatibility of Chlorine and Sodium Hydroxide with Various Materials, Edition 2

E. Manufacturers Standardization Society Of The Valve And Fittings Industry (MSS)

1.	MSS SP-72-2010a	Ball Valves with Flanged or Butt-Welding Ends for General Service
2.	MSS SP-122-2012	Plastic Industrial Ball Valves

F. National Electrical Manufacturer's Association (NEMA)

1.	NEMA 250-08	Enclosures for Electrical Equipment (1000 Volts Maximum)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 Submittals.

B. RSN 46 31 11-1, Approval Drawings and Data:

1. Drawings in Government Format showing the layout and dimensions equipment. Show:
    a. Proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.
    b. Piping, valves, and associated equipment.
2. Commercial products data for pipe, pipe fittings, flanges, valves, unions, and appurtenances. Include parts lists, schedule, capacity, weight, pressure class, materials, and coating of equipment.

3. Commercial products data for instrumentation and control components. Include manufacturer's name, model number, and specifications that illustrate each component meets requirements.

4. Detailed installation instructions and drawings showing installation details, detail dimensions, and locations of conduit connections.

C. RSN 46 31 11-2, Check Prints:

1. Schematic and wiring diagrams for all electrical equipment as required by Section 01 33 26 – Electrical Drawings and Data.

D. RSN 46 31 11-3, Final Data and Drawings:

1. Typed and bound Service Manual:

a. An index.

b. Previously approved information submitted under RSN 46 31 11-1 Approval Drawings and Data in both booklet form and a CD in PDF format.

c. Complete parts identification lists.

d. List of the parts recommended by the manufacturer to be replaced after 1 and 3 year(s) of service.

e. Instructions for installing, lubricating, and maintaining the system and appurtenances.

f. Instructions for maintaining and lubricating the system and appurtenances.

g. Any applicable test records or reports.

2. As-built Drawings:

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect all equipment delivered and placed in storage from unauthorized use, the weather including humidity and temperature variation, dirt and dust, or other contaminants.

1.05 PERFORMANCE REQUIREMENT

A. General

1. Furnish and install chlorine feed equipment including piping, valves, controls, instrumentation, and appurtenances required to:

a. Withdraw chlorine gas from the chlorine gas containment vessel described in Section 46 31 13 – Chlorine Gas Containment System.

b. Withdraw water from pumping plant discharge manifolds as water supply for chlorine solution.

c. Mix chlorine gas and water supply to produce chlorine solution for injection into pumping plant feed manifolds.

d. Inject chlorine solution into feed manifolds.

2. Separate chlorine feed systems are required for reaches 12B and 12.1 pipelines.

3. Install chlorine vacuum and solution piping for future pre-storage chlorine feed system.

4. Treat water by the application of chlorine solution against a positive head of 47 feet using the pumping plant discharge water for operation under a variation in pressure from 50 psi (minimum) to 75 psi (maximum).

5. Capable of delivering chlorine from a minimum of 30 pounds to a maximum of 500 pounds in 24 hours and capable of continuous operation at rated capacity.

6. Parts subject to contact with chlorine shall be made of materials resistant to the action of chlorine at the pressures and concentrations that could be encountered. Materials shall be suitable for such service in accordance with Chlorine Institute Pamphlets 1, 6, and 164.

B. Chlorine Feed System:

1. Chlorine feed system shall consist of controls and devices:

a. Chlorine pressure gauge or other device that indicates loss of chlorine pressure,

b. Chlorine pressure-reducing valve, a meter with rate-of-flow indicator (rotameter), injector, pressure-relief valves, water-pressure gauges, water strainers, backflow preventer and water-pressure regulator if required.

c. Designed so that the chlorine gas feed rate control is under a vacuum while in operation.

d. Mix chlorine gas with water after being measured through the meter.

e. Function under normal pressure variations in the chlorine containers and the water supply operating the system.

f. In case of failure of the chlorine supply, the ejector shall automatically protect against flooding or damage. Prevent water to get back into the chlorine inlet line or dry-gas control parts.

g. Readily accessible for inspection, cleaning, adjustment, repairs, and replacements.

2. Chlorinator Controls:

a. Semi-automatic with manual adjustment bypass option.

b. Capable of receiving standard 4-20 mA control signals.

c. Continuously adjust the rate of chlorine feed automatically in direct proportion to flow and chlorine residual of the water being chlorinated.

d. Start and stop the chlorine-feeding system automatically with the starting and stopping of the water being chlorinated.

e. Manual bypass shall consist of adjustment and indicating devices for regulating the chlorine dosage manually.

f. Maintain the feed rate within 4 percent of the indicated rate.

g. Require no manual attention other than adjustment of the required chlorine residual.

h. Pre-mounted on nonmetallic panel with connections for power, SCADA, and vacuum piping/tubing.

3. Vacuum Regulators:

a. Provide a vacuum regulator check unit on the fail-safe valve outlet on chlorine gas containment vessel, which converts chlorine to a less than atmospheric pressure state for the chlorinators.

b. Allow for manual gas shut-off, and contain liquid chlorine drip legs and integral drip leg heaters.

c. Rated for up to 500 lbs/day.

4. Automatic Switchover Valves:

a. Provide one loss of chlorine supply-operated automatic gas switchover valve with mechanical over-ride for each pair of containment vessels for installation in the vacuum gas header from the paired vessels.

b. Selects which cylinder is on-line supply or standby. When the on-line supply is exhausted, the automatic switchover valve shall switch positions and place the standby supply cylinder on-line.

c. Rated for up to 500 lbs/day.

d. Equipped with gas traps and filters.

e. Factory set.

f. Provide remote indication switches for connection to SCADA to indicate on-line or standby status of cylinders.

C. Vacuum and Chlorine Relief:

1. Limit the vacuum within the chlorine-feeding system.

2. Release chlorine gas pressure build up (due to malfunctioning equipment) in parts of the system normally under vacuum to an outside atmosphere vent

3. A vacuum sealing valve that seals off the system when excessive vacuum is present may be substituted for the vacuum relief valve.

D. Ejectors:

1. Provided to receive chlorine gas and solution water supply and to discharge the resulting solution to the points of application.
2. Check valve assemblies to prevent solution water from entering the gas vacuum connection.
3. Sized to feed up to 500 lbs/day.

E. Corporation Stop Assembly:

1. Introduce chlorine solution into the water manifold by inserting a diffuser tube into the main through a corporation stop.
2. Include corporation stop, solution tube, solution tube adapter, packing nut, safety chain, and threaded inlet connection.
3. Solution tube:
   a. Extend into the water manifold to a third of the pipeline diameter.
   b. Diffuser style with multiple holes for distribution of the injected solution.
4. Include safety device connection to prevent accidental withdrawal of the solution tube while under pressure and/or surge conditions.
5. Wetted components shall be compatible with the injected solution.
6. Rated for 150 psi.

F. Alarm Actuators:

1. Indicate loss of vacuum, excess vacuum, and solution water supply low pressure.
2. Connected to the SCADA system.

1.06 QUALIFICATIONS

A. Provide material and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products.

B. Similar to a system that has been in use for 2 years.

1.07 SPARE PARTS

A. Provide the following spare parts:

1. One spare flow rate indicator (rotameter) for each system.
2. Three each of all special gaskets to fit all joints and unions.
3. One set of all necessary hose clamps to suit all hose connections.
4. Vacuum tubing: 50 feet of each size.
5. Plastic ball valves for vacuum tubing: Two of each size.
6. V-notch part for chlorinator controller: Two per system.

7. Fifty ton-container valve gaskets.
8. One 4 ounce bottle of ammonia.
9. Two self-contained air breathing units.
10. Two emergency repair kits for chlorine ton containers.

PART 2 PRODUCTS

2.01 CHLORINE PRESSURE/VACUUM GAUGES

A. #35-1009AW-02L-30/100 with diaphragm 02-310UM-02T-CF by Ashcroft Inc., 250 East Main Street, Stratford, CT 06614; or equal with the following essential characteristics:

1. Dial: 3.5 inch dial.
2. Pressure range: 30 inch vacuum - 100 psi.
3. Diaphragm material: Tantalum.
4. Diaphragm body and process connection: Monel with ¼ inch MNPT.
5. Filling fluid: Halocarbon.

2.02 PIPE

A. Steel Pipe:

1. Service: Water supply upstream of pressure reducing valve.
   a. Material: ASTM A53/A53M, galvanized.
   b. Unions and fittings: Malleable-iron conforming to ASME B16.3.

B. PVC Pipe:

1. Service: Chlorine Solution Piping and water supply downstream of pressure reducing valve:
   a. Schedule 80 conforming to ASTM D1785 or ASTM F441.
   b. Fittings:
      1) Exposed: Flanged or threaded.
      2) Buried: Socket weld.
2. Service: Chlorine gas vacuum:
   a. Conform to CI Pamphlet 1 and CI Pamphlet 6.
   b. CPVC conforming to ASTM F441, Schedule 80.
   c. Fittings: Flanged or threaded.

2.03 CORRUGATED METAL PIPE

A. General:

1. Corrugated metal pipe for buried pipe casing by site entrance gate crossing.

B. Corrugations:

1. 2-2/3-inch by 1/2-inch.
2. Annular or helical.

C. Sheet thickness: 0.064.

D. Diameter: 16 inches (nominal).

E. Corrugated Steel Pipe:

1. ASTM A 760, Type I.
2. Galvanized.

2.04 VALVES

A. Ball Valves:

1. Service: For water supply pipeline connections.
    a. Model F201CS12 by Milwaukee Valve Company, 16550 West Stratton Drive, New Berlin, WI 53151; or equal with the following essential characteristics:
        1) Conforms to MSS SP-72.
        2) Carbon steel body with stainless steel ball.
        3) Full port design, 1/4 turn operation.
        4) 250-pound working pressure minimum.
        5) Class 150 flanged ends.
2. Service: For water or chlorine solution.
    a. MSS SP-122.
    b. Schedule 80 PVC with Viton seals.
    c. Full port.
    d. True-union.
    e. 1-1/2-inch and smaller with socket weld ends.
    f. 2-inch and larger with flanged ends.
    g. Manual operated: Tee handle or lever.
    h. Motor operated:

1) Power: 120 VAC, single phase.

2) Motor: Corrosion-resistant reversing.

3) Cycle time: 5 seconds.

4) Enclosure: NEMA 4X.

5) Override: Manual.

6) Position indicator: High visibility.

7) Position status limit switches.

3. Service: Chlorine gas (vacuum):

a. MSS SP-122.

b. Schedule 80 CPVC with Viton seals. ASTM 1784.

c. Full port.

d. True-union with threaded ends.

e. 1-inch and smaller.

B. Water Supply Pressure Reducing Valves:

1. Model 690-01 pressure reducing valve as manufactured by Cla-Val Company, P.O. Box 1325, Newport Beach, CA 92659-0325, or equal; having the following essential characteristics:

a. Flow rate: 20 to 100 gal/min.

b. Inlet pressure: 200 psi for pipeline 12.1 and 100 psi for pipeline 12B.

c. Outlet pressure: Capable of an adjustable outlet pressure range between 50 psi and 75 psi.

d. Globe pattern.

e. Flanged connections, class 150, in accordance ASME B16.42, faced and drilled in accordance with ASME B16.5.

f. Ductile iron construction for flanges, body and cover.

g. Bronze trim.

h. Epoxy coated.

2.05 PIPE SLEEVES AND SEALS

A. Pipe Sleeves:

1. Steel sleeves for pipes through exterior walls:

a. Form with galvanized steel pipe or No. 18 United States Standard Steel gauge galvanized steel.

b. Anchor collar/weep ring:

1) Mid span of the sleeve.

2) Continuously welded on both sides.

3) 1/4-inch thick steel plate extending 2 inches radially out from the outer diameter of the sleeve.

c. Internal diameter large enough to allow use of mechanical wall seal.

2. Plastic sleeves for pipes through exterior walls:

a. Model CS by PSI-Thunderline/Link-Seal®, 6525 Goforth Street, Houston, TX 77021; Infinity® Wall Sleeve by Advance Products & Systems, Incorporated, P.O. Box 60399, Lafayette, LA 70596; or equal with the following essential characteristics:

1) Anchor collar/weep ring:

a) Mid span of the sleeve.

b) Extending 2 inches radially out from the outer diameter of the sleeve.

2) Molded from HDPE.

3) Locator caps for installation.

4) Internal diameter large enough to allow use of mechanical wall seal.

B. Mechanical Wall Seal:

1. Modular, water tight, mechanical seal, consisting of inter-locking, synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.

2. Stainless steel hardware.

2.06 FLOW METERS

A. Model 3-8510-XX Integral Mount Paddlewheel Flow Sensor with Model 3-8550-1 Flow Transmitter as manufactured by Georg Fischer Signet LLC, 3401 Aero Jet Avenue, El Monte, CA 91731; or equal with the following essential characteristics:

1. Measure flow rate and record water usage for the chlorine solution water supply.

2. Local flow rate and total flow indication.

3. Loop powered 4-20 mA output to SCADA system.

4. PVC true-union tee installation fitting.

2.07 CHLORINE GAS LEAK DETECTORS

A. General: Provide a warning of the presence of chlorine gas in the Outdoor Chlorine Storage Area and Chlorine Feed Building.

B. Contain electro-chemical sensing cells requiring minimum maintenance and sensitive to the presence of chlorine gas only.

1. Connect the sensing cell to the electrical circuit to give an alarm when one ppm or more chlorine gas (by volume) is present in the air.
2. Failures in the internal electrical circuit shall cause an alarm condition.
3. Wall mounted units, suitable for operation on 120 volts, single-phase, 60-hertz.
4. Operate annunciators with a normally-closed contact.
5. Operate exhaust fans in case of chlorine leaks with a normally-open dry contact.
6. The leak detector housing and the remote sensor cable shall be radio frequency interference (RFI) shielded.

C. Alarm Annunciator and Beacon:

1. Suitable for wall mounting.
2. Rotating strobe with red housing.
3. Audible horn, 90 dB.
4. Weather resistant.
5. 24V DC powered.

D. Wind Sock and Pole:

1. Orange nylon open tube.
2. Aluminum pole.
3. Rated for 100 mph wind gusts.

E. Provide detection system with 90 minute battery backup.

1. NEMA 4X enclosure with heater.

2.08 NAMEPLATES

A. Equipment items shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.09 MISCELLANEOUS SUPPORTS

A. Bolts, nuts, anchors, washers, and all other types of supports necessary for the installation of the equipment shall be galvanized steel, cadmium plated steel, or Type 316 stainless steel.

B. Supports shall be in accordance with Section 05 50 00 – Metal Framing.

2.10 WOODEN BULK HEAD

A. Plywood: APA SP1 – MDO General, B-C, G-5.

1. Thickness: 3/8-inch.
2. Marked in accordance with APA SP1.
3. Dimensions: 2 feet by 2 feet.

B. Fasteners:

1. Screws: Self Drilling, Zinc-coated and not less than 3/8 longer than plywood thickness.

C. Lumber:

1. Species:
   a. Southern Yellow Pine
   b. Preservative-Treated Lumber: for underground use.
2. Grade:
   a. Lumber 2-Inches (Nominal) Thick and 4-Inches (Nominal) or Greater in Width: WWPA G5 No 2.
3. Attach to plywood allowing 1-inch gap between casing pipe and lumber.

2.11 PIPE BEDDING

A. ASTM C-33, coarse sand 100 percent passing 3/8-inch screen and 95 percent passing No. 4 screen.

2.12 METALLIC WARNING TAPE

A. Compliant with ASTM D882 and ASTM D 2103.

B. Standard 6-inch wide, commercial quality, detectable underground warning tape.

C. Continuous tape with message “Caution Buried Pipeline Below.”

D. Color: Yellow.

2.13 ELECTRICAL WORK

A. Electrical work shall be in accordance with Division 26 - Electrical.

2.14 COATINGS

A. Coatings shall be in accordance with Section 09 96 20 – Coatings.

2.15 OPERATING INSTRUCTIONS

A. Provide operating instructions for each chlorine feed system including control diagrams showing the complete layout of the entire system as follows:

1. Prepare typed condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system.
2. Laminate operating instructions and control diagram pages and place in 3-ring "D" style binder.

B. The operating instructions shall be posted next to the feed system before acceptance testing of the systems.

2.16 SPECIAL TOOLS

A. For each type of equipment furnished provide:

1. Special tools necessary for adjustment, operation, maintenance, and disassembly.
2. One or more steel cases mounted on the wall complete with flat key locks, two keys, and clips or hooks to hold each tool in a convenient location. Tools shall be high-grade, smooth, forged, alloy tool steel.

B. Tools shall be delivered at the same time as the equipment and handed over on completion of the work

PART 3 EXECUTION

3.01 INSTALLATION

A. Install chlorine feed equipment and appurtenances in accordance with CI Pamphlet 1 and CI Pamphlet 6 in accordance with the instructions of the manufacturer.

B. Laying of Pipe:

1. Install pipes in conformity to the approved design plan and in coordination with the COR.
2. Clean each section of pipe and each fitting before installation.
3. Lower pipe, fittings, and valves, into the trench preventing damage to pipe. Use approved slings when required.
4. Lay pipe true and uniform to line and grade, with no visible change in alignment at any joint unless curved alignment is called for on the plans.
    a. If deflection is required, maximum deflection must not exceed the manufacturer's recommendation for the type of pipe and joint being used.

5. Whenever pipe laying is discontinued for an hour or more, close open ends of pipe with water-tight plugs.

C. Joining Methods:

1. Solvent cement pipe sections in accordance with ASTM D2467, ASTM D2672 and ASTM D3139.

D. Earthwork and Trenches:

1. Perform earthwork in accordance with drawings 1695-D-175 and -176 and Section 31 23 22 – Pipe Trench Earthwork.

2. Pipe bedding in accordance with ASTM C-33.

E. Corrugated Metal Pipe and Wooden Bulkhead:

1. Install corrugated metal pipe in accordance with drawings 1695-175 and -176 and Section 33 42 30 – Corrugated Metal Pipe Culverts.

   a. Corrugated metal pipe shall extend 20 feet past centerline of double-swing gate in both directions.

2. Install sand bedding inside corrugated metal pipe to support carrier piping at specified grade.

3. Install a wooden bulkhead at ends of the casing to keep backfill material out of the casing pipe.

   a. Bulkhead shall not extend more than 6-inches above top of corrugated metal pipe.

   b. Notch bulkhead to allow 1/2-inch clearance around carrier piping.

   c. Extend bulkhead and notches 2 inches below bottom of carrier piping.

   d. Bulkhead shall not rest on or contact carrier piping.

F. Metallic Detectable Warning Tape:

1. Lay continuous metallic warning tape above runs of nonmetallic pipe to facilitate locating the pipe at a later date.

G. Install supports for exposed piping and tubing within vaults and buildings.

H. Install chlorinator controls as shown on drawing 1695-D-193.

I. Install one chlorine leak detector in the Chlorine Feed Building near the exhaust fan intake.

J. Install one chlorine leak detector in the Outdoor Chlorine Storage Area.

K. Install alarm annunciators and beacons and wind sock as directed by the COR.

L. Install electrical connections in accordance with Division 26.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Hydrostatically test water supply, solution piping, and sample tubing for leaks as follows:

1. Furnish testing equipment, as approved by COR, which provides observable and accurate measurements of leakage under specified conditions.
2. Maximum Filling Velocity: 0.25-foot per second calculated based on full area of pipe.
3. Expel air from piping system during filling.
4. Test pressure: 150 percent of system operating pressure based on pressure as measured at the lowest point on the line. Test pressure for some segments may be reduced, subject to COR approval.
    a. Water supply piping and steel tubing: Maximum test pressure not to exceed 225 psi.
    b. Solution piping: 50 psi.
5. Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.
6. Maintain hydrostatic test pressure continuously for 2 hours minimum.
7. Allowable leakage: Zero.

B. Vacuum test chlorine vacuum pipes as follows:

1. Furnish testing equipment, as approved by COR, which provides observable and accurate measurements of leakage under specified conditions.
2. Apply and maintain specified test pressure with vacuum pump. Valve off piping system when test pressure is reached.
3. Maintain vacuum continuously for 2 hours minimum.
4. Allowable leakage: Zero.

C. Perform operating tests to assure that the chlorine feed systems operate properly in accordance with manufacturer’s instructions.

D. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be repeated.

E. Document field tests performed to meet specified performance criteria indicating final control settings and submit as part of RSN 46 31 11-2.

3.03 MANUFACTURER'S FIELD SERVICES

A. Provide the services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified for the following:

1. Supervision of installation, adjustment, and testing of the equipment.
2. Training of operation and maintenance personnel.

3.04 TRAINING

A. Provide materials, manuals, and field training for up to 12 designated operating staff members.

B. Conducted by manufacturer's representative and provided for a total period of 8 hours of normal working time.

C. Start after the system is functionally complete but prior to final acceptance tests.

D. Training shall cover items contained in the operating and maintenance instructions.

END OF SECTION

SECTION 46 31 12

CHLORINE RESIDUAL SAMPLING EQUIPMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in price offered in the schedule for Chlorine Disinfection System.

1.02 REFERENCE STANDARDS

A. American Iron and Steel Institute (AISI)

1. Type 304

B. AISIASTM International (ASTM)

1.	ASTM A269-10	Seamless and Welded Austenitic Stainless Steel Tubing for General Service
2.	ASTM A351-13a	Castings, Austenitic, for Pressure-Containing Parts
3.	ASTM D1785-12	Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
4.	ASTM F1970-12	Special Engineered Fittings, Appurtenances or Valves for use in Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Systems

C. Manufacturers Standardization Society Of The Valve And Fittings Industry (MSS)

1.	MSS SP-72-2010a	Ball Valves with Flanged or Butt-Welding Ends for General Service
2.	MSS SP-110-2010	Ball Valves Threaded, Socket Welded, Solder Joint, Grooved and Flared End
3.	MSS SP-122-2012	Plastic Industrial Ball Valves
4.		

D. National Electrical Manufacturer’s Association (NEMA)

1.	NEMA 250-08	Enclosures for Electrical Equipment (1000 Volts Maximum)
2.	NEMA TC 2-03	Electrical Polyvinyl Chloride (PVC) Tubing and Conduit

E. NSF International (NSF)

1. NSF 61-2010a Drinking Water System Components

F. Underwriter Laboratories (UL)

1. UL 508A-2010 Industrial Control Panels

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 Submittals.

B. RSN 46 31 12-1, Approval Drawings and Data:

1. Drawings in Government Format showing the layout and dimensions of all equipment furnished. Drawings shall include mounting and anchorage requirements. Piping, valves, and associated equipment shall be shown.
2. Commercial products data for pipe, pipe fittings, flanges, valves, unions, and appurtenances. Include parts lists, schedule, capacity, weight, pressure class, materials, and coating of each item of equipment where applicable.
3. Commercial products data for residual analyzer, package sump pump unit, and pre-cast pullbox. Include electrical requirements, installation instructions, parts lists, weight, and materials of each item of equipment where applicable.
4. Installation details, detail dimensions, and locations of conduit connections.
5. Schematic and wiring diagrams for electrical equipment as required by Section 01 33 26 – Electrical Drawings and Data.

C. RSN 46 31 12-2, Final Drawings and Data:

1. Typed and bound Service Manual which includes:
   a. An index
   b. Previously approved information submitted under RSN 46 31 12-1 Approval Drawings and Data in both booklet form and a CD in PDF format.
   c. Complete parts identification lists.
   d. Instructions for installing, lubricating, and maintaining the system and appurtenances.
   e. Any applicable test records or reports.
2. As-built Drawings:

1.04 PERFORMANCE REQUIREMENT

A. Furnish and install free chlorine residual sampling equipment including sample lines, valves, flow controls, instruments, and appurtenances required to:

1. Sample and measure free chlorine residual from reach 12A pipeline in Chlorine Injection Vault 1.
2. Sample and measure free chlorine residual from storage tank outlet manifold in Chlorine Sample Tap Manhole.
3. Sample and measure free chlorine residual from reach 12.1 pipeline in Flow Meter Vault 1.
4. Sample and measure free chlorine residual from reach 12B pipeline in Flow Meter Vault 1.
5. Collect sample drains and pump back into reach 12A pipeline in Chlorine Injection Vault 1.

B. Free chlorine residual measurements shall be sent to SCADA system for control of chlorine feed systems.

1.05 SPARE PARTS

A. Provide the following spare parts:

1. Sample drain return pump and motor.
2. Residual chlorine analyzer.

PART 2 PRODUCTS

2.01 PIPE AND TUBING

A. Steel Tubing:

1. Stainless steel meeting ASTM A269, Type 316.
2. Fittings: Compression or threaded, Type 316 stainless.

B. PVC Tubing:

1. Material: Clear, braid reinforced PVC hose.
2. NSF-61 certified.
3. Size:
   a. 0.5-inch internal diameter with 215 psi working pressure rating for reach 12A pipeline and storage tank outlet manifold connections to analyzer location.
   b. 0.375-inch internal diameter with 230 psi working pressure rating for reaches 12B and 12.1 pipeline connections to analyzer location.
4. Fittings: Hose barb with stainless steel clamp.

C. PVC Pipe:

1. Service: Sample drain and return piping.
2. Size: 2-inch and less.
3. Schedule 80 PVC conforming to ASTM D1785.
4. Solvent weld fittings.

D. PVC Conduit:

1. Service: Carrier pipe for sample lines.
2. 2-inch Schedule 80 conforming to NEMA TC-2.

E. Pipe Sleeves and Seals:

1. In accordance with Section 46 31 11 – Chlorine Feed Equipment.

2.02 VALVES

A. Ball Valves:

1. Service: For pipeline sample connections, Model 30SSOF-02-LS by Milwaukee Valve Company, 16550 West Stratton Drive, New Berlin, WI 53151; or equal with the following essential characteristics:
   a. Conforms to MSS SP-110.
   b. Stainless steel body and ball.
   c. Full port design, 1/4 turn operation.
   d. 250-pound working pressure minimum.
   e. Threaded ends.
2. Service: For pipeline sump pump connection, Model F201CS12 by Milwaukee Valve Company, 16550 West Stratton Drive, New Berlin, WI 53151; or equal with the following essential characteristics:
   a. Conforms to MSS SP-72.
   b. Carbon steel body with stainless steel ball.
   c. Full port design, 1/4 turn operation.
   d. 250-pound working pressure minimum.
   e. Class 150 flanged ends.
3. Service: For residual analyzer and drain connections.
   a. Conforms to MSS SP-122.
   b. PVC with EPDM seals.
   c. 2-inch and smaller.

B. Check Valves:

1. Conforms to ASTM F1970.
2. PVC with EPDM seals.
3. True Union style.

C. Flow Control Valve:

1. For reaches 12B and 12.1 pipeline connections, Model FM38 Flo-Miser by W. A. Kates Company, 1363 Anderson, Clawson, MI 48017; or equal with the following essential characteristics:
   a. Flow range: 0.3 to 3 gpm.
   b. Materials: 316 stainless steel.
   c. Pressure rating: 1,000 psi minimum.
   d. Maintain flow rate within 5 percent of set point with varying upstream pressure.

2.03 RESIDUAL CHLORINE ANALYZERS

A. General:

1. Amperometric type for the measurement of free residual chlorine in water over a range of 0 to 5 mg/l.
2. Indicating, amplification, and transmission equipment.

B. Mounting:

1. Wall-mounted on a panel, with built-in sample water line and filter.
2. Terminate internal wiring for the analyzer at a single junction box inside the analyzer.

C. Sampling Cell:

1. Contain 2 electrodes which continuously detect the free chlorine residual in the sample and generate an electrical signal proportional to the free chlorine residual concentration.
2. Prevent the adherence of any foreign materials to the electrode surface.

D. Measurement requirements:

1. Temperature Range: 32 degrees Fahrenheit to 122 degrees Fahrenheit.
2. Sample Water Flow Rate: 0.13 GPM or 8 gal/hr minimum.
3. Sample Pressure: 5 psig maximum at inlet point.
4. Sample Supply: Continuous. Electrodes must be kept wet with fresh water.
5. Speed of Response: 4 seconds. Full-scale residual change 90 to 120 seconds.
6. Range: 0 to 0.1 to 0 to 20 mg/l. Field adjustable.

7. Accuracy: 0.003 mg/l or +/-1 percent of range, whichever is larger.
8. Sensitivity: 0.001 mg/l (1 ppb).

E. Electrical Characteristics:

1. Power Consumption: 10W max.
2. Power Requirements: 120VAC, 50/60 Hz, single phase.
3. Output Signal: (2) isolated 4-20 mA (residual, pH, temperature or control).
4. Relay Contact: 10 Amps @ 120VAC or 24VDC, resistive load, 5 Amps @ 240VAC, resistive load.
5. Input Signal: 4-20 mA (flow input).
6. Enclosure: NEMA 4X.

F. Sample flow control: Sample flow rate regulator to permit easy setting of the optimum flow.

G. Reagents: The analyzers shall be designed to utilize inexpensive reagents such as battery acid or vinegar for pH control of the sample as necessary.

H. Connections: Sample piping shall be installed for connections at the bottom of the panel as shown on drawing 1695-D-193.

2.04 SAMPLE DRAIN TANK

A. Part Number A-FS0125-32 as manufactured by Ace Roto-Mold/Den-Hartog, Den Hartog Industries, Inc., 4010 Hospers Drive South, Hospers, IA 51238-0425; part number N-40298 as manufactured by Norwesco, Incorporated, 4365 Steiner Street, St. Bonifacius, MN 55375-0439; or equal with the following essential characteristics:

1. Horizontal leg style polyethylene tank.
2. Capacity: 125 gallons.
3. Polyethylene resin meeting NSF 61.
4. Translucent.
5. Free standing.
6. Calibrated in gallons with markings.
7. Vented lid: 8-inch diameter, minimum.
8. Outlet fitting: 2-inch MNPT.

B. Provide 2-inch MNPT PVC bulkhead fitting at horizontal centerline at end of tank above outlet fitting.

C. Provide tie down straps.

2.05 SAMPLE DRAIN RETURN PUMP

A. CRI 1-2 A-FGJ-I-V-HQQV as manufactured by Grundfos Pumps Corporation, 17100 W. 118th Terrace, Olathe, KS 66061; or equal with the following essential characteristics:

1. Vertical, non-self-priming, multistage, in-line centrifugal pump.
2. Capacity: 10 gpm at 40 feet total dynamic head.
3. Materials of construction:
    a. Pump housing: Stainless steel conforming to ASTM A351 CF 8M.
    b. Impeller: Stainless steel conforming to AISI 304.
4. Operating altitude: 6,700 feet ASL.
5. Ambient temperature: 55 degrees Fahrenheit minimum to 104 degrees Fahrenheit maximum.
6. Pump speed: 3425 rpm.
7. Flanged connections.
8. Motor data:
    a. Horsepower: 1/2 HP maximum.
    b. Power: 3-phase, 208-230/460 V, 60-hertz
    c. Efficiency: 75 percent minimum at full load.
    d. TEFC.

2.06 PUMP CONTROLLER

A. Control Panel: The pump control panel shall incorporate the following elements, and criteria:

1. The pump controller and all its components shall be housed in a NEMA 3R, UL listed, ventilated enclosure. The controller shall have a main power disconnect switch, with enclosure door interlock, which shall require opening the disconnect switch before the control cabinet may be opened. The system shall provide for a single point electrical connection, with all power, both primary, and secondary to be de-activated with opening the main disconnect switch.
2. The entire controller shall be UL 508A listed, INDUSTRIAL CONTROL PANELS, and have all UL listed devices of Touch Safe design, which shall eliminate any bare handed shock hazard. All primary and secondary power branch circuit breakers of modular, Touch Safe design for safe removal without the use of tools. All secondary control circuit wiring shall be 24 volts, AC/DC, or less, to include all pilot lights, selector switches, panel meters, and alarm devices. The Primary motor branch circuits shall have thermal magnetic circuit breaker protection, (primary fuses shall not be acceptable). There shall be no part of the interior of the control enclosure, which shall produce a bare handed shock hazard even with the controller powered up.

B. Operation Sequence:

1. High tank level shall start sample drain return pump.
2. Low tank level shall stop pumping.
3. High-high and low-low tank level shall provide alarm signals to the SCADA system.

C. Furnish level sensors for connection to controller. Adjustable pumping range shall be a minimum of 6 inches to 24 inches.

D. Alarm Settings:

1. High level: 28 inches.
2. Low level: 4 inches.

2.07 PULLBOXES

A. Precast Concrete:

1. Inside dimensions: 4 feet high x 4 feet wide x 4 feet long.
2. Traffic rated access cover.
3. In accordance with Section 03 48 00 – Precast Concrete Vaults.

2.08 PIPE HANGERS AND SUPPORTS

A. In accordance with Section 05 50 00 – Metal Fabrications.

PART 3 EXECUTION

3.01 INSTALLATION

A. Perform earthwork in accordance with drawings and Section 31 23 11 – Earthwork for Structures.

B. Install sample tubing carrier pipe in accordance with Section 46 31 11 – Chlorine Feed Equipment.

C. Install precast concrete pullbox PB1 at TP-7 shown on drawing 1695-D-175 and pullbox PB2 between TP-4 and TP-5 approximately 200 feet to 250 feet from TP-7.

1. Terminate carrier pipe for sample lines at inside walls of vaults, pullboxes, and manholes.
2. Other trench piping shall be continuous through the pullboxes.

D. Install pipeline connections in vaults and manhole.

E. Install sample tubing in carrier pipe. No tubing connectors within the carrier pipe. Tubing connectors shall be in vaults, pullboxes, manholes, and buildings.

F. Install supports for exposed piping and tubing within vaults, pullboxes, manholes, and buildings.

G. Install sample drain tank and sample drain return pump on 4-inch equipment pads in accordance with standard drawing 40-D-5599 and as shown on drawing 1695-D-193.

H. Install chlorine residual analyzers as shown on drawing 1695-D-193.

I. Install electrical connections in accordance with Division 26.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Hydrostatically test sample tubing and sample return piping for leaks as follows:

1. Furnish testing equipment, as approved by COR, which provides observable and accurate measurements of leakage under specified conditions.
2. Maximum Filling Velocity: 0.25-foot per second calculated based on full area of pipe.
3. Expel air from piping system during filling.
4. Test pressure: 150 percent of system operating pressure based on pressure as measured at the lowest point on the line. Test pressure for some segments may be reduced, subject to COR approval.
    a. Pre- and post-storage sample tubing: 30 psi.
    b. 12.1 and 12B sample tubing downstream of flow controller: 30 psi.
    c. Steel tubing including flow controller: Maximum test pressure not to exceed 250 psi. Test with water supply piping under Section 46 31 11 – Chlorine Feed Equipment.
    d. Sample return piping: 50 psi.
5. Apply and maintain specified test pressure with hydraulic force pump. Valve off piping system when test pressure is reached.
6. Maintain hydrostatic test pressure continuously for 2 hours minimum.
7. Allowable leakage: None.

B. If deficiencies are revealed during tests, correct deficiencies and repeat tests.

C. Document field tests performed to meet specified performance criteria indicating final control settings.

D. Provide manufacturer’s representative and training in accordance with Section 46 31 11 – Chlorine Feed Equipement.

END OF SECTION

SECTION 46 31 13

CHLORINE GAS CONTAINMENT SYSTEMS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in price offered in the schedule for Chlorine Disinfection System.

1.02 REFERENCE STANDARDS

A. ASME International (ASME)

1.	ASME BPVC-VIII-2010	Rules for Construction of Pressure Vessels
2.	ASME BPVC-IX-2010	Boiler and Pressure Vessel Code - Section IX - Welding and Brazing Qualifications

B. ASTM International (ASTM)

1.	ASTM A36 / A36M - 12	Carbon Structural Steel
2.	ASTM A516 / A516M - 10	Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service

C. Chlorine Institute (CI)

1.	CI Pamphlet 1-08	Chlorine Basics, Edition 7

D. National Electrical Manufacturer's Association (NEMA)

1.	NEMA 250-08	Enclosures for Electrical Equipment (1000 Volts Maximum)

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 Submittals.

B. RSN 46 31 13-1, Qualifications:

1. Manufacturer:
    a. Certified data of qualifications of the manufacturer of the containment system equipment. The certified data shall consist of a list of manufacturer's existing installations with equipment size, dates, location, contact name, and contact telephone number.
    b. Include welder's ASME BPVC Section IX certifications.
2. Installer:

a. List the installer's recent installations. Include equipment size, dates, location, contact name, and contact telephone number.

C. RSN 46 31 13-2, Approval Drawings and Data:

1. Drawings in Government Format showing the layout and dimensions of all equipment furnished, fabrication assembly, and the configuration. Drawings shall include containment vessel dimensions, wall thickness, mounting, and anchorage requirements.

2. Piping, valves, and associated equipment shall be shown.

3. Commercial products data for pipe, pipe fittings, flanges, valves, unions, and appurtenances. Information to include parts lists, schedule, capacity, weight, pressure class, materials, and coating of each item of equipment where applicable.

4. Certifications:

a. Certification and ASME code data reports in accordance with ASME BPVC code. The certification shall include certification of hydrostatic testing.

D. RSN 46 31 13-3, Final Drawings and Data:

1. Typed and bound Service Manual which includes:

a. An index.

b. Previously approved information submitted under Approval Drawings and Data submittal in both booklet form and a CD in PDF format.

c. Complete parts identification lists.

d. Instructions for installing, lubricating, and maintaining the system and appurtenances.

e. Any applicable test records or reports.

2. As-Built drawings:

a. Provide 22-inch by 34-inch size drawings with BOR title block.

b. Provide CDs in AutoCAD format.

1.04 SPARE PARTS

A. Each containment system shall be furnished at a minimum with the following spare parts:

1. One Viton O-ring.

2. One chlorine transfer hose.

3. One Yoke.

4. One Yoke adaptor.

5. One Twisted chlorine wrenches.

6. One One-half-inch valve rebuild kit.

7. Six Vessel closure locking nut gaskets.
8. One 1 lb. Container 25-5S Grease.
9. One Pressure/vacuum gauge 30/100.
10. One CGA fitting.
11. One roll of Teflon pipe tape, 50-ft. minimum length.

B. Provide the following additional spare parts:

1. Two 55-lb Nitrogen containers- filled.
2. Two Nitrogen pigtail assembly with fitting.
3. Two Leak test assembly w/chlorine ton valve.
4. Two Adjustable (0-500 psi) (testing) nitrogen regulator with 1/4 x 1/4 Flare outlet connections.
5. Two Nitrogen Safety Relief Valve.

1.05 DELIVERY, STORAGE AND HANDLING

A. Comply with the manufacturer's recommendations in handling and storing equipment. Store all equipment to permit easy access for inspection and identification.

B. Coordinate with the manufacturer of the chlorine gas containment system equipment for proper location.

1.06 PERFORMANCE REQUIREMENT

A. Furnish and install containment systems for 4 one-ton chlorine gas containers.

B. Furnish and install two fixed container loader systems.

C. General layout and dimensions shall be as shown on drawing 1695-D-180.

D. Equipment provided under this Section shall be furnished by a single supplier or manufacturer who shall assume full responsibility for the completeness of the system.

1.07 QUALIFICATIONS

A. Manufacturer and Manufacturer Representative:

1. Minimum of 5 installations in service for a minimum of 5 years.

B. Installer:

1. Minimum of 3 existing containment systems.

C. Welders:

1. Qualify welders in accordance with ASME BPVC Section IX using procedures, materials, and equipment of the type required for the work. Acceptable procedures are:
    a. SMAW P1-B1.
    b. GTAW/SMAW P1-42-1A.
    c. SMAW/SAW P1-1A.
    d. GTAW P1-1A.
    e. FCAW P1-1-3/4 (for non-pressure welds only).

PART 2 PRODUCTS

2.01 GENERAL

A. Provide chlorine gas containment equipment for secondary containment of a single 1-ton chlorine gas container.

B. Components exposed to chlorine liquid, chlorine solution, or chlorine gas shall be suitable for the service.

C. Electronic components, panels and switches in the Chlorine Feed Building shall be encapsulated or otherwise protected by NEMA 250 - 4 enclosures.

D. Connect alarm contacts from pressure switches, leak detectors, and fail-safe valve position indicators as part of the controls under Section 46 31 11 – Chlorine Feed Equipment for local and remote indication and monitoring.

2.02 CHLORINE GAS CONTAINMENT SYSTEM

A. Model One-Ton ChlorTainer® as manufactured by TGO Technologies Incorporated, Santa Rosa, CA 95403 or equal with the following essential characteristics:
    1. 40-inch diameter containment vessel for a single one-ton chlorine container.
    2. Operates with a vacuum-operated solution feed system.
    3. Nitrogen gas/electrically operated fail-safe valve.
    4. Nitrogen gas supply and fail safe actuator.
    5. 120 vac electrical connection to fail safe actuator.
    6. Interior vessel rollers, pressure relief valve.
    7. Vacuum/pressure gauge.
    8. Pressure supply flex hose (interior).
    9. Valves, piping and fitting accessories.
    10. Weighing system.

B. Containment Vessel:

1. Design pressure: 250 psig at 300 degrees Fahrenheit, minimum design metal pressure (MDMT) equals –20 degrees Fahrenheit at 250 psig; 1/16-inch corrosion allowance provided.

2. Materials of construction:

   a. Pressure vessel: ASTM A516, Grade 70 E.

   b. Support structure: ASTM A36.

3. Vessel door:

   a. Class 150, chain driven horizontal double bolt door closure design; SYPRIS® Technologies, Tube Turns Division, 2612 Howard Street, Louisville, KY 40211; or equal with the following essential characteristics:

      1) Pressure rating: 285 psi.

      2) Double bolt yoke closure.

      3) Operator: Chain and sprocket drive with manual hand wheel.

      4) O-ring material: Viton.

4. Bosset fittings:

   a. Mount into interior of vessel.

   b. Connections:

      1) Primary gas draw.

      2) Alternate gas draw.

5. Interior rollers:

   a. Model 21L Roller Trunnions by Force Flow, 2430.Stanwell Drive, Concord, CA 94520; or equal with the following essential conditions:

      1) Welded steel construction, ASTM A36.

      2) Rollers: Ultra high molecular weight (UHMW) polyethylene with stainless steel shafts.

      3) Slotted holes for attachment.

6. Threaded elbow-couplings:

   a. Welded into interior of vessel.

   b. Locations:

      1) Pressure check.

      2) Vacuum/pressure gauge.

      3) Pressure relief valve.

C. Ton Valves:

1. Ton container valves: Sherwood Type 1214 X1-B1 by Sherwood, 2111 Liberty Drive, Niagara Falls, NY 14304-37444; or equal with the following essential characteristics:
    a. Materials of construction:
        1) Body: Silicon Bronze Alloy B.
        2) Stem: Monel.
    b. Size: 3/4-14 NGT (LL)-1.
    c. Packing: Teflon.
2. Locations:
    a. Primary gas draw bosset fitting.
    b. Alternate gas draw bosset fitting.
    c. Pressure check.
    d. Vacuum/pressure gauge.

D. Vessel Interior Chlorine Transfer Hose and Yoke Assembly:
1. Provide one chlorine transfer hose within interior of each containment vessel:
    a. Corrugated Monel 400 with stainless steel guard cover.
    b. Pressure tested with gas at a minimum of 750 psig.
    c. 1/4-inch I.D. x 38 in. in length with ¼ in. MNPT ends.
2. Provide Yoke Adaptor 1/2-14 NPT (male), Yoke Assembly, and 1/2 x 1/4 in.-3000 lb. threaded 90 degree Monel 400 elbow for each transfer.

E. Vessel Pressure Relief Valve:
1. Crosby 900 Omni Trim Valve Model No. 951631 MA Inconel X750 Spring by Pentair Ltd, 5500 Wayzata Boulevard, Suite 800, Minneapolis, MN 55416 or equal with the following essential characteristics:
    a. Valve size: 3/4-inch MNPT inlet, 1 inch FNPT outlet.
    b. Materials for valve shall be Teflon Seat, Carbon Steel Container, Monel Base, Monel Disc, Monel Insert, Monel Disc Holder, Monel Guide, and Inconel X750 Steel spring.
    c. Pressure setting: 225 psig.

F. Vessel Vacuum/Pressure Gauge:
1. Pressure/vacuum gauge and diaphragm shall be #35-1009AW-02L-30/100 with diaphragm 02-310UM-02T-CF by Ashcroft Inc., 250 East Main Street, Stratford, CT 06614; or equal with the following essential characteristics:
    a. Dial: 3.5 inch dial.
    b. Pressure range: 30 inch vacuum - 100 psi.

c. Diaphragm material: Tantalum.

d. Diaphragm body and process connection: Monel with 1/4-inch MNPT.

e. Filling fluid: Halocarbon.

G. Chlorine Pressure Switch:

1. Connected to the pressure/vacuum gauge.

2. Model A1F-0-SS-1-2 Pressure Switch by Mercoid, 102 Indiana Hwy. 212, Michigan City, IN 46360; or equal with the following essential characteristics:

a. Pressure range: 4-75 psi factory set at 15 psi rising with Nema 4X enclosure.

b. Diaphragm Seal: Model EWX247CTN with Halocarbon fill by Ametek (US Gauge), 900 Clymer Avenue, Sellersville, PA 18960; or equal with the following essential characteristics.

1) Non-gasketed diaphragm seal.

2) Top body and instrument connection: 316 Stainless steel with 0.5-inch FNPT.

3) Diaphragm material: Tantalum.

4) Diaphragm body and process connection: Hastelloy C276 with 0.25-inch MNPT.

5) Filling fluid: Halocarbon.

H. Fail-Safe Actuator and Valve Systems:

1. One fail-safe actuator and valve system shall be provided for each containment vessel. One backup manually operated valve system shall be provided for each containment vessel.

2. Fail-safe assembly:

a. Actuator: Jamesbury Model VPVL051SR6 by Jamesbury Incorporated, 44 Bowditch Drive, Shrewsbury, MA 01545; or equal with the following essential characteristics:

1) Electro-pneumatic with spring return (fail closed).

b. Limit Switch: Quartz Model QN33C02SRA by StoneL, 26271 US Highway 59, Fergus Falls, MN 56537; or equal with the following essential characteristics:

1) Intrinsically safe, SST N.O. switching sensor dual module, status indicator (Red – closed, Green – open).

c. Solenoid Valve: Model EF8320G174/120V by ASCO, Hanover Road, Florham Park, NJ 07932; or equal with the following essential characteristics:

1) Three way valve.

2) NEMA 4X Explosion proof enclosure.

3) Brass body with 1/4-inch NPT connections.

4) 120 vac operation.

d. Ball Valve: Series 4000 Model 4CBC-7173XTB-2 by Jamesbury; or equal with the following essential characteristics:

1) ½ inch, Monel body, Hastalloy ball, Teflon seats, chlorine cleaned.

e. Nitrogen supply system.

3. Backup manual ball valve: Series 4000 Model 4CBC-7173XTB-2 by Jamesbury; or equal with the following essential characteristics:

a. 1/2-inch, Monel body, Hastalloy ball, Teflon seats, chlorine cleaned.

4. Nitrogen system for pneumatic operation of fail-safe valve system:

a. 55 cf. high pressure nitrogen gas cylinder.

b. Model 25-80P-580 pressure regulator by Harris Calorific, Incorporated, 2345 Murphy Boulevard, Gainesville, GA 30504; or equal with the following essential characteristics:

1) Outlet pressure: 80 psi (fixed).

c. One pigtail assembly of 1/4-inch-1500 psi, 72 inch long Teflon tube with braided stainless steel covering, with 1 safety relief valve.

2.03 CONTAINER LOADING SYSTEM:

A. Provide two chlorine gas container loaders with the following essential characteristics:

1. One 10-foot long gravity roller section.

2. Two 4-foot long gravity roller sections.

a. One 4-long gravity roller section attached at each end of the 10-foot long section.

b. Attachment shall allow 4-foot section to be raised (pivoted) and secured in an upright position. This provides space for opening of the containment vessel door and for storage when not in use.

c. Gas spring-assist cylinders shall be provided to safely raise and lower the 4-foot gravity roller section.

3. Support structure for the gravity roller sections to match the elevation required by the containment vessel.

a. Support structure for the 10-foot long gravity roller section shall be anchored to the floor.

b. Support structure for the 10-foot long gravity roller section shall include side rails with rollers to contain 1-ton gas storage cylinder within the loader assembly.

c. Support for the 4-foot long gravity roller sections shall be attached to the drop-down sections.

4. Winch system to safely remove 1-ton gas storage cylinder from containment vessels.

2.04 CHLORINE WEIGHT SCALES

A. Weight scale: Wizard 4000 Electronic Scale by Force-Flow, 2430 Stanwell Drive, Concord, CA 94520; or equal, having the following essential characteristics:

1. Sized and designed for the chlorine gas container containment system and associated single one-ton gas container.

2. Fit within the dimensions of the equipment (gas container containment system and single one-ton chlorine gas container) it supports.

3. Digital readout:

a. Housed in NEMA 4X enclosure.

b. Dual display type with the capability to display net, gross, and tare values.

c. Equipped with a digital keyboard for easy entry of tare values.

4. Outputs: 4-20 mA DC for remote signal transmission of scale contents (chlorine weight).

2.05 ANCHOR BOLTS

A. Sized by the equipment manufacturer, using methods designed to transfer the full, ultimate strength of the anchor bolt to the concrete foundation.

B. Adhesive or expansion anchors per Section 05 50 00 – Metal Fabrications.

2.06 FABRICATION

A. Vessel shall be fabricated in accordance with ASME BPVC Section VIII, Div. 1.

B. Each containment vessel shall bear a stainless steel ASME nameplate. Each nameplate shall bear the applicable code symbol. Vessel manufacturer shall be authorized by ASME to apply applicable code symbols.

C. Vessel welding shall be in accordance with ASME Code Section IX using any of the following welding procedures: SMAW P1-B1, GTAW/SMAW P1-42-1A, SMAW/SAW P1-1A, GTAW P1-1A, FCAW P1-1-3/4 (for non-pressure welds only).

D. All welds shall be visually inspected.

E. Spot radiograph welds per UW-52 of ASME BPVC Section VIII, Div 1. One increment of weld shall include a junction.

F. Each containment vessel shall be tested in accordance with ASME BPVC after fabrication and prior to coating. Completed vessels shall be hydrostatically tested to 375 psig at the factory per UG99.

G. Containment systems will be factory inspected by the Government.

H. Hydrostatic testing will be witnessed by the Government.

2.07 COATINGS

A. Coatings shall be in accordance with Section 09 96 20 – Coatings.

2.08 SPECIAL TOOLS

A. For each type of equipment furnished provide:

1. Special tools necessary for adjustment, operation, maintenance, and disassembly. Tools shall be high-grade, smooth, forged, alloy tool steel.
2. A grease gun or other lubricating device for each type of grease required. Grease guns shall be lever type.
3. One or more steel cases mounted on the wall complete with flat key locks, two keys, and clips or hooks to hold each tool in a convenient location.

B. Tools shall be delivered at the same time as the equipment and handed over on completion of the work.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with the manufacturer's instructions and recommendations and the approved Shop Drawings.

B. Equipment shall be set on concrete bases, secured with anchor bolts and grouted in accordance with 03 63 00 – Epoxy Grout.

C. If the Government determines that damaged equipment can be repaired at the site, all repairs shall be made by the manufacturer or in accordance with the manufacturer's instructions and under his supervision. Repairs made shall be subject to the approval of the Government at the Contractor's expense.

3.02 START-UP AND TEST

A. Test equipment per manufacturer's instructions following installation of the equipment, controls, valves and piping.

B. Make all necessary repairs and/or adjustments. Tests and adjustments shall be repeated until, in the opinion of the Government, the installation is complete and the equipment is functioning properly and accurately, and is ready for permanent, continuous operation.

3.03 TRAINING

A. Provide materials, manuals, and training for up to 12 individuals.

B. Provide documentation noting training syllabus and who was trained.

3.04 MANUFACTURER'S REPRESENTATIVE SERVICES

A. Check completed installation.

B. Test system.

C. Train operation and maintenance personnel.

END OF SECTION

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SECTION 46 31 53
WARNING SIGNS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in prices offered in the schedule for other items of work.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 - Submittals.

B. RSN 46 31 53-1, Approval Data:

1. Manufacturer's product data for sign.
2. Drawing showing location and type of sign.

PART 2 PRODUCTS

2.01 WARNING SIGNS

A. OSHA Danger Sign:

1. Heavy Duty Aluminum:
   a. 25 percent postconsumer content.
   b. 25 percent recovered materials content.
2. Minimum width: 14 inches.
3. Minimum height: 10 inches.
4. Sign text: "Danger: Chlorine Gas".

2.02 ACCESSORIES

A. Attachment: Manufacturers recommended installation hardware.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in locations shown on the drawings.

END OF SECTION

SECTION 51 00 00

INFORMATION AVAILABLE TO OFFERORS

PART 1 GENERAL

1.01 ORDER OF PRECEDENCE

A. In case of differences between sections in Division 51 - Information Available to Offerors and sections in other divisions of the specifications, the requirements in the other divisions will govern.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 51 00 10
PERMIT APPLICATION

PART 1 GENERAL

1.01 PERMIT APPLICATIONS

A. Refer to Section 01 55 20 – Traffic Control for details regarding the permit application.

New Mexico DEPARTMENT OF TRANSPORTATION
MOBILITY FOR EVERYONE

INSTRUCTIONS FOR COMPLETING A UTILITY PERMIT

Any installation of utility facilities on NMDOT right-of-way, or revision of existing facilities thereon, will require the prior approval of a Utility Permit. No construction will be performed on State right-of-way before the utility has received an executed permit from the Commission.

If the application is for a parallel installation, justification as to why private right-of-way may not be utilized must be furnished.

All Utility Permit applications shall consist of the **ORIGINAL** permit form, signed as an individual owner or by authorized officers of companies or municipalities.

All **ORIGINAL** Utility Permit application for installations within Catron, Cibola, McKinley and Sandoval Counties shall be submitted to: **NMDOT District Six, Traffic Permit Section, P.O. Box 2160, Milan, NM 87021.**

The permit application shall be accompanied by a plan/sketch, showing the complete proposed installation details. This plan/sketch shall show: mile post, right-of-way, access control lines and any other pertinent data required to indicate **EXACT** physical location of the proposed installation. For proposed aerial installations, the plan/sketch shall show complete dimensions of the proposed facility, including vertical clearances above roadways (typical section) all poles, anchors and other appurtenances shall be referenced to the right-of-way or the project centerline. For proposed subsurface installations, the sketch shall include a profile indicating depth of cover, physical dimensions, method and length of encasement.

Upon receipt of the approved permit, the applicant shall notify the District Six Traffic Section in writing prior to the date of starting the proposed installation and upon completion. All installations are subject to inspection by NMDOT forces.

PLEASE COMPLETE FORMS IN BLACK INK.

General Office | P.O. Box 1149 | Santa Fe, NM 87504-1149

B.

Any application for proposed structural installations under State roadways, i.e.: manholes, tunnels, culverts, etc., shall include a detailed structural design drawing showing all physical elements of the proposed structural installation. These will require the approval of the NMDOT Bridge Engineer.

The protection of the public and handling of traffic during the construction of the facility are the responsibility of the permit applicant. At least one lane must be kept open to traffic at all times. Barricades, flagmen, signs and flares shall be provided as necessary.

Traffic control shall be in accordance with the Manual on Uniform Traffic Control Devices.

AERIAL FACILITIES, PARALLEL

If application is for a parallel installation, **justification as to why private right-of-way may not be utilized must be furnished.** Should private right-of-way be unavailable then the proposed installation of aerial utility facilities parallel to a State roadway shall be located one foot within the right-of-way line, wherever practical. Minor variations will be processed on an individual basis. In no case shall parallel facilities be permitted within access control lines at any controlled access location.

AERIAL FACILITIES, CROSSING

The proposed installation of aerial utility facilities crossing a State roadway should cross the roadway at an angle of **90 degrees**, wherever practical. Poles, anchors and other appurtenances shall be located at, near or outside of State rights-of-way. No crossing components shall obtrude upon the foreslope, shoulder or roadway surface and all vertical clearances shall conform to the relevant codes. Minor variations will be processed on an individual basis. In no case shall poles, anchors or other surface components of aerial crossings be permitted within access control lines at any controlled access location.

BURIED FACILITIES, PARALLEL

If application is for a parallel installation, **justification as to why private right-of-way may not be utilized must be furnished**. Should private right-of-way be unavailable then the proposed installation of buried utility facilities parallel to a State roadway should be located **five (5)** feet within the right-of-way line, wherever practical. Minor variations will be processed on an individual basis. In no case shall parallel facilities be permitted within access control lines at any controlled access location. All buried facilities shall be installed at a depth of **seventy-two (72)** inches or more from the surface to the top of the facility. All trenches and ditches will be backfilled and compacted by the permit applicant. All excavations outside the roadway foreslopes shall be compacted to a density equal to the surrounding undisturbed soil (Standard Compaction Test, AASHTO Method T-99 or equivalent). Parallel ditches in excess of 350 feet in length shall not remain open over twenty-four (24) hours. Wherever possible, any excavations on or near a traveled way should not remain open overnight. The permit applicant shall be responsible for the backfill and compaction of all excavations, and shall be responsible for the safety of the traveling public.

BURIED FACILITIES, CROSSING

The proposed installation of buried utility facilities crossing a State roadway should cross at an angle of **ninety (90)** degrees, wherever practical. Surface components of proposed buried crossings shall be within **five (5)** feet of the right-of-way line. All buried facility crossings shall be installed at a depth of **seventy-two (72)** inches or more from the low point of the roadway to the top of the facility. Minor variations will be processed on an individual basis. In no case shall surface components of buried crossings be permitted within the access control lines at any controlled access location.

Wherever possible, installation of buried facilities crossing a State roadway shall be performed by boring or jacking under the roadway. Installation by open cut of the roadway will be permitted only where boring or jacking is not feasible. The permit applicant shall be responsible for surface restoration on open cut installations, and may be required to assume maintenance on the portion of roadway affected until the Department repaves the roadway.

All proposed buried carrier pipes crossing a State roadway shall be constructed of steel, case iron or reinforced concrete pipe and/or shall be encased in metal pipe. Each question of encasement shall be considered on any individual basis. For all controlled access locations, the encasement shall extend completely across the access control lines. For other locations the encasement shall extend from toe of slope to toe of slope.

Complicated utility requests should be discussed with the **District Six-Traffic Engineer**, prior to submission. The Traffic Engineer may be contacted at (505) 285-3220 in Milan, New Mexico.

RENEWAL AND REVOCATIONS

The permit applicant shall be responsible for notifying the NMDOT of the removal of abandoned facilities. The applicant shall also be responsible for the renewal of permit upon their expiration. The construction of any facility upon State right-of-way without an executed permit, or the violation of any terms or conditions of a permit, may be just cause for the complete removal of such facilities at the sole cost of the owner thereof.

FORM

Begin with the line entitled **(UNDERSIGNED)**. A home and/or business phone number for the owner or his representative is to be included on the application.

Location on the proposed utility is to be described by the **SECTION/TOWNSHIP/RANGE** and urban areas, by **BLOCK/LOT/SUB** (where applicable). In addition, a distance from a NMDOT mile marker to the centerline of the utility in rural areas must be included. In urban areas, distances from existing intersection or other stationary objects, which can be identified on highway plans, to the centerline of the utility must be included.

The review of the permit normally requires **thirty (30)** days for completion. Please allow this amount of time when planning work schedules.

PLEASE COMPLETE ALL FORMS IN BLACK INK.

UTILITY APPLICATION REQUIREMENTS

The following are requirements for obtaining a Utility Permit.

1. Insurance naming the NMDOT as additionally insured. (Section 12.11)

2. Utility Companies must provide documented authorization from the agencies for installations on land controlled by the U.S. Forest Service, BLM, U.S. Military Bases, Indian Lands and other designated state lands. (Section 12.9)

3. Traffic control plans shall be submitted in accordance to the Manual on Uniform Traffic Control Devices, Part Six current edition (Section 12.9).

4. Archeological Clearance. The Department, contact Ms. Genevieve Head, Archeological Department, at 827-5513 (Section 12.6.8), may have already cleared the area in question. If the area has not been cleared the attached Environmental Scoping Review Checklist **shall** be included.

5. Provide **as built plans** within thirty (30) days of project completion (Section 12.7.2).

OBTAINING ARCHEOLOGICAL CLEARANCE

1. Locate your project on a location map. Include section, township and range on the map. The map should be suitable for comparison with a U.S.G.S. 7.5' quad map. Sufficient landmarks shall be included on the map so that the project location can be located in the Environmental Section.

2. Write a description of your project and include it with the map. The description should include dimensions (length and width), and the nature of the project.

   EXAMPLE: "{Company} will install a buried cable in the {State Route} right-of-way. The installation will start at the junction of NM44 & NM126 and proceed south for 528 feet. At this location, the installation will leave the right-of-way and enter private land. The trench will be three feet wide."

The Department jurisdiction is only over right-of-way, which is not adjacent to State Trust or Federal land: BLM, National Forest, BIA, etc.

3. Include your name, address, telephone, and fax number. If you do not include your fax number, the archeological clearance will be mailed to you.

4. The attached "**Environmental Scoping Review**" checklist shall accompany all submitted materials.

5. The New Mexico Department of Transportation contact for cultural resources on utility projects is:

   NMDOT Environmental Section, **Genevieve Head**
   P.O. Box 1149
   Santa Fe, NM 87504
   Phone: (505) 827-5513 Fax: (505) 827-6862

UTILITY SURVEY DATA REQUIREMENTS

The following "metadata" (data about the data) shall be submitted with each utility's as-builts and electronic file, preferably as a separate text file on the submittal media. This information is critical to the Department so as to properly archive the data, as well as to provide follow-up capability in the event problems arise with the data:

1. District Utility Permit number.
2. Name, address and phone number of the responsible Land Surveyor.
3. Date of survey completion.
4. Equipment used to conduct the survey (e.g. total station, GPS, spirit level).
5. Reference mark(s) used to tie the survey to NM State Plane Coordinate System 1983, and to North American Vertical Datum 1988.
6. Ground-to-Grid combined scale factor used.

Note that elevations <u>SHALL</u> be provided every 500', and at all break points, including high and low points.

UTILITY PERMIT CHECK LIST

- ☐ Insurance naming the NMDOT as additionally insured. (Section 12.11)
- ☐ Documented authorization from the agency for the installation **when** the U.S. Forest Service, BLM, U.S. Military Bases, Indian Lands and other designated state lands controls the land. (Section 12.8)
- ☐ Traffic control plans shall be submitted in accordance to the Manual on Uniform Traffic Control Devices, Part Six current edition. (Section 12.9)
- ☐ Archeological clearance. (Section 12.6.8)
- ☐ Provide as built plans within thirty (30) days of project completion. (Section 12.7.2)
- ☐ Note seeding requirements for District Six on page 19 of current regulations. (Section 12.5.2)
- ☐ Return the completed **ORIGINAL** permit package to: **NMDOT, Traffic Permit Section**
  P.O. Box 2160
  Milan, NM 87021

District Six Traffic Section

APPLICATION FOR PERMIT TO INSTALL UTILITY FACILITIES

WITHIN PUBLIC RIGHT OF WAY

TO: NEW MEXICO DEPARTMENT
OF TRANSPORTATION
DISTRICT SIX
P.O. BOX 2160
MILAN, NM 87021

Permit No. _____

_____New Installation
_____Renewal Permit
_____Relocation
_____Remain in Place

1. Pursuant to New Mexico Statutes Annotated, 1978 Compilation, Sections 67-8-13 and 69-8-14, the undersigned

_____

Address:_____

herein makes application to use highway right of way to install:

Size and Type of Facility_____

in the following location: NM Project No._____ State Road No._____

Hwy. Station _____ to Hwy Station_____Mile Post _____to Mile Post_____

County Section _____, Township _____ , Range _____

2. For the purpose of this application "within" shall be construed as meaning "on, over, under, across, or along".
   a. 'Engineer' shall be construed as meaning the District Engineer of the New Mexico Department of Transportation or his representative.
   b. 'Applicant' shall be construed as meaning the individual, firm, corporation, association, governmental subdivision, or other organization making application, or the successors of any of the above.
   c. Facility' shall be construed as meaning, but not limited to, and publicly, privately, cooperatively, municipally or governmentally owned facility used for carriage, distribution or transmission of water, gas or electricity, oil and products derived therefrom, sewage, steam or other projects carried by means of pipelines, conduits, wires, culverts, ditches, conveyors or other methods.
   d. If application is for a parallel installation, justification as to why private right of way may not be utilized must be furnished.

3. Applicant proposes to relocate, install or leave facility _____feet within the _____right-of-way line. The proposed installation shall be:

_____
(Crossing or Parallel) (Subsurface or Overhead) (Boring, Jacking or Pavement Cut)

   a. If applicant requests installation by pavement cut, complete justification therefore shall be submitted by attachment.
   b. Where application for pavement cut is justified, the application may be held in abeyance pending receipt of cash bond in an amount to be fixed by the Engineer.

4. There is attached hereto a diagrammatic dimensioned drawing showing the location of existing and/or proposed installation referenced to roadway and right of way, right of way lines, any access control lines, distance of proposed installation above or below grade, highway stationing, identification of materials to be used and any other pertinent data. If application is for parallel installation, nature of adjacent land use shall be shown. Proposed installation on or in bridge or other structures, or for the installation of any structures, will require detailed structural drawings.

5. Applicant desires this permit to be in affect for _25____years. Permit will not be issued for a period longer than 25 years must be renewed upon expiration and the burden of timely renewal is on the Applicant. The Applicant shall formally notify the Engineer of actual commencement and completion of construction of the installation. The Applicant shall also formally notify the Engineer of removal or abandonment of the facility, or relinquishment of the permit.

6. The signing of the application by the Engineer and returning it to the Applicant shall validate this application as a permit. The granting of this permit shall not be construed as granting any easement or property right.

7. Servicing of facilities will not be permitted within the access control lines on any controlled access project. Should an emergency occur, the Applicant shall notify the Engineer and shall provide such flagmen, flashers, warning or other safety devices as required by the Engineer. All routine maintenance shall be performed from outside any access control lines.

8. The relocation or installation of facilities within public right of way shall be in strict conformance with all provisions of this application, drawing and the instructions for Utility Permits, as they may be modified by the Engineer, and no departure there from may be made without the written consent of the Engineer. All facilities shall be so placed that they will not interfere with nor endanger any roadway features nor other existing facilities. All construction of facilities shall be subject to the inspection and approval of the Engineer. All such work shall be performed so that danger, inconvenience and delay to the traveling public will be held to a minimum. Protection and handling of traffic during the installation are the responsibility of the Applicant, and must be approved by the Engineer.

District Six Traffic Section

9. The applicant will, except as otherwise ordered by the Engineer, restore the public right of way, and all bridges or other structures thereon or adjacent thereto which have been altered or affected by facility installation performed hereunder, in accordance with sound construction practices and the Engineer's specifications, and shall cause the work to be done in a workman like manner. If any damage is caused to the highway right of way or to any bridge, structure or improvement thereon or adjacent thereto by reason of the installation, maintenance, alteration or removal of such facilities or other appurtenances, the Applicant will reimburse the Engineer the full amount thereof promptly upon demand by the Engineer; provided, however, that the obligation imposed under this paragraph shall not apply in the event the damage resulted from causes beyond the control of the Applicant. All such facilities located within the right of way shall at all times be kept in such repair so as not to damage the highway, inconvenience or endanger the traveling public and shall be kept free from advertisement, posters and the like.

10. The applicant will at all times indemnify and save harmless the Engineer from any and all claims of every kind of character caused by or incident to the installation, alteration, removal or condition of these facilities in the right of way and will promptly reimburse the Engineer for any and all expenses incurred by the Engineer in resisting any such claim or claims. Nothing herein shall be construed to mean that the Applicant hereunder will indemnify and save harmless the Engineer from any claim caused by or incident to any neglect, carelessness or breach of duty on the part of the Engineer.

11. Should the Applicant at any time fail to promptly and fully perform any of the obligations imposed hereby and after thirty (30) days written notice thereof, the Engineer may at his option (a) cause the obligations to be fully carried out and performed, and the Applicant will promptly reimburse the Engineer for all costs and expenses incident thereto, (b) may summarily order the removal of such facility and if the Applicant fails to comply within a reasonable time, the Engineer may direct the removal of the facility with all costs and expenses thereto to be borne by the Applicant.

12. If by reason of any change in the location, construction, grade or by any other matter affecting the highway upon which any facility is located because of changing traffic conditions or otherwise, it shall become advisable in the opinion of the Engineer that said facility be removed, relocated or otherwise modified, the Applicant, upon written notice from the Engineer, shall remove, relocate or modify such facility without undue delay in such manner as the Engineer may direct or approve, at the Applicant's expense and at no cost to the Engineer. All facilities located on public right of way under the dual jurisdiction of the State and a subordinate governmental entity shall comply with all applicable rules and regulations of such entity properly and lawfully in force and including but not limited to provisions of the local franchises not in conflict with the rules and regulations of the Engineer. The Engineer makes no warranty either express or implied as to the continued existence of any highway in any particular location and expressly assumes no obligation with regard to the facility upon change, vacation or abandonment of any highway portions thereof.

13. Neither the making of this application nor anything herein contained shall constitute a waiver on the part of the Applicant of any rights or claims had or made by some with respect to the occupancy of the streets and highways under the Constitution and Laws of the State of New Mexico, nor shall anything herein contain in anywise prejudice or impair any rights or claims existing independent of this application with respect to the construction, operation and maintenance of the applicants facilities in the State of New Mexico.

14. Each copy of the application must be signed by the Applicant as an individual owner or by any official designated to execute such documents. This application is hereby granted subject to all provisions herein and to the following special provision, changes or amendments:

    a. All work performed on State Right-of-Way shall meet the Standard Specifications for Road and Bridge Construction (2000 Edition).
    b. The State's right of way must be restored to it's original condition or better by the Applicant.
    c. Traffic Control shall be in accordance with the Manual on Uniform Traffic Control Devices. (Current Edition)
    d. The Applicant shall notify the District 6 Traffic Section at least 48 hours prior to the start and 48 hours after completion of said project.
    e. The Special Utility Permit Provisions attached hereto as Attachment One and hereby incorporated by reference.
    f. To the extent required by contract or law, this permit is subject to prior approval by underlying fee owner, further identified "_____"
    g. The utility owner shall provide "as-built" horizontal and vertical utility location information, **within thirty (30) days of completion of the project**, in hard copy and electronic file in AUTOCAD DWG (3D) OR MICROSTATION DGN (3D) format. The standard horizontal datum shall be North American Datum 1983 (NAD 83) and standard projections shall be the New Mexico State Plane Coordinate System 1983 (NMSPCS83). The standard vertical datum shall be North American Vertical Datum 1988 (NAVD88). The preferred media in which this data must be submitted is CD ROM; 3.5" diskette may be used for the data submittal. The utility location information shall be tied to Departmental monuments and referenced to highway mileposts or to highway project construction stationing, and certified by a New Mexico Registered Land Surveyor. Metadata or "data about the data" shall be submitted with each utility's as-built electronic file, preferably as a separate text file on the electronic submittal media, and shall include: 1.) District Utility Permit Number. 2.) Name, address and phone number of the responsible land surveyor. 3.) Date of completion of survey. 4.) Equipment used to conduct the survey. 5.) Horizontal and vertical control marks used to tie the survey to the NMSPC83 and NAVD88. 6.) Ground to Grid combined scale factor used. 7.) Elevations shall be provided every 500 feet and at all survey break points, including all high and low points

Applicant _____

By _____ Date _____

Title _____

Approval of this permit is hereby given this _____ day of _____ 20_____

NEW MEXICO DEPARTMENT OF TRANSPORTATION

By: _____
District Engineer

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 52 00 00

DRAWINGS

PART 1 GENERAL

1.01 DISCREPANCIES, ERRORS, OR OMISSIONS

A. Inform the CO of discrepancies discovered on drawings in accordance with clause at FAR 52.236-21, Specifications and Drawings for Construction.

B. In accordance with clause at FAR 52.236-21, Specifications and Drawings for Construction, in case of discrepancies, written specifications take precedence over drawings unless otherwise specified.

1.02 PROJECT CONDITIONS

A. Where there are differences as determined by the CO between details and dimensions shown on drawings and details and dimensions of existing features at jobsite, use details and dimensions of existing features at jobsite.

1.03 STANDARD DRAWINGS

A. Standard drawings may show details which are not a part of work under this contract. Disregard details shown on these drawings which are not applicable to work under this contract.

1.04 COPIES OF DRAWINGS

A. One set of full-size (22 inches by 34 inches) drawings, except standard drawings, will be furnished to the Contractor.

B. Upon request, additional half-size (11 inches by 17 inches) copies of standard drawings will be furnished to the Contractor.

1.05 LIST OF DRAWINGS

A. Drawings listed in Table 52 00 00A - List of Drawings, are made a part of Section C - Description/Specifications.

1.06 DRAWING NUMBERS IN NUMERICAL ORDER

A. Specification drawings are listed in numerical order in Table 52 00 00B - Drawings in Numerical Order.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

Table 52 00 00A - List of Drawings

Sheet No.	Drawing No.	Title
General:		
1	1695-D-98	Key Map, Vicinity Map and Area Map
2	1695-D-99	Site Plan
3	1695-D-100	Site Plan – Sections
Civil:		
4	1695-D-108	Excavation – Typical Sections
5	1695-D-196	Service Yard Surfacing – Plan and Details
6	1695-D-203	Emergency Outlet Ditch
7	1695-D-204	Access Road – Plan and Profile
General Structural:		
8	1695-D-101	General Structural Design Data – Sheet 1 of 2
9	1695-D-102	General Structural Design Data – Sheet 2 of 2
10	1695-D-103	Concrete Retaining Wall – Site Plan
11	1695-D-104	Concrete Retaining Wall - Sections
12	1695-D-107	Concrete Retaining Wall – Sections and Detail
13	1695-D-189	W-Beam Guardrail – Plan and Sections
Pumping Plant:		
14	1695-D-119	General Arrangement – Plan – El. 6691.50 – Sheet 1 of 2
15	1695-D-120	General Arrangement – Plan – El. 6691.50 – Sheet 2 of 2

Table 52 00 00A - List of Drawings

Sheet No.	Drawing No.	Title
16	1695-D-121	General Arrangement – Sections 1-1 and 2-2
17	1695-D-122	General Arrangement – Sections 3-3 and 4-4
Pumping Plant – Architectural:		
18	1695-D-110	Floor Plan
19	1695-D-111	Roof Plan
20	1695-D-112	Elevations
21	1695-D-113	Building Sections A-A and B-B
22	1695-D-114	Building Sections - C-C and D-D
23	1695-D-115	Enlarged Floor Plan, Schedules and Frame Types
24	1695-D-116	Interior Roof Plan and Wall Elevations
25	1695-D-117	Details – Sheet 1 of 3
26	1695-D-118	Details – Sheet 2 of 3
27	1695-D-195	Details – Sheet 3 of 3
Pumping Plant – Structural:		
28	1695-D-123	Concrete Outline – Plan – El. 6691.50
29	1695-D-124	Concrete Outline – Sections 1-1, 2-2, and Details
30	1695-D-125	Concrete Outline – Sections 3-3 Thru 8-8
31	1695-D-127	Reinforcement Design – Plan – El. 6691.50
32	1695-D-128	Reinforcement Design - Sections
33	1695-D-129	Reinforcement Design – Plan – El. 6691.50 - Sections
34	1695-D-130	Reinforcement Design – Sections and Details
34A	1695-D-327	Steel Manifold Encasements – Concrete Outline and Reinforcement Design – Plan and Sections – Sheet 1 of 3

Table 52 00 00A - List of Drawings

Sheet No.	Drawing No.	Title
34B	1695-D-328	Steel Manifold Encasements – Concrete Outline and Reinforcement Design – Plan and Sections – Sheet 2 of 3
34C	1695-D-329	Steel Manifold Encasements – Concrete Outline and Reinforcement Design – Plan and Sections – Sheet 3 of 3
35	1695-D-131	Structural Steel – 5-Ton Crane Runway Girders – Plans, Sections, and Details – Sheet 1 of 3
36	1695-D-132	Structural Steel – 5-Ton Crane Runway Girders – Plans, Sections, and Details – Sheet 2 of 3
37	1695-D-133	Structural Steel – 5-Ton Crane Runway Girders – Plans, Sections, and Details – Sheet 3 of 3
38	1695-D-134	Structural Steel – Roof Framing Plan, Sections, and Details – Sheet 1 of 3
39	1695-D-135	Structural Steel – Roof Framing Plan, Sections, and Details – Sections – Sheet 2 of 3
40	1695-D-136	Structural Steel – Roof Framing Plan, Sections and Details – Sheet 3 of 3
41	1695-D-138	Structural Steel – Roof Cover Sub-Frame
42	1695-D-139	Structural Steel – Removable Roof Cover Frame
43	1695-D-140	Structural Steel – Framing Plan – El. 6691.50 – Base Plates
44	1695-D-141	Structural Steel – Sections and Details – Sheet 1 of 5
45	1695-D-142	Structural Steel – Sections and Details – Sheet 2 of 5
46	1695-D-143	Structural Steel – Sections and Details – Sheet 3 of 5
47	1695-D-144	Structural Steel – Sections and Details – Sheet 4 of 5
48	1695-D-145	Structural Steel – Sections and Details – Sheet 5 of 5
49	1695-D-191	Pipe Trenches – El. 6691.50 – Miscellaneous Metalwork – Trench Grating and Embedded Angles – Plans, Sections and Details
Pumping Plant – Masonry:		

Table 52 00 00A - List of Drawings

Sheet No.	Drawing No.	Title
50	1695-D-146	General Notes and Typical Details
51	1695-D-147	Plan – El. 6691.50
52	1695-D-148	Elevations and Sections – Sheet 1 of 2
53	1695-D-149	Elevations and Sections – Sheet 2 of 2
54	1695-D-150	Plan – Sheet 2 of 2
55	1695-D-151	Elevations, Sections, and Details – Sheet 3 of 3
Pumping Plant – Mechanical:		
56	1695-D-257	5-Ton Capacity Overhead Traveling Crane – Plan and Section
57	1695-D-260	Air Chamber Sump Lift Station – Section and Detail
58	1695-D-261	Pumping Plant and Air Chamber – Gravity Drainage – Plan and Section
59	1695-D-262	Auxiliary Piping – Partial Plan El. 6691.50
60	1695-D-263	Auxiliary Piping – Partial Plan El. 6691.50
61	1695-D-264	Auxiliary Piping – Sections
62	1695-D-265	Auxiliary Piping – Sections and Details
63	1695-D-266	Mechanical Seal Cooling Water Pipe Diagram
64	1695-D-267	Mechanical Seal Cooling Water Details
65	1695-D-182	On-Site Sewage Disposal System – Plan – Sheet 1 of 3
66	1696-D-183	On-Site Sewage Disposal System – Profile – Sheet 2 of 3
67	1695-D-184	On-Site Sewage Disposal System – Septic Tank Profile – Foundation, Plan, Sections, and Details – Sheet 3 of 3
Steel Manifold and Air Chamber:		
68	1695-D-205	Steel Manifold and Storage Tank - Plan
69	1695-D-206	Steel Manifold – Plan, Section, and Details – Sheet 1 of 2

Table 52 00 00A - List of Drawings

Sheet No.	Drawing No.	Title
70	1695-D-207	Steel Pipe Manifold – Sections and Detail – Sheet 2 of 2
71	1695-D-208	Steel Manifold – Plan and Sections – Sheet 1 of 6
72	1695-D-209	Steel Manifold – Sections and Detail – Sheet 2 of 6
73	1695-D-210	Steel Manifold – Section – Sheet 3 of 6
74	1695-D-211	Steel Manifold – Section – Sheet 4 of 6
75	1695-D-212	Steel Manifold – Sections and Detail – Sheet 5 of 6
76	1695-D-213	Filling Lines – Plans and Sections – Sheet 6 of 6
77	1695-D-214	Steel Manifold – Bypass and Intertie – Plan and Details – Sheet 1 of 2
78	1695-D-215	Steel Manifold – Bypass and Intertie – Sections and Details – Sheet 2 of 2
79	1695-D-216	Steel Manifold – Twin Lakes Turnout – Plan, Sections, and Detail
80	1695-D-217	Steel Manifold – Storage Tank Drain – Plan and Section
81	1695-D-218	Steel Manifold – Sections and Details – Sheet 1 of 2
82	1695-D-219	Steel Manifold – Sections and Details – Sheet 2 of 2
83	1695-D-220	Air Chamber – 12.1 – Plan, Section, and Detail – Sheet 1 of 4
84	1695-D-221	Air Chamber – 12B – Plan, Section, and Detail – Sheet 2 of 4
85	1695-D-222	Air Chamber – Sections and Details – Sheet 3 of 4
86	1695-D-223	Air Chamber – Sections and Details – Sheet 4 of 4
HVAC:		
87	1695-D-269	Schedules and Design Data
88	1695-D-270	Pumping Plant

Table 52 00 00A - List of Drawings

Sheet No.	Drawing No.	Title
89	1695-D-271	Disinfection Building
90	1695-D-272	Control Sequences and Details
Water Storage Tank:		
91	1695-D-106	1.1 MG Prestressed Concrete Storage Tank – Plan and Section
92	1695-D-224	1.1 MG Steel Storage Tank – Plan, Sections, and Details – Sheet 1 of 3
93	1695-D-225	1.1 MG Steel Storage Tank – Sections and Details – Sheet 2 of 3
94	1695-D-226	1.1 MG Steel Storage Tank – Sections and Details – Sheet 3 of 3
Chlorine Feed Building and Outdoor Chlorine Storage – Architectural:		
95	1695-D-154	Floor Plan and Schedules
96	1695-D-155	Roof Plan and Roof Details
97	1695-D-156	Elevations
98	1695-D-157	Building Sections A-A, B-B, and C-C
99	1695-D-158	Typical Block Coursing Elevations and Details
100	1695-D-159	Door and Miscellaneous Details
Chlorine Feed Building and Outdoor Chlorine Storage – Structural:		
101	1695-D-160	Concrete Outline and Reinforcement Design – Foundation Plan, Sections, and Details – Sheet 1 of 2
102	1695-D-161	Concrete Outline and Reinforcement Design – Foundation Plan, Sections, and Details – Sheet 2 of 2
103	1695-D-166	Roof Design – Roof Framing Plan, Sections, and Details
104	1695-D-137	Structural Steel – Roof Framing Plan and Sections
105	1695-D-152	Structural Steel – Sections and Details – Sheet 1 of 2

Table 52 00 00A - List of Drawings

Sheet No.	Drawing No.	Title
106	1695-D-153	Structural Steel – Sections and Details – Sheet 2 of 2
107	1695-D-167	2-Ton Monorail Crane – Plan and Sections
Chlorine Feed Building and Outdoor Chlorine Storage – Masonry Design:		
108	1695-D-162	Plan
109	1695-D-163	Sections – Sheet 1 of 3
110	1695-D-164	Sections – Sheet 2 of 3
111	1695-D-165	Sections – Sheet 3 of 3
Chlorination Piping System:		
112	1695-D-173	Chlorination System – Process and Instrumentation Diagram – Sheet 1 of 2
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END OF SECTION

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SECTION 53 10 00
GEOLOGICAL INVESTIGATIONS

PART 1 GENERAL

1.01 GENERAL

A. This section describes surface and subsurface geologic conditions for the Tohlakai Hill project area. Other sections of these specifications contain geological and geotechnical information important for understanding the significance of the geologic conditions to the construction operations.

B. Tohlakai Hill project area foundation and site geology are discussed for major project features which include: the pumping plant building; water storage tanks; H. P. Concrete Wall (retaining wall separating the pumping plant building and tanks); Chlorine Disinfection Building; Twin Lakes Turnout Pipeline and Road crossing; Reach 12.1 Pipeline and Road Crossing; and Reach 12B Pipeline. The water storage tanks are named as follows: T1 located on northwest-side, T2 is located in the middle, and T3 is located east-side of the project area.

C. The geologic drawings, sections, descriptions, water-level data, test data, logs of subsurface explorations, and geologic surface map data contained in these specifications include the geologic data on which design of the work are based and are considered. Selected samples recovered during subsurface exploration were tested to determine physical properties for the final design of the Tohlakai Hill Project and supersede any previous versions, which may be available for examination by bidders. Only the data that are specific to the needs of these specifications are included in these specifications. These data are contained in Section 53 20 00 - Records of Geologic and Subsurface Investigations. Bidders are encouraged to inspect the site and to obtain their own samples and perform tests on the materials to evaluate properties, which the bidder believes to be significant.

D. Unconsolidated soil materials recorded in all geologic exploration logs included in these specifications were classified under Unified Soil Classification System procedures as described in Reclamation standards USBR 5000-86 (laboratory classification) and USBR 5005-86 (visual classification). These two procedures are similar to ASTM D 2487-06 and ASTM D 2488-06, respectively. Copies of the above Reclamation procedures are available for review through the FCCO. Also refer to drawing 103-D-347.

E. Descriptions of bedrock materials, including weathering, fracturing, hardness, etc., have been standardized as shown and defined on standard drawings 40-D-7022 and 40-D-7023. These standards are further explained and defined in the Reclamation Engineering Geology Field Manual

F. Geologic data describes geologic conditions at the specific locations and dates collected. Encountered geologic conditions and contacts will differ from locations not investigated.

All interpretive drawings are prepared to suggest general trends between data points and do not depict local irregularities. Details of important geologic considerations related to the excavation of the foundation for the proposed site are discussed in Site Geology, and Geotechnical Considerations. Addition information is provided in the applicable Earthworks sections.

G. Select samples recovered during investigations were tested by the USBR's FCCO Laboratory. Summaries of Physical Properties Test Results are contained in Section 53 20 00, Records of Geologic and Subsurface Investigations. Additional information regarding Reclamation laboratory testing is available by contacting the Reclamation, FCCO materials laboratory at telephone number 505-324-5035. Additional information regarding laboratory testing conducted by a private laboratory is available by contacting Reclamation, Materials Engineering and Research Laboratory in Denver, at telephone number 303-445-2395.

H. The geology site conditions for the foundation of the proposed project features are shown on drawings1695-529-511, 1695-529-513, 1695-529-514, and 1695-529-716, included in Section 53 20 00. Geologic data applicable to pipeline segments and road crossings are shown on drawings 1695-D 198, 1695-D-202, 1695-D-309, and 1695-D-310, included in Section 52 00 00. Drawings and geologic logs, included in Section 52 00 00 and Section 53 20 00, should be used for a more complete characterization of the geologic conditions.

I. The bedrock surface as depicted on the geologic sections may not indicate final foundation grade or define the limits of excavation.

J. Copies of the following reports and memoranda, which contain pertinent information on the area, site geology, and materials properties, may be examined at Bureau of Reclamation, FCCO, 2200 Bloomfield Highway, Farmington, New Mexico; or at the Technical Service Center, 6th and Kipling, Building 67, Room 1068, Denver, Colorado. Bidders wishing to inspect the reports and memoranda should make arrangements through the FCCO at (505) 325-1794.

1. Navajo Gallup Water Supply Project – Reach 12 – Geologic Design Data Report, 2011.
2. Geologic Design Data Report - Reach 12b Pipeline and Tohlakai Hill Pumping Plant and Tank Sites – Navajo Gallup Water Supply Project, 2011.
3. Supplemental Geologic Design Data Report Reach 12b Pipeline and Reach 12.1 Highway Crossing – Navajo Gallup Water Supply Project, 2012.
4. Supplemental Geologic Design Data Report Reach 12b Pipeline – Navajo Gallup Water Supply Project, September 2012.
5. Supplemental Geologic Design Data Report Tohlakai Pumping Plant, Navajo Gallup Water Supply Project, 2013.
6. Technical Memorandum MERL-2013-23: Geotechnical Laboratory Testing to Characterize Foundation Materials, Tohlakai Hill Pumping Plant, Navajo Gallup Water Supply Project, New Mexico, 2013.

1.02 REFERENCE STANDARDS

A. ASTM International standards (ATSM)

1. ASTM D 2487-06 Classification of Soils for Engineering Purposes (Unified Soil Classification)
2. ASTM D 2488-06 Description and Identification of Soils (Visual-Manual Procedure)

B. Bureau of Reclamation standards (USBR)

1. Earth Manual, Part 2, Third Edition (1990)

   Procedure No. and Title

   a. USBR 5000-86 Determining Unified Soil Classification (Laboratory Method)
   b. USBR 5005-86 Determining Unified Soil Classification (Visual Method)
   c. USBR 5500-86 Performing Laboratory Compaction of Soils – 5.5-lbm Rammer and 18-inch Drop
   d. USBR 7205-86 Determining Unit Weight of Soils In-place by the Sand-Cone Method

2. Engineering Geology Field Manual, Second Edition (1998).

1.03 GEOLOGIC INVESTIGATIONS

A. Geologic investigations conducted for the Tohlakai Hill project area are listed below; and pertinent data are contained in Section 53 20 00 - Records of Geologic and Subsurface Investigations.

1. Previous Investigations. - No investigations prior to 2010 were conducted for the project area.
2. Current Investigations. - Geologic investigations were conducted in phases and documented within the geologic reports cited above. Only subsurface investigations within about 100 feet from the proposed locations for the pumping plant building, tanks and associated infrastructure; the pipeline alignment; and the road crossings are included in these specifications. Relevant geologic investigations conducted by the FCCO in 2010, 2011, 2012 and 2013 include: 19 drill holes and 9 test pits. In-place density test using the sand cone replacement method, according to USBR 7205, was conducted in selected test pits. Compaction testing, according to USBR 5500, on material sampled from test pits and from one drill hole were conducted. Geologic mapping was conducted around the Tohlakai Hill project area at a scale of 1 inch to 100 feet. Geologic logs and laboratory data from investigations are included in Section 53 20 00 – Records of Geologic Investigations and Data. Geologic surface mapping and

locations of applicable subsurface investigations and stick log data are provided on drawings 1695-529-511, 1695-529-514, 1695-D-198, and 1695-D-202.

a. Investigations Near the Tohlakai Hill Pumping Plant Building – Eight drill holes were advanced in 2011 and 2013 investigations within and near the footprint for the proposed Tohlakai Hill Pumping Plant Building (pumping plant building). Drill holes advanced in 2011 include DHR12-1, -2 and -3. Drill holes advanced in 2013 include DHTH-13-1, -2, -5, -6 and -7. Geologic surface mapping of the area is included on 1695-529-511 (also provides surface geology data for the storage tanks, H.C. Concrete Wall, chlorination building and portions of the pipeline alignment).

b. Investigations Near the Storage Tank Foundations – Six drill holes were advanced in 2011 and 2013 within and near the footprints of the three proposed tanks. Drill holes advanced in 2011 include DHR12-4, -5 and -6. Drill holes advanced in 2013 include DHTH-13-7, -8, and -9. A test pit, TPR12-40, was excavated in 2011.

c. Investigations Near the H.C. Concrete Wall (between the pumping plant building and storage tanks) – One drill hole, DHTH-13-4, was advanced in 2013 near the retaining wall footprint.

d. Investigations Near the Chlorine Disinfection Building – Drill hole DHTH-13-3 was advanced in 2013 and test pit TPR12-38 was excavated in 2011 within and near the footprint of the Chlorine Disinfection Building. Test pit TPR12-38 included an in-place density test and a compaction test on sampled material.

e. Investigations Near the Twin Lakes Turnout Pipeline Alignment and Road Crossing – Three test pits, TPR12-37, -42, and -44, were excavated in 2011 near the Twin Lakes Turnout Pipeline (pipeline) alignment. Test pits TPR12-37 and -44 included in-place density testing. Test pit TPR12-42 included a compaction test on sampled material. On the east-side of the highway, investigations near the pipeline alignment and road crossings include drill hole SPT12.1-1 and test pit TPR12.1-1 both conducted in 2011. Test pit TPR12.1-1 included an in-place density test and a compaction test on sample material. On the west-side of the highway investigations near the pipeline alignment and road crossings include drill hole SPT12.1-2 and test pit TPR12.1-2 both conducted in 2011. TPR12.1-2 included an in-place density test and a compaction test on sampled material.

f. Investigations Near the Reach 12.1 Pipeline Alignment and Road Crossing – Drill hole DHR12-3 is located about 45 feet to the north of the start of the Reach 12.1 pipeline segment. On the east-side of the highway, investigations near the pipeline alignment and road crossings include drill hole SPT12.1-1 and test pit TPR12.1-1 both conducted in 2011. Test pit TPR12.1-1 included an in-place density test and a compaction test on sample material. On the west-side of the highway investigations near the pipeline alignment and road crossings include drill hole SPT12.1-2 and

test pit TPR12.1-2 both conducted in 2011. TPR12.1-2 included an in-place density test and a compaction test on sampled material.

g. Investigation Near the Reach 12B Pipeline Alignment – Drill hole DHR12-3 is located about 50 feet to the north of the start of the Reach 12B pipeline segment. Drill hole SPT12.1-1 is located about 50 feet northwest of the terminal end of the Reach 12B pipeline segment.

3. Equipment:

a. Drill holes DHR12-1 through -7, and SPT12.1-1 and -2 were drilled using a Central Mining Equipment 75 truck-mounted drill rig with 3.25-inner-diameter augers. Standard penetration testing was conducted using a 2-inch outer diameter by 1-3/8-inch inner diameter by 2-1/2-foot-long split spoon sampler and advanced using an automatic hammer system.

b. Drill holes DHTH-13-1 through -10 were drilled using a Gus Pech Bratt 22R Rotary drill rig. Samples were collected using a Modified California Sampler with a 2-inch inner diameter, 16-inch-long center barrel with four 4-inch-long by 1.94-inch inner diameter brass rings.

c. Test pits TPR12-19 and TPR12-37, -38, -39, -40, -42, and -44 were excavated using a Case 580M Rubber Tired Backhoe. The bucket used was 1-foot-wide with teeth.

d. Test pits TPR12.1-1 and -2 were excavated using a John Deere 310J Rubber Tired Backhoe. The bucket used was 1-foot-wide with teeth.

1.04 REGIONAL GEOLOGY

A. The project area is located entirely within the Navajo section of the San Juan Basin, a section characterized by young plateaus, mesas, and dry-wash canyons presently being eroded in an arid climate. The San Juan Basin is a structural depression on the order of about 5,000 feet and contains Tertiary-age soil deposits, resting on rocks of Cretaceous-age, which crop out at the ground surface around the margins of the basin.

1.05 SITE GEOLOGY

A. Topography and Drainage: The proposed Tohlakai Hill project area is located on low hill with higher elevations on the east-side and dropping in elevation to Highway 491 on the west-side of the project area. Natural drainage of storm water and snowmelt currently enters near the center of the project area on the east-side between the proposed pumping plant building and storage tanks. Drainage currently exits the project area on the south and southwest-side of the project area. The Twin Lakes Turnout pipeline alignment intersects the natural drainage at about station 12+00 to 14+50, which will require diversion of surface water and may require additional unwatering/dewatering. The pipeline alignment also intersects the designed drainage ditch around the perimeter and a designed drainage outlet for Tohlakai Hill project, which will require diversion of surface water and proper sequencing during the construction of the pipeline and Tohlakai Hill project features.

B. Stratigraphy: The entire project area is underlain by the sedimentary bedrock unit of the Menefee Formation. Bedrock is exposed at the surface and covered by unconsolidated soil deposits with varying thicknesses. Unconsolidated soil deposits overlay bedrock along the pipeline segment alignments and road crossings.

1. Surficial Deposits - Quaternary Alluvium (Qal): All unconsolidated soil deposits in the project area, regardless of depositional origin, are referred to as Quaternary Alluvium (Qal). Quaternary Alluvium (Qal) will be referred to as "soil" within these specification descriptions below. Soil units are derived from a variety of sources including: eolian deposition, alluvial deposition, sheet flow, and weathering and decomposition of in-place sandstone, claystone, shale, and siltstone bedrock. Soil materials near the highway and other roads may contain imported fill material and road base material. Soil ranges from Silty Sand (SM), to Clayey Sand (SC), to Lean Clay with Sand ((CL)s). For more detail, refer to specific geologic logs.

2. Bedrock - Menefee Formation (Kmf): The Upper Cretaceous Menefee Formation (Kmf) constitutes bedrock in the project area and consists of interbedded sandstone and claystone, with lesser amounts of shale, and siltstone. Claystone and sandstone are the two units observed in pertinent investigations as part of these specifications. The bedrock has a shallow dip toward the northeast.

a. The sandstone is fine- to medium-grained, light brown, gray and white in color. Sandstone encountered in drill holes and test pits is mostly characterized as intensely weathered to moderately weathered, soft to hard, and slightly fractured. Harder more competent zones of sandstone have been encountered within the project area and are classified as fresh (unweathered) and hard.

b. The claystone is sandy, light brown in color and is generally laminated to thinly bedded, generally ranging from decomposed to moderately weathered. Most claystone encountered within drill holes and test pits was characterized as intensely weathered, and ranged from soft to moderately soft. The claystone often grades to siltstone and occasionally becomes fissile, grading to shale. Portions of the claystone had high shrink/swell potential and will rapidly breakdown due to air and water slaking when exposed.

1) Twenty-two samples of claystone were sent to a laboratory for one-dimensional swell-consolidation tests. Claystone tested has a low to high expansion potential. Samples were collected using a Modified California Sampler. Additional samples of disturbed material from drill hole cuttings were tested for re-use as engineering fill for construction. Laboratory data is discussed in the technical memorandum cited above. Laboratory tests conducted on samples of claystone and bedrock samples may not represent expansion potential of all soil and bedrock materials that may be encountered during construction. Bedrock encountered

during excavation may have actual expansion conditions greater or less than estimated by the contractor from laboratory test data.

3. Expansive soils (sometimes referred to as swelling soils) are generally clay soils and soft bedrock that contain water –absorbing minerals. Expansive soils undergo a significant increase in volume when exposed to increased moisture.

C. Tohlakai Hill Pumping Plant Building Foundation and Site Geology:

1. On the south-side of the proposed pumping plant building soil was encountered at the ground surface and ranged in depth from 10.0 to 13.1 feet below the groundsurface (bgs). DHTH-13-1 and -6, and DHR12-2 and -3 encountered Silty Sand (SM) ranging from 7.7 to 13.1 feet bgs; DHR12-2 encountered Clayey Sand (SC) from 7.7 to 10.9 feet bgs. The top of claystone was encountered ranging from 10.0 to 13.1 feet bgs and claystone ranged from decomposed to moderately weathered and very soft to moderately soft. The claystone is an average of about 13 feet thick overlying sandstone. Intensely weathered, very soft to soft sandstone was encountered below the claystone in three of the four drill holes listed above.

2. Near the center of the proposed pumping plant building soil was encountered from 0.0 to 12.5 feet bgs in drill hole DHTH-13-7. This drill hole encountered Silty Sand (SM) from 0.0 to 5.1 feet, and Clayey Sand (SC) from 5.1 to 12.5 feet bgs. Claystone was encountered from 12.5 to 17.0 feet and sandstone from 17.0 to 20.0 feet bgs. Claystone encountered is intensely weathered and soft to moderately soft. Sandstone encountered is intensely weathered and soft.

3. On the north-side of the proposed pumping plant building soil was encountered at the ground surface and ranged in depth from 4.3 to 7.0 feet bgs. DHTH-13-5 encountered Clayey Sand (SC) from 0.0 to 7.0 feet bgs. DHTH-13-2 and DHR12-1 encountered Silty Sand (SM) from 0.0 to a depth of 5.0 and 4.3 feet bgs, respectively. Claystone was encountered below soil deposits in the three drill holes listed. Claystone encountered is mostly intensely weathered and soft to moderately soft, with some zones characterized as very intensely weathered. Underlying the claystone, the top of sandstone was encountered at depths ranging from 15.4 to 21.0 feet bgs. A harder more competent zone of sandstone was encountered from 11.4 to 12.8 feet bgs in drill hole DHR12-1, and is characterized as fresh (unweathered) and hard.

D. Proposed Storage Tanks Foundation and Site Geology:

1. Storage tank T1 is located on the northwest-side of the project area. Claystone was encountered at and near the ground surface during geologic surface mapping and within drill holes DHTH-13-8, DHR12-4, and DHR12-5. Soil is encountered near the north and east edges of the T1 tank footprint. Drill hole DHR12-4 encountered Silty Sand (SM) from 0.0 to 6.8 feet, claystone from 6.8 to 18.2 feet, and sandstone from 18.2 to 33.5 feet bgs. Near the center of the proposed tank T1, drill hole DHTH-13-8 encountered claystone from 0.0 to 8.0 feet, and sandstone from 8.0 to 20.4 feet bgs. Drill hole DHR12-5 located near the southern edge of the proposed tank T1 footprint encountered claystone from 0.0

to 30.6 feet bgs, with zones of sandstone at about 8.4 feet, from 13.7 to 14.9 feet, and at about 20.5 feet bgs. Claystone encountered is intensely weathered and soft to moderately soft, with a zone of decomposed claystone encountered in DHR12-5. Sandstone encountered in DHR12-4 from 18.2 to 33.5 is characterized as slight-to-moderately weathered and moderately soft to hard.

2. Storage tank T2 is the middle tank. Soil and claystone are encountered at the ground surface at the tank T2 footprint. Claystone is mapped at the groundsurface on the northwest-side of the tank footprint. Drill hole DHTH-13-10 was advanced near the center of the proposed tank T2 and encountered Silty Sand (SM) from 0.0 to 4.8 feet bgs. DHTH-13-10 encountered sandstone from 4.8 to 7.0 feet, claystone from 7.0 to 15.3, sandstone from 15.3 to 17.0 feet, and claystone from 17.0 to 25.4 feet bgs. On the south-side of tank T2 drill hole DHR12-6 encountered Silty Sand (SM) from 0.0 to 9.4 feet of Silty Sand (SM) overlying claystone and sandstone bedrock. Test pit TPR12-39 is located about 35 feet to the southwest of DHR12-6 and the test pit encountered claystone at 0.5 feet bgs. Claystone and sandstone encountered are characterized as intensely weathered and soft to moderately soft.

3. Storage tank T3 is located on the east-side of the project area. Claystone and a thin cover of soil overlying claystone are encountered along the ground surface at the footprint of tank T3. Drill hole DHTH-13-9 and test pit TPR12-40 were conducted near the center of the tank T3 footprint. Drill hole DHTH-13-9 encountered claystone from 0.0 to 2.0 feet, sandstone from 2.0 to 12.0 feet, and claystone from 12.0 to 20.4 feet bgs. Claystone encountered is intensely weathered and soft to moderately soft. Sandstone encountered is intensely weathered and soft. Test pit TPR12-40 encountered Silty Sand (SM) from 0.0 to 0.3 feet, and claystone from 0.3 to 4.5 feet bgs.

E. H.C. Concrete Wall Foundation and Site Geology:

1. Soil and claystone are encountered at the ground surface as shown on surface geologic mapping and subsurface investigations at the footprint of the H.C. Concrete Wall (retaining wall). The eastern portion of the retaining wall will cross the natural drainage, which will require surface water diversion and may require additional unwatering/dewatering efforts. Soil depths may be greater and bedrock may be weathered to a greater degree within and near the drainage. Drill hole DHTH-13-4 was advanced near the middle of the retaining wall and encountered intensely weathered and soft to moderately soft claystone from 0.0 to 9.0 feet bgs.

F. Chlorine Disinfection Building Foundation and Site Geology:

1. The Chlorine Disinfection Building footprint is coved by up to 16.5 feet of soil overlying claystone. Drill hole DHTH-13-3 was advanced near the center of the building footprint. DHTH-13-3 encountered Silty Sand (SM) from 0.0 to 10.0 feet, Clayey Sand (SC) from 10.0 to 16.5 feet, claystone from 16.5 to 20.8 feet, and sandstone from 20.8 to 21.7 feet bgs. Claystone encountered is intensely weathered and soft to moderately soft. Sandstone encountered is intensely

weathered and moderately soft. On the east-side of the building test pit TPR12-38 encountered soil from the ground surface to a total depth of 10.5 feet bgs. TPR12-38 encountered Silty Sand (SM) from 0.0 to 0.3 feet, Sandy Lean Clay (s(CL)) from 0.3 to 2.0 feet, and Clayey Sand (SC) from 2.0 to 10.5 feet bgs.

G. Twin Lakes Turnout Pipeline and Road Crossing Foundation and Site Geology:

1. Twin Lakes Turnout Pipeline alignment is about 1,800 feet in length (drawing 1695-D-198). The pipeline alignment exits at the middle of the west-side of the Tohlakai Hill project area. The pipeline alignment intersects a natural drainage between about 12+00 to 14+50, which will require diversion of surface water and may require additional unwatering/dewatering efforts. The pipeline alignment intersects the drainage ditch (near station 11+90) and drainage ditch outlet (about station 13+80 to 14+30); both are to be constructed in this specification and will require proper construction sequencing. The pipeline intersects the Tohlakai Hill access road (about station 18+80 to 19+40) to be constructed in this specification and will require proper construction sequencing. The road crossing of Highway 491 starts at about station 21+46 to 23+92. The pipeline alignment terminates at station 28+03.89.

2. Three tests pits were excavated to the left (east) of the pipeline alignment and subsurface geologic contacts will vary at the pipeline alignment. Test pit TPR12-37 encountered Silty Sand (SM) from 0.0 to 0.3 feet, Clayey Sand (SC) from 0.3 to 3.0 feet; Silty Sand (SM) from 3.0 to 5.0 feet; and intensely and moderately weathered, very soft to soft sandstone from 5.0 to 9.0 feet bgs. Test pit TPR12-44 encountered Clayey Sand (SC) from 0.0 to 0.5 feet; Lean Clay with Sand ((CL)s) from 0.5 to 1.5 feet; Clayey Sand (SC) from 1.5 to 10.0 feet; and intensely to moderately weathered, soft claystone from 10.0 to 11.0 feet bgs. Test pit TPR12-42 encountered Sandy Lean Clay s(CL) from 0.0 to 12.5 feet bgs.

3. Twin Lakes Turnout Road Crossing Foundation and Site Geology:

   a. Four investigations were conducted to investigate the Twin Lakes Turnout Road Crossing; one drill hole and one test pit were conducted on both the east- and west-sides of Highway 491. Investigations were conducted ranging from about 72 to 120 feet left of the road crossing alignment. Actual geologic contacts and top of bedrock depths may differ from descriptions reported in geologic logs. Geologic investigations were projected to the alignment and subsurface geologic contacts may differ from information provided below. Refer to drawing 1695-D-202 and 1695-D-198, and geologic logs for more detail.

   b. On the east-side of Highway 491, drill hole SPT12.1-1 and test pit TPR12.1-1 were completed. SPT12.1-1 encountered Sandy Lean Clay (s(CL)) from 0.0 to 7.1 feet, and then bedrock from 7.1 feet to a total depth of 33.0 feet. Bedrock encountered within SPT12.1-1 include: light brown, fine- to medium-grained, intensely to moderately weathered, soft sandstone from 7.1 to 16.2 feet; tan to dark brown, intensely weathered, soft claystone (with thin interbeds of sandstone) from 16.2 to 18.0 feet; sandstone from 18.0 to 20.0 feet; and slightly weathered, soft claystone

from 20.0 to 33.0 feet. Only one of two standard penetration test (SPT) depth intervals was conducted within soil. Blows recorded per 6-inch-depth intervals were 10 blows from 4.5 to 5.0 feet and 14 blows from 5.0 to 5.5 feet. The test portion of second SPT depth interval was within sandstone. TPR12.1-1 encountered Silty Sand (SM) from 0.0 to 1.3 feet, and Clayey Sand (SC) from 1.3 to 12.5 feet.

c. On the west-side of the Highway 491, drill hole SPT12.1-2 and test pit TPR12.1-2 were completed. SPT12.1-2 encountered only soil, with no classification given for material from 0.0 to 4.0 feet, Silty Sand (SM) from 4.0 to 11.5 feet, Sandy Lean Clay (s(CL)) from 11.5 to 14.7 feet, Clayey Sand (SC) from 14.7 to 22.7 feet, Lean Clay with Sand ((CL)s) from 22.7 to 24.0 feet, and Clayey Sand (SC) from 24.0 feet to the total depth of 30.5 feet. Eleven SPT depth intervals were conducted and twenty-two 6-inch-depth intervals had an average of 9 blows per 6-inches, and ranged between 6 to 11 blows per 6-inches. TPR12.1-2 encountered Lean Clay (CL), and Sandy Lean Clay (s(CL)) to a total depth of 12.0 feet.

H. Reach 12.1 Pipeline Alignment and Road Crossing Foundation and Site Geology:

1. Reach 12.1 Pipeline alignment is about 1,041 feet in length (drawing 1695-D-310). The pipeline alignment exits at the south-side of the Tohlakai Hill project area. The pipeline alignment intersects a drainage ditch (near station 121010+58) to be constructed in this specification. The pipeline intersects the Tohlakai Hill access road to be constructed in this specification twice; between about stations 121010+70 to 121011+25, and between stations 121014+50 to 121015+30. The road crossing of Highway 491 is located between about station 121017+80 to 121020+25. The pipeline alignment terminates at station 121020+80.

2. Drill hole DHR12-3 is located about 45 feet north of the start of the Reach 12.1 pipeline alignment (station 121010+39). DHR12-3 encountered Silty Sand (SM) from 0.0 to 13.1 feet and then bedrock to the total depth of 33.9 feet. Olive gray to dark gray claystone with interbeds of sandstone were encountered from 13.1 to 23.5 feet bgs. Decomposed and very soft claystone was encountered from 13.1 to 17.3 feet and moderately weathered and moderately soft claystone was encountered from 17.3 to 23.5 feet bgs. Light gray, fine- to medium-grained, intensely weathered and moderately soft sandstone was encountered from 23.5 to 33.9 feet bgs.

3. No subsurface geologic investigations were conducted between the start of the Reach 12.1 pipeline alignment (station 121010+39) and drill hole SPT12.1-1 advanced near station 121016+85. Soil is encountered along the groundsurface between the stations discussed above.

4. Drill hole SPT12.1-1 is located about 22 feet left (south) of the Reach 12.1 pipeline alignment, near about station 121016+85. SPT12.1-1 encountered Sandy Lean Clay (s(CL)) from 0.0 to 7.1 feet, and then bedrock from 7.1 feet to a total depth of 33.0 feet. Bedrock encountered within SPT12.1-1 include: light brown, fine- to medium-grained, intensely to moderately weathered, soft sandstone from 7.1 to 16.2 feet; tan to dark brown, intensely weathered, soft claystone (with thin

interbeds of sandstone) from 16.2 to 18.0 feet; sandstone from 18.0 to 20.0 feet; and slightly weathered, soft claystone from 20.0 to 33.0 feet. Only one of two standard penetration test (SPT) depth intervals was conducted within soil.

5. Reach 12.1 Road Crossing Foundation and Site Geology:

   a. The Reach 12.1 Road Crossing is located in closer proximity to the four geologic investigations relative to the Twin Lakes Turnout Road Crossing. The Reach 12.1 Road Crossing is located about 50 feet from the Twin Lakes Turnout Road Crossing. Refer to geologic information, drawings and logs described in the Twin Lakes Turnout Road Crossing Foundation and Site Geology section above. Investigations were conducted ranging from about 22 to 42 feet from the road crossing alignment. Actual geologic contacts and top of bedrock depths may differ from descriptions reported in geologic logs.

I. Reach 12B Pipeline Alignment Foundation and Site Geology:

1. Reach 12B Pipeline alignment is about 640 feet in length (drawing 1695-D-309). The pipeline alignment exits at the south-side of the Tohlakai Hill project area. The pipeline alignment intersects a drainage ditch (near station 12510+35) to be constructed in this specification. The pipeline intersects the Tohlakai Hill access road to be constructed in this specification twice; between about stations 12510+40 to 12511+50, and between stations 12513+60 to 12514+80. The pipeline alignment terminates at station 12516+40.

2. Reach 12B Pipeline alignment is parallel to the Reach 12.1 Pipeline alignment and is located a distance of about 25 feet to the left (southeast)(slightly higher in elevation). Refer to geologic information, drawings and logs described in the Reach 12.1 Pipeline Alignment and Road Crossing Foundation and Site Geology section above.

J. Groundwater Occurrence: Groundwater was not encountered in any investigations at the Tohlakai Hill project area at the time investigations were conducted. The water-level data show the conditions at the particular time or times the information was obtained and may not indicate variations such as those caused by periods of drought, increased rainfall, seasonal fluctuations in precipitation, or application of irrigation water.

1.06 GEOTECHNICAL CONSIDERATIONS

A. Temporary and Permanent Cut Slopes and Slope Stability: All cut slopes shall be constructed in accordance with the Reclamation Safety and Health Standards and OSHA standards. Recommendations are for dry or adequately drained materials. These recommendations are for all slopes with a vertical height less than twenty feet. Slopes with a vertical height greater than twenty feet should be designed by a registered professional engineer in accordance with the Reclamation Safety and Health Standards and OSHA standards. Materials with excessive moisture will require further flattening for stability or other slope stability measures.

1. Temporary slopes excavated in Fill and soil shall conform to OSHA slope requirements.
2. Temporary slopes excavated in decomposed to intensely weathered bedrock, as determined by the Contracting Officer Representative, shall be 1.5H:1V or flatter.
3. Temporary slopes excavated in moderately weathered to fresh bedrock, as determined by the Contracting Officer Representative, shall be 1H:1V or flatter.
4. Permanent cut slopes excavated in Fill and soil, and in bedrock shall be 2H:1V or flatter.

B. Excavation Considerations:

1. Soil can be excavated using common excavation methods.
2. Decomposed to moderately weathered claystone and decomposed to intensely weathered sandstone can be excavated using common methods. Less weathered claystone and sandstone layers may require rock excavation techniques.
3. Local, hard, moderately or less weathered zones and cemented zones may be encountered within decomposed and weathered bedrock. These zones are likely to require rock excavation. Excavation of these zones may generate large blocks that may have to be reduced to a manageable size by hydraulic hoe-ram, mechanical splitting, or other non-explosive methods.
4. Excavation of bedrock in confined areas with limited access for ripping with a bull dozer and single ripper shank may require rock excavation methods (such as excavation with a hydraulic hoe ram).

C. Constructability Considerations:

1. Use of Clayey Soils and Claystone for Construction Material: The reuse of clayey soil and claystone bedrock excavated for Tohlakai Hill project features is specified within the Earthwork Sections Division 31 of this Specification. Clayey soil and claystone materials with moisture contents in excess of proscribed limits may be difficult to achieve material compaction requirements. Clayey soils and excavated claystone is susceptible to swelling and shrinking and will require proper protection from rain and surface water; and application of water for construction purposes.
2. Excavated Clayey Soil and Claystone Slopes and Foundations: Excavated temporary and permanent slopes exposing clayey soil and claystone bedrock are susceptible to increased rates of erosion and strength loss related to slopes for project features and access roads, and to support equipment travel. Clayey soils and claystone that form slopes, excavated surfaces for material placement, and access roads may become muddy and excessively slick with rain, surface run-off, or water applied for construction.

1.07 GROUNDWATER AND SURFACE WATER OCCURRENCE

A. Groundwater: The water-level data show the conditions at the particular time or times the information was obtained and may not indicate variations such as those caused by periods of drought, increased rainfall, seasonal fluctuations in rainfall, or application of irrigation water.

1. Groundwater was not encountered within the drill hole and test pit investigations within the Tohlakai Hill project area.

B. Surface Water: Diversion and care of surface water and run off will be required during construction. Natural drainage currently enters near the center of the project area on the east-side between the proposed pumping plant building and storage tanks. Drainage currently exits the project area on the south and southwest-side of the project area. The Twin Lakes Turnout pipeline alignment intersects the natural drainage at about station 12+00 to 14+50, which will require diversion of surface water and may require additional unwatering/dewatering. The pipeline alignment also intersects the designed drainage ditch around the perimeter and a designed drainage outlet for Tohlakai Hill project, which will require diversion of surface water and proper sequencing during the construction of the pipeline and Tohlakai Hill Pumping Plant project features.

END OF SECTION

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SECTION 53 20 00

RECORDS OF GEOLOGIC AND SUBSURFACE INVESTIGATIONS

PART 1 GENERAL

1.01 LIST OF DRAWINGS

G1.	103-D-347	Unified Soil Classification
G2.	40-D-6493	Standard Descriptors and Descriptive Criteria for Rock
G3.	40-D-6499	Standard Descriptors and Descriptive Criteria for Discontinuities
G4.	1695-529-513	San Juan Lateral – Reach 12 - General Geologic Legend Explanation and Notes
G5.	1695- 529-511	San Juan Lateral – Tohlakai Hill Pumping Plant - Location of Exploration and Surface Geology
G6.	1695-529-514	San Juan Lateral – Tohlakai Hill Pumping Plant – Geologic Section AA- AA' and B-B'
G7.	1695-529-716	San Juan Lateral - Tohlakai Hill Pumping Plant – Geologic Section C-C'
•	1695-D-198	*Refer to Specification Section 52 00 00 – Drawings:* Reach 11 Twin Lakes Turnout – Plan and Profile
•	1695-D-202	*Refer to Specification Section 52 00 00 – Drawings:* Highway 491 Bore Crossings
•	1695-D-309	*Refer to Specification Section 52 00 00 – Drawings:* Reach 12B Pipeline – Plan and Profile
•	1695-D-310	*Refer to Specification Section 52 00 00 – Drawings:* Reach 12.1 Pipeline – Plan and Profile

1.02 DRILL HOLE LOGS

G8. DHR12-1
G9. DHR12-2
G10. DHR12-3
G11. DHR12-4
G12. DHR12-5
G13. DHR12-6
G14. DHR12-7
G15. DHTH-13-1
G16. DHTH-13-2
G17. DHTH-13-3
G18. DHTH-13-4
G19. DHTH-13-5
G20. DHTH-13-6
G21. DHTH-13-7

G22. DHTH-13-8
G23. DHTH-13-9
G24. DHTH-13-10
G25. SPT12.1-1
G26. SPT12.1-2

1.03 TEST PITS LOGS

G27. TPR12-19
G28. TPR12-37 Sheet 1 of 2
G29. TPR12-37 Sheet 2 of 2
G30. TPR12-38
G31. TPR12-39
G32. TPR12-40
G33. TPR12-42
G34. TPR12-44 Sheet 1 of 1
G35. TPR12-44 Sheet 2 of 2
G36. TPR12.1-1
G37. TPR12.1-2

1.04 SUMMARY OF PHYSICAL PROPERTIES TEST RESULTS

G38. Summary of Physical Properties Test Results (DHTH-13-1)
G39. Summary of Physical Properties Test Results (Reach 12.1 - SPT12.1-1 and -2)
G40. Summary of Physical Properties Test Results (Reach 12 - TPR12-19)
G41. Summary of Physical Properties Test Results (Reach 11/12 Tank and Pumping Plant – TPR12-37 through -44)
G42. Summary of Physical Properties Test Results (Reach 12.1 - TPR12.1-1 and -2)

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION