SECTION 01111 - 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.” Promptly inform the CO of discrepancies discovered on the drawings. The CO will make a determination in writing. Any adjustment by the Contractor without such a determination shall be at its own risk and expense.

1.02 PROJECT CONDITIONS

A. Where there are minor 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 SPECIFICATIONS DRAWINGS

A. Electronic copies of the following drawings are available to offerors upon request, in AutoCAD DWG (.dwg) format.

1. 423-D-631, 423-300-3001, 423-D-642, 423-D-644, 423-D-651, 423-D-659, 423-D-664, 423-D-742, 423-D-667, 423-D-632, 423-D-633, 423-D-698, 423-D-635, 423-D-741, 423-D-694, and **423-D-695**.
2. To receive electronic copies of drawings, submit request to COR in writing.
3. Reference drawings and informational drawings are available in Adobe® PDF (.pdf) format.

B. Additional electronic drawings (AutoCAD Format Release 2004) for as built purposes will be made available to the Contractor upon written request and approval by the COR.

C. AutoCad version of standard drawings is not available.

1.04 INFORMATIONAL DRAWINGS

A. Some drawings are marked "for information only" in the drawing list and are included to show some feature about which additional knowledge may be required for the proposal.

B. If there are differences as determined by the CO between details and dimensions shown on these drawings and those of existing features at jobsite, use details and dimensions of existing features at jobsite.

1.05 COPIES OF DRAWINGS

A. Five sets of full-size (22- by 34-inches) drawings, except standard drawings, will be furnished to the Contractor for construction purposes.

B. Upon request, five additional half-size (11- by 17-inches) copies of standard drawings will be furnished to the Contractor for construction purposes.

1.06 LIST OF DRAWINGS

A. Drawings listed in Table 01111A - List of Drawings, are made a part of these specifications.

1.07 DRAWING NUMBERS IN NUMERICAL ORDER

A. Specification drawings are listed in numerical order in Table 01111B - Drawings in Numerical Order.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

Table 01111A - List of Drawings

Sheet No.	Drawing No.	Title
General:		
1	423-D-639	Location Map
2	423-D-640	General Notes
3	423-D-807	Summary Logic Diagram – Sheet 1 of 2
4	423-D-808	Summary Logic Diagram – Sheet 2 of 2
5	423-D-629	Materials Distribution Diagram – Sheet 1 of 1
6	423-D-630	Mass Haul Diagram for Drop 2 Inlet Canal – Sheet 1 of 3
7	423-D-833	Mass Haul Diagram for Drop 2 Inlet Canal – Sheet 2 of 3

Table 01111A - List of Drawings

Sheet No.	Drawing No.	Title
8	423-D-834	Mass Haul Diagram for Drop 2 Inlet Canal – Sheet 3 of 3
9	423-D-631	Reservoir - General Plan – Sheet 1 of 1
Civil Site Construction:		
10	423-D-643	Drop 2 Inlet Canal – Right of Way – Data Table
11	423-D-642	Drop 2 Inlet Canal, Reservoir, Siphon, and Outlet Canal – General Plan – Sheet 1 of 16
12	423-D-644	Drop 2 Inlet Canal – Station 4+11.42 to Station 23+00 – Plan and Profile – Sheet 2 of 16
13	423-D-645	Drop 2 Inlet Canal – Station 23+00 to Station 47+00 – Plan and Profile – Sheet 3 of 16
14	423-D-746	Drop 2 Inlet Canal – Station 47+00 to Station 71+00 – Plan and Profile – Sheet 4 of 16
15	423-D-747	Drop 2 Inlet Canal – Station 71+00 to Station 95+00 – Plan and Profile – Sheet 5 of 16
16	423-D-648	Drop 2 Inlet Canal – Station 95+00 to Station 119+00 – Plan and Profile – Sheet 6 of 16
17	423-D-649	Drop 2 Inlet Canal – Station 119+00 to Station 143+00 – Plan and Profile – Sheet 7 of 16
18	423-D-650	Drop 2 Inlet Canal – Station 143+00 to Station 167+00 – Plan and Profile – Sheet 8 of 16
19	423-D-651	Drop 2 Inlet Canal – Station 167+00 to Station 191+00 – Plan and Profile – Sheet 9 of 16
20	423-D-652	Drop 2 Inlet Canal – Station 191+00 to Station 215+00 – Plan and Profile – Sheet 10 of 16
21	423-D-653	Drop 2 Inlet Canal – Station 215+00 to Station 239+00 – Plan and Profile – Sheet 11 of 16
22	423-D-654	Drop 2 Inlet Canal – Station 239+00 to Station 263+00 – Plan and Profile – Sheet 12 of 16

Table 01111A - List of Drawings

Sheet No.	Drawing No.	Title
23	423-D-655	Drop 2 Inlet Canal – Station 263+00 to Station 287+00 – Plan and Profile – Sheet 13 of 16
24	423-D-656	Drop 2 Inlet Canal – Station 287+00 to Station 311+00 – Plan and Profile – Sheet 14 of 16
25	423-D-657	Drop 2 Inlet Canal – Station 311+00 to Station 335+00 – Plan and Profile – Sheet 15 of 16
26	423-D-658	Drop 2 Inlet Canal – Station 335+00 to Station 354+75.76 – Plan and Profile – Sheet 16 of 16
27	423-D-659	Drop 2 Outlet Canal – Station 22+47.12 to Station 31+51 – Plan and Profile – Sheet 1 of 1
28	423-D-660	Typical Canal Sections – Sections and Details – Sheet 1 of 1
29	423-D-661	Canal Wasteway – Plan and Section – Sheet 1 of 3
30	423-D-662	Canal Wasteway - Sections and Detail – Sheet 2 of 3
31	423-D-832	Canal Wasteway – Section and Details – Sheet 3 of 3
32	423-D-731	Canal Lining Joints – Details – Sheet 1 of 1
33	423-D-641	Safety Cable – Plan, Section and Details – Sheet 1 of 1
34	423-D-632	Reservoir – General Excavation Plan – Sheet 1 of 1
35	423-D-633	Reservoir - Forebay/Afterbay and Canal Area – Detailed Excavation Plan – Sheet 1 of 1
36	423-D-828	Reservoir and Forebay/Afterbay Excavation – Typical Cross Section – Sheet 1 of 1
37	423-D-634	Reservoir – Southeast Embankment Plan – Sheet 1 of 1
38	423-D-635	Reservoir – Inlet/Outlet Area – Detailed Plan – Sheet 1 of 1
39	423-D-636	Reservoir – Inlet/Outlet Area – Sections – Sheet 1 of 1
40	423-D-637	Reservoir – Inlet/Outlet Area – Details – Sheet 1 of 1

Table 01111A - List of Drawings

Sheet No.	Drawing No.	Title
41	423-D-638	Reservoir – Embankment – Typical Cross Sections – Sheet 1 of 1
42	423-D-754	Reservoir – Embankment – Typical Interior Slope Details – Sheet 1 of 1
43	423-D-756	Wasteway at Reservoir Station C 25+00 – Plan and Sections - Sheet 1 of 1
44	423-D-757	Wasteway at Reservoir Station E 95+00 – Plan and Sections - Sheet 1 of 1
45	423-D-778	Access Ramp at Reservoir Station C 6+00 – Plan and Sections – Sheet 1 of 1
46	423-D-779	Access Ramp at Reservoir Station E 145+00 – Plan and Sections – Sheet 1 of 1
47	423-D-780	Access Ramp at Reservoir Station E 164+24 – Plan and Sections – Sheet 1 of 1
48	423-D-694	Forebay/Afterbay, Pipe Crossing and Outlet Canal – General Plan – Sheet 1 of 1
49	423-D-698	Forebay/Afterbay – General Plan and Section – Sheet 1 of 1
50	423-D-755	Forebay/Afterbay – Typical Embankment Sections and Geomembrane Anchor Detail – Sheet 1 of 1
51	423-D-689	County Road Relocation – Station 500+00 to Station 524+50 – Plan, Profile, and Sections – Sheet 1 of 4
52	423-D-690	County Road Relocation – Station 524+50 to Station 547+50 – Plan and Profile – Sheet 2 of 4
53	423-D-691	County Road Relocation – Station 547+50 to Station 560+90 - Plan and Profile – Sheet 3 of 4
54	423-D-741	County Road Relocation – O&M Access Road – Plan, Profiles, Sections, Detail – Sheet 4 of 4
55	423-D-737	Access Road to Powerplant – Plan and Profile – Sheet 1 of 2

Table 01111A - List of Drawings

Sheet No.	Drawing No.	Title
56	423-D-738	Access Road to Powerplant – Sections and CALTRANS References – Sheet 2 of 2
57	423-300-3001	Interstate 8 Detour – Plan View – Sheet 1 of 9
58	423-300-3004	Interstate 8 Detour – Plan and Profile – Alignment A – Sta. 9+37.25 to 24+50.74 – Sheet 2 of 9
59	423-300-3005	Interstate 8 Detour – Plan and Profile – Alignment B – Sta. 10+00 to 25+00 – Sheet 3 of 9
60	423-300-3006	Interstate 8 Detour – Plan and Profile – Alignment B – Sta. 25+00 to 40+00 – Sheet 4 of 9
61	423-300-3007	Interstate 8 Detour – Plan and Profile – Alignment B – Sta. 40+00 to 54+00 – Sheet 5 of 9
62	423-300-3008	Interstate 8 Detour – Plan and Profile – Alignment B – Sta. 54+00 to 69+71.07 – Sheet 6 of 9
63	423-300-3009	Interstate 8 Detour – Plan and Profile – Alignment C – Sta. 53+67.57 to 64+41.89 – Sheet 7 of 9
64	423-300-3002	Interstate 8 Detour – Pavement Details – Sheet 8 of 9
65	423-300-3003	Interstate 8 Detour – Pavement Details – Sheet 9 of 9
66	423-D-831	9-Foot Diameter Steel Pipe Installation – Plan – Sheet 1 of 4
67	423-D-695	9-foot Diameter Steel Pipe Installation – Profile, Trench, and Detail – Sheet 2 of 4
68	423-D-696	9-Foot Diameter Steel Pipe Installation – Trench Profile, Section, and Fitting Details – Sheet 3 of 4
69	423-D-697	9-Foot Diameter Steel Pipe Installation – Trench Profile, Section, and Fitting Details – Sheet 4 of 4
70	423-D-663	Existing Coachella Canal Turnout Modification 3D Isometric – Sheet 1 of 1
71	423-D-664	Existing Coachella Canal Turnout Modification – General Plan – Sheet 1 of 1

Table 01111A - List of Drawings

Sheet No.	Drawing No.	Title
72	423-D-666	Existing Coachella Canal Turnout Modification – Construction Sequencing – Sheet 1 of 1
72A	**423-D-829**	**Temporary Sheet Pile – Details – Sheet 1 of 1**
73	423-D-665	Existing Coachella Canal Turnout Modification – Demolition Plan – Plan, Sections and Detail – Sheet 1 of 1
74	423-D-742	Existing Coachella Canal Turning Modification – Temporary Bypass Plan – Sheet 1 of 3
75	423-D-743	Existing Coachella Canal Turnout Modification – Temporary Bypass Profile – Sheet 2 of 3
76	423-D-744	Existing Coachella Canal Turnout Modification – Temporary Bypass – Sections – Sheet 3 of 3
77	423-D-667	Existing Coachella Canal Turnout Modification – Earthwork – Plan – Sheet 1 of 5
78	423-D-668	Existing Coachella Canal Turnout Modification – Earthwork – Sections – Sheet 2 of 5
79	423-D-669	Existing Coachella Canal Turnout Modification – Earthwork – Sections – Sheet 3 of 5
80	423-D-670	Existing Coachella Canal Turnout Modification – Earthwork – Sections – Sheet 4 of 5
81	423-D-671	Existing Coachella Canal Turnout Modification – Earthwork – Sections – Sheet 5 of 5
82	423-D-732	Existing Coachella Canal Turnout Modification – Final Grade, Access and Fencing – Sheet 1 of 1
83	423-D-733	Existing Coachella Canal Turnout Modification – Turnout Abandonment – Plan, Section and Detail – Sheet 1 of 1
84	423-D-672	Existing Coachella Canal Turnout Modification – Concrete and Reinforcement Outlines – General Plan – Sheet 1 of 1

Table 01111A - List of Drawings

Sheet No.	Drawing No.	Title
85	423-D-673	Existing Coachella Canal Turnout Modification – Concrete and Reinforcement Outlines – Combined Flumes – Plan – Sheet 1 of 9
86	423-D-674	Existing Coachella Canal Turnout Modification – Concrete and Reinforcement Outlines - Combined Flumes – Section – Sheet 2 of 9
87	423-D-675	Existing Coachella Canal Turnout Modification – Concrete and Reinforcement Outlines – Combined Flumes – Section – Sheet 3 of 9
88	423-D-676	Existing Coachella Canal Turnout Modification – Concrete and Reinforcement Outlines – Combined Flumes – Sections – Sheet 4 of 9
89	423-D-677	Existing Coachella Canal Turnout Modification – Concrete and Reinforcement Outlines – Combined Flumes – Sections – Sheet 5 of 9
90	423-D-678	Existing Coachella Canal Turnout Modification – Concrete and Reinforcement Outlines – Combined Flumes – Sections – Sheet 6 of 9
91	423-D-679	Existing Coachella Canal Turnout Modification – Concrete and Reinforcement Outlines - Combined Flumes – Sections – Sheet 7 of 9
92	423-D-680	Existing Coachella Canal Turnout Modification – Concrete and Reinforcement Outlines – Combined Flumes – Section and Details – Sheet 8 of 9
93	423-D-681	Existing Coachella Canal Turnout Modification – Concrete and Reinforcement Outlines - Combined Flumes – Sections and Detail – Sheet 9 of 9
94	423-D-682	Existing Coachella Canal Turnout Modification – Drop 2 Inlet Canal Transition – Concrete and Reinforcement Outlines – Plan – Sheet 1 of 5

Table 01111A - List of Drawings

Sheet No.	Drawing No.	Title
95	423-D-683	Existing Coachella Canal Turnout Modification – Drop 2 Inlet Canal Transition – Concrete and Reinforcement Outline – Sections – Sheet 2 of 5
96	423-D-684	Existing Coachella Canal Turnout Modification – Drop 2 Inlet Canal Transition – Concrete and Reinforcement Outline – Sections – Sheet 3 of 5
97	423-D-685	Existing Coachella Canal Turnout Modification – Drop 2 Inlet Canal Transition – Concrete and Reinforcement Outline – Sections – Sheet 4 of 5
98	423-D-686	Existing Coachella Canal Turnout Modification – Drop 2 Inlet Canal Transition – Concrete and Reinforcement Outlines – Section – Sheet 5 of 5
99	423-D-687	Existing Coachella Canal Turnout Modification – Coachella Flume and Transition – Concrete and Reinforcement Outlines – Plan and Detail – Sheet 1 of 6
100	423-D-688	Existing Coachella Canal Turnout Modification – Coachella Flume and Transition – Concrete and Reinforcement Outlines – Section – Sheet 2 of 6
101	423-D-725	Existing Coachella Canal Turnout Modification – Coachella Flume and Transition – Concrete and Reinforcement Outlines – Sections – Sheet 3 of 6
102	423-D-726	Existing Coachella Canal Turnout Modification – Coachella Flume and Transition – Concrete and Reinforcement Outlines – Sections – Sheet 4 of 6
103	423-D-727	Existing Coachella Canal Turnout Modification – Coachella Flume and Transition – Concrete and Reinforcement Outlines – Sections – Sheet 5 of 6
104	423-D-728	Existing Coachella Canal Turnout Modification – Coachella Flume and Transition – Concrete and Reinforcement Outlines – Section – Sheet 6 of 6
105	423-D-729	Existing Coachella Canal Turnout Modification – Coachella Canal Lining Repair – Plan and Section – Sheet 1 of 2

Table 01111A - List of Drawings

Sheet No.	Drawing No.	Title
106	423-D-730	Existing Coachella Canal Turnout Modification – Coachella Canal Lining Repair – Sections – Sheet 2 of 2
107	423-D-692	County Road Trapezoidal Crossing – General Plan, Profile, and Section – Sheet 1 of 5
108	423-D-693	County Road Trapezoidal Crossing – Concrete Outline – Plan, Sections, and Details – Sheet 2 of 5
109	423-D-734	County Road Trapezoidal Crossing – Concrete Outline – Sections and Details – Sheet 3 of 5
110	423-D-735	County Road Trapezoidal Crossing – Structure Reinforcement – Plan, Section, and Details – Sheet 4 of 5
111	423-D-736	County Road Trapezoidal Crossing – Structure Reinforcement – Sections and Detail – Sheet 5 of 5
112	423-D-720	Transition/Trashrack/Gate Structure – Earthwork Plan – Sheet 1 of 4
113	423-D-721	Transition/Trashrack/Gate Structure – Trashrack and Bridge Deck – Earthwork Sections – Sheet 2 of 4
114	423-D-722	Transition/Gate Structure – Trashrack/Bridge Deck – Earthwork Sections – Sheet 3 of 4
115	423-D-723	Transition/Trashrack/Gate Structure – Trashrack and Bridge Deck – Earthwork Section – Sheet 4 of 4
116	423-D-709	Transition/Trashrack/Gate Structure – Transition – Plan – Sheet 1 of 10
117	423-D-710	Transition/Trashrack/Gate Structure – Transition – Section – Sheet 2 of 10
118	423-D-711	Transition/Trashrack/Gate Structure – Transition – Section – Sheet 3 of 10
119	423-D-712	Transition/Trashrack/Gate Structure – Trashrack and Bridge Deck – Plan – Sheet 4 of 10

Table 01111A - List of Drawings

Sheet No.	Drawing No.	Title
120	423-D-713	Transition/Trashrack/Gate Structure – Trashrack and Bridge Deck – Section – Sheet 5 of 10
121	423-D-714	Transition/Trashrack/Gate Structure – Trashrack and Bridge Deck – Sections – Sheet 6 of 10
122	423-D-715	Transition/Trashrack/Gate Structure – Gate Structure – Plan – Sheet 7 of 10
123	423-D-716	Transition/Trashrack/Gate Structure – Gate Structure – Plan and Section – Sheet 8 of 10
124	423-D-717	Transition/Trashrack/Gate Structure – Gate Structure – Sections – Sheet 9 of 10
125	423-D-718	Transition/Trashrack/Gate Structure – Gate Structure – Sections and Details – Sheet 10 of 10
126	423-D-719	Transition/Trashrack/Gate Structure – Sponge Rubber Filler – Sheet 1 of 1
127	423-D-703	Inlet/Outlet Structure – Typical Earthwork Sections – Sheet 1 of 1
128	423-D-699	Inlet/Outlet Structure – Partial Plan – Sheet 1 of 4
129	423-D-700	Inlet/Outlet Structure – Partial Plan and Details – Sheet 2 of 4
130	423-D-701	Inlet/Outlet Structure – Sections and Detail – Sheet 3 of 4
131	423-D-702	Inlet/Outlet Structure – Sections – Sheet 4 of 4
132	423-D-708	Pipe Inlet Structure Earthwork – Earthwork Plan and Sections – Sheet 1 of 1
133	423-D-704	Pipe Inlet Structure – Plan, Section and Details – Sheet 1 of 4
134	423-D-739	Pipe Inlet Structure – Sections – Sheet 2 of 4
135	423-D-740	Pipe Inlet Structure Earthwork – Plan and Sections – Sheet 3 of 4

Table 01111A - List of Drawings

Sheet No.	Drawing No.	Title
136	423-D-745	Pipe Inlet Structure – Sections – Sheet 4 of 4
137	423-D-705	Pipe Outlet Transition – Site and Earthwork Plan – Sections and Details – Sheet 1 of 3
138	423-D-706	Pipe Outlet Transition – Concrete Outline and Reinforcement – Plan and Section – Sheet 2 of 3
139	423-D-707	Pipe Outlet Transition – Concrete Outline and Reinforcement – Sections – Sheet 3 of 3
140	423-D-774	Concrete Foundations – Electrical Equipment and Water Level Sensor – Plans and Sections – Sheet 1 of 1
Architectural:		
141	423-D-809	Control Building – Floor Plan – Sheet 1 of1
142	423-D-810	Control Building – Roof Plan – Sheet 1 of 1
143	423-D-811	Control Building – Elevations – Sheet 1 of 1
144	423-D-812	Control Building – Floor Plan – Sheet 1 of 1
145	423-D-813	Control Building – Roof Details – Sheet 1 of 1
146	423-D-814	Control Building – Door and Louver Schedule, and Details – Sheet 1 of 1
147	423-D-815	Control Building – Concrete Outline and Reinforcement Design – Plans, Sections and Detail – Sheet 1 of 1
148	423-D-816	Control Building – Masonry Design – Plan – El. 162.00 and Details – Sheet 1 of 1
149	423-D-817	Control Building – Masonry Design – Sections – Sheet 1 of 1
Metalwork:		
150	423-D-764	Inlet/Outlet Structure – Miscellaneous Metalwork – Grated Walkways – Plan and Section – Sheet 1 of 1

Table 01111A - List of Drawings

Sheet No.	Drawing No.	Title
151	423-D-765	Trashrack Structure – Miscellaneous Metalwork – Grated Walkways – Plan and Section – Sheet 1 of 1
152	423-D-766	**Pipe** Inlet Structure – Miscellaneous Metalwork – Grated Walkways – Plan and Section – Sheet 1 of 1
153	423-D-767	**Pipe** Inlet Structure – Miscellaneous Metalwork – Top Mounted Pipe Guardrail – Sheet 1 of 1
154	423-D-768	Coachella Turnout – Miscellaneous Metalwork – W-Beam Guardrail - Plan and Sections – Sheet 1 of 1
155	423-D-769	Coachella Turnout – Miscellaneous Metalwork – Frame and Grate – Plan, Sections, and Details – Sheet 1 of 1
156	423-D-770	Various Structures – Miscellaneous Metalwork – Pipe Guardrail and Section – Sheet 1 of 1
157	423-D-771	Stoplog Storage Facility and Debris Pad – Miscellaneous Metalwork – Plan, Sections, and Detail – Sheet 1 of 1
158	423-D-772	Water Level Sensor Mounting Pole – Miscellaneous Metalwork – elevation, Sections and Details – Sheet 1 of 1
159	423-D-773	Miscellaneous Metalwork – Control Building – Tubular Frames, Grill Frames, and Guard Posts – Sheet 1 of 1
160	423-D-775	Electrical Equipment Support – Miscellaneous Metalwork – Elevation, Sections and Views – Sheet 1 of 1
161	423-D-788	Transition/Trashrack/Gate Structure – Trashrack - Plan and Sections – Sheet 1 of 1
Equipment:		
162	423-D-571	Inlet/Outlet Structure No. 1, No. 2, and Transition/Trashrack/Gate Structure – 120” by 120” Slide Gate – Installation – Sheet 1 of 1
163	423-D-572	Siphon Inlet Structure – 120” by 84” Slide Gate – Installation – Sheet 1 of 1

Table 01111A - List of Drawings

Sheet No.	Drawing No.	Title
164	423-D-792	Stoplog Seats and Guides – Plans – Installation - Assemblies – Sheet 1 of 2
165	423-D-793	Stoplog Seats and Guides – Sections and Details – Sheet 2 of 2
166	423-D-789	Reservoir Stoplogs – Installation, Assembly, and Details – Sheet 1 of 3
167	423-D-790	Reservoir Stoplogs – Sections and Details – Sheet 2 of 3
168	423-D-791	Reservoir Stoplogs – Parts – Sections- Details – Sheet 3 of 3
169	423-D-799	Stoplog Seats and Guides – Plan – Assembly – Sections – Details – Sheet 1 of 1
170	423-D-796	Coachella Turnout Stoplogs – Installation, Assembly, and Details – Sheet 1 of 3
171	423-D-797	Coachella Turnout Stoplogs – Sections and Details – Sheet 2 of 3
172	423-D-798	Existing Coachella Canal Turnout Modification – Coachella Turnout Stoplogs – Parts – Sections – Details – Sheet 3 of 3
173	423-D-794	Reservoir Stoplog Lifting Beam – Installation and Assembly – Sheet 1 of 2
174	423-D-801	Turnout Stoplog Lifting Beam – Installation and Assembly – Sheet 1 of 2
175	423-D-795	Stoplog Seats and Guides – Hooks – Sheet 1 of 1
176	423-D-800	Stoplog Storage Facility – Storage Guides – Installation – Section – Details – Sheet 1 of 1
Special Construction:		
177	423-D-785	Water Level System – Sensor Mountings – Plan – Sections - Detail – Sheet 1 of 1
178	423-D-781	Canal Measuring Device – Side-Looking Doppler Current Meter – Plan, Sections and Details – Sheet 1 of 1

Table 01111A - List of Drawings

Sheet No.	Drawing No.	Title
Conveying Systems:		
179	423-D-783	Trashrack and Bridge Deck – Trash Rake and Conveyors – Plan and Sections – Sheet 1 of 2
180	423-D-784	Trashrack and Bridge Deck – Trash Rake Conveyors – Plan and Sections – Sheet 2 of 2
Electrical Installation:		
181	423-D-821	Electrical Distribution Single-Line Diagram – DHA & DHB Panelboard Schedules – Sheet 1 of 1
182	423-D-822	Forebay/Afterbay Area – Conduit Plan – Sheet 1 of 1
183	423-D-823	Forebay/Afterbay Area Gate Structures – Conduit Plan – Sheet 1 of 1
184	423-D-824	Conduit and Cable Schedule – Sheet 1 of 1
185	423-D-825	Control Building – Lighting and Receptacle Plan – Sheet 1 of 1
186	423-D-826	Control Building – External Conduit and Wireway Plan – Grounding Plan – Sheet 1 of 1
187	423-D-786	Pipe Outlet Structure – Conduit and Grounding Plan – Sheet 1 of 1
188	423-D-782	Control Building – Engine-Generator Set – Plan and Sections – Sheet 1 of 1
Informational:		
189	212-D-3124	All-American Canal – Sta. 1905+70 – Drop No. 1 and Coachella Turnout – Turnout – Gate Section
190	212-D-3125	All-American Canal – Sta. 1905+70 – Drop No. 1 and Coachella Turnout – Barrel Section
191	212-D-3126	All-American Canal – Sta. 1905+00 – Drop No. 1 and Coachella Turnout – Outlet Transition

Table 01111A - List of Drawings

Sheet No.	Drawing No.	Title
192	212-D-3127	All-American Canal – Sta. 1905+70 – Drop No. 1 and Coachella Turnout – Lateral Turnout – Barrel – Transition - Lining
193	212-D-3110 (AC-0046)	All-American Canal – Sta. 1905+70 – Drop No. 1 and Coachella Turnout – General Plan – Topography and Sections
194	100-C-90 (AC-0464)	Denver Office Standard Drawing – 5’-0” x 4’-0” Cast Iron Gate – Heads 0 to 15 Feet
195	423-D-646	Drop 2 Inlet Canal – Power Pole Relocation – Plans – Sheet 1 of 1
196	423-D-647	Drop 2 Inlet Canal – Power Pole Relocation – Plans – Sheet 2 of 2
197	AAC-237	Bookman-Edmonston – All American Canal Lining Project – Plan and Profile – Reach 3 – 2194+00 to 2222+00
198	AAC-148	Bookman-Edmonston – All American Canal Lining Project – Canal Confluence Structure – Plan – Sheet 1 of 3
199	AAC-149	Bookman-Edmonston – All American Canal Lining Project - Canal Confluence Structure – Sections and Details – Sheet 2 of 3
200	AAC-150	Bookman-Edmonston – All American Canal Lining Project - Canal Confluence Structure – Sections and Concrete Lining Joint Layout – Sheet 3 of 3
201	T3	State of California – Department of Transportation – Temporary Railing – (Type K)
Standard Drawings:		
202	40-D-4334	Typical Grounding Details – Sheet 1 of 2
203	40-D-4335	Typical Grounding Details – Sheet 2 of 2
204	40-D-4753	Typical Grounding Details for Switchyard and Substations – Sheet 1 of 1

Table 01111A - List of Drawings

Sheet No.	Drawing No.	Title
205	40-D-5247	Buildings – Joints in Concrete Structures
206	40-D-6032	Induction Motors – Design and Nameplate Data to be Furnished by Contractor
207	40-D-6234	Standard Nameplates
208	40-D-6263	General Notes and Minimum Requirements for Detailing Reinforcement
209	40-D-6376	Fencing Within Right-Of-Way-Typical Grounding Details – Sheet 1 of 1
210	40-D-6460	Safety Ladder for Concrete Lined Canals
211	40-D-6463	PVC Waterstops – 6” Type, 9” Type and 12” Type
212	40-D-6591	Side Mounted Pipe Guardrails
213	40-D-6592	Top Mounted Pipe Guardrails
214	40-D-7012	General Concrete Outline Notes
215	40-D-7016	Chain Link Fencing Requirements – Soil Installation
216	104-D-1150	Device Designations and Symbols To Be Used On Single-Line and Schematic Diagrams
217	104-D-1152	Power – And Pumping Plants – Electrical Installation - Drawing Format
218	104-D-1165	Electrical Installation - Main Control Board CSA – Panel 7R Wiring Diagram

Table 01111B - Drawings in Numerical Order

Drawing No.	Sheet No.
423-D-	
423-D-571	162

Table 01111B - Drawings in Numerical Order

Drawing No.	Sheet No.
423-D-572	163
423-D-629	5
423-D-630	6
423-D-631	9
423-D-632	34
423-D-633	35
423-D-634	37
423-D-635	38
423-D-636	39
423-D-637	40
423-D-638	41
423-D-639	1
423-D-640	2
423-D-641	33
423-D-642	11
423-D-643	10
423-D-644	12
423-D-645	13
423-D-646	195
423-D-647	196
423-D-648	16
423-D-649	17
423-D-650	18

Table 01111B - Drawings in Numerical Order

Drawing No.	Sheet No.
423-D-651	19
423-D-652	20
423-D-653	21
423-D-654	22
423-D-655	23
423-D-656	24
423-D-657	25
423-D-658	26
423-D-659	27
423-D-660	28
423-D-661	29
423-D-662	30
423-D-663	70
423-D-664	71
423-D-665	73
423-D-666	72
423-D-667	77
423-D-668	78
423-D-669	79
423-D-670	80
423-D-671	81
423-D-672	84
423-D-673	85

Table 01111B - Drawings in Numerical Order

Drawing No.	Sheet No.
423-D-674	86
423-D-675	87
423-D-676	88
423-D-677	89
423-D-678	90
423-D-679	91
423-D-680	92
423-D-681	93
423-D-682	94
423-D-683	95
423-D-684	96
423-D-685	97
423-D-686	98
423-D-687	99
423-D-688	100
423-D-689	51
423-D-690	52
423-D-691	53
423-D-692	107
423-D-693	108
423-D-694	48
423-D-695	67
423-D-696	68

Table 01111B - Drawings in Numerical Order

Drawing No.	Sheet No.
423-D-697	69
423-D-698	49
423-D-699	128
423-D-700	129
423-D-701	130
423-D-702	131
423-D-703	127
423-D-704	133
423-D-705	137
423-D-706	138
423-D-707	139
423-D-708	132
423-D-709	116
423-D-710	117
423-D-711	118
423-D-712	119
423-D-713	120
423-D-714	121
423-D-715	122
423-D-716	123
423-D-717	124
423-D-718	125
423-D-719	126

Table 01111B - Drawings in Numerical Order

Drawing No.	Sheet No.
423-D-720	112
423-D-721	113
423-D-722	114
423-D-723	115
423-D-725	101
423-D-726	102
423-D-727	103
423-D-728	104
423-D-729	105
423-D-730	106
423-D-731	32
423-D-732	82
423-D-733	83
423-D-734	109
423-D-735	110
423-D-736	111
423-D-737	55
423-D-738	56
423-D-739	134
423-D-740	135
423-D-741	54
423-D-742	74
423-D-743	75

Table 01111B - Drawings in Numerical Order

Drawing No.	Sheet No.
423-D-744	76
423-D-745	136
423-D-746	14
423-D-747	15
423-D-754	42
423-D-755	50
423-D-756	43
423-D-757	44
423-D-764	150
423-D-765	151
423-D-766	152
423-D-767	153
423-D-768	154
423-D-769	155
423-D-770	156
423-D-771	157
423-D-772	158
423-D-773	159
423-D-774	140
423-D-775	160
423-D-778	45
423-D-779	46
423-D-780	47

Table 01111B - Drawings in Numerical Order

Drawing No.	Sheet No.
423-D-781	178
423-D-782	188
423-D-783	179
423-D-784	180
423-D-785	177
423-D-786	187
423-D-788	161
423-D-789	166
423-D-790	167
423-D-791	168
423-D-792	164
423-D-793	165
423-D-794	173
423-D-795	175
423-D-796	170
423-D-797	171
423-D-798	172
423-D-799	169
423-D-800	176
423-D-801	174
423-D-807	3
423-D-808	4
423-D-809	141

Table 01111B - Drawings in Numerical Order

Drawing No.	Sheet No.
423-D-810	142
423-D-811	143
423-D-812	144
423-D-813	145
423-D-814	146
423-D-815	147
423-D-816	148
423-D-817	149
423-D-821	181
423-D-822	182
423-D-823	183
423-D-824	184
423-D-825	185
423-D-826	186
423-D-828	36
423-D-829	**72A**
423-D-831	66
423-D-832	31
423-D-833	7
423-D-834	8
423-300-	
423-300-3001	57
423-300-3002	64

Table 01111B - Drawings in Numerical Order

Drawing No.	Sheet No.
423-300-3003	65
423-300-3004	58
423-300-3005	59
423-300-3006	60
423-300-3007	61
423-300-3008	62
423-300-3009	63
AAC-	
AAC-148	198
AAC-149	199
AAC-150	200
AAC-237	197
T3	
T3	201
100-C-	
100-C-90	194
212-D-	
212-D-3110	193
212-D-3124	189
212-D-3125	190
212-D-3126	191
212-D-3127	192
40-D-	

Table 01111B - Drawings in Numerical Order

Drawing No.	Sheet No.
40-D-4334	202
40-D-4335	203
40-D-4753	204
40-D-5247	205
40-D-6032	206
40-D-6234	207
40-D-6263	208
40-D-6376	209
40-D-6460	210
40-D-6463	211
40-D-6591	212
40-D-6592	213
40-D-7012	214
40-D-7016	215
104-D-	
104-D-1150	216
104-D-1152	217
104-D-1165	218

END OF SECTION

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SECTION 01330 - SUBMITTALS

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:

1. If submittals are not submitted in a timely manner, the CO may retain appropriate amounts of applicable progress payments.

1.02 REFERENCES

A. California Department of Transportation (CALTRANS)

1. CALTRANS SS Standard Specifications, State of California, Business, Transportation, and Housing Agency, Department of Transportation, May 2006
2. CALTRANS SSP Standard Special Provisions, State of California, Business, Transportation, and Housing Agency, Department of Transportation, May 2006

1.03 DEFINITIONS

A. Days: Calendar days.

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

C. Submittal Types, as listed in Table 01330A – List of Submittals:

1. A – Approval:
   a. Government approval is required.
   b. Within the terms of the clause at FAR 52.236-21 “Specifications and Drawings for Construction,” Approval submittals are considered to be “shop drawings.”
   c. Approval however does not relieve the Contractor of the responsibility to perform the work.
2. I – Informational:
   a. Government approval is not required.

b. Within the terms of the clause at FAR 52.236-21 “Specifications and Drawings for Construction,” Informational submittals are not considered to be “shop drawings.”

c. The Government may return an Informational submittal or ask for additional information when an Informational submittal does not comply with the specifications.

1.04 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. Allow space for review stamps.
3. Size: D size (22 inches by 34 inches) or similar.
4. Draw to scale with neat lettering using drafting equipment or computer drafting equipment.
5. Final drawings:
   a. AUTOCAD® format (.dwg) or Drawing Transfer Format (.dxf) on CD-ROM disc.
   b. Original D size (22 inches by 34 inches) plots.
   c. Show as-built changes, including revision dates, made during installation.

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 out items that do not apply.

E. Certifications:

1. Submittals requiring certification by a registered professional: Signed and sealed by registered professional.

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

F. Manuals:

1. Copies: Bound and indexed.

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 in .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.

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.

I. Warranties:

1. Provide in accordance with Section 01781 – Project Record Documents.

1.05 SUBMITTALS PROCEDURES

A. Submit only checked submittals. 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 01330A - List of Submittals. A complete set includes all listed items for RSNs with multiple parts.

C. Submit number of sets specified in "No. of sets to be sent to:" columns in Table 01330A - List of Submittals.

D. Include the following information in transmittal letters:

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

E. More than one RSN may be submitted under a transmittal letter, provided the responsible code is the same.

F. For RSNs required by Section 02052 – Interstate 8 Highway, the title indicated in the column “Clause or Section Title” includes the title of the specifications section and the title of the applicable Caltrans Standard Specifications Section or the title of the Caltrans Special Provisions Section.

1.06 REVIEW OF SUBMITTALS

A. Time Required:

1. Submittal review will require 28 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 approval 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. One set of submittals required for approval will be returned either approved, approved subject to identified changes, or not approved.

2. Submittals not approved:

a. Revise and resubmit for approval.

b. Show changes and revisions with revision date.

c. Describe reasons for significant changes in transmittal letter.

d. Resubmit returned submittals within 28 days after receiving the comments, unless otherwise specified.

e. Requirements for initial submittals apply to resubmittals.

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

4. 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.

1.07 TRANSMITTAL

A. Addresses for codes listed in Table 01330A - List of Submittals:

1. Contracting Officer (LC-3100), Bureau of Reclamation, PO Box 61470, Boulder City NV 89006-1470; Express Mail: 500 Fir Street, Boulder City NV 89005.
2. Contracting Officer's Representative, Bureau of Reclamation, Yuma Area Office, 7301 Calle Agua Salada, Yuma AZ 85364-9763.
3. Contracting Officer's Representative (LC-6000), Bureau of Reclamation, PO Box 61470, Boulder City NV 89006-1470; Express Mail: 500 Fir Street, Boulder City NV 89005.
4. 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, Denver CO 80225.

B. Send original transmittal letter with appropriate number of sets to office listed in "Responsible Code" column in Table 01330A – List of Submittals except as provided below.

1. When COR is responsible code listed in "Responsible Code" column in Table 01330A – List of Submittals, send 2 copies of submittal to COR at Yuma Area Office address shown above, and send 3 copies of submittal to COR, Bureau of Reclamation, Lower Colorado Regional Office, PO Box 61470, 500 Fir Street, Boulder City NV 89006-1470.
2. When COR is not responsible code listed in "Responsible Code" column in Table 01330A – List of Submittals, send 1 copy of submittal to COR at Yuma Area Office address shown above, and send 2 copies of submittal to COR, Bureau of Reclamation, Lower Colorado Regional Office, PO Box 61470, 500 Fir Street, Boulder City NV 89006-1470.
3. Responsible codes starting with "86-" are located in the Technical Service Center. Send these submittals to the 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 01330A – 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 01330A - List of Submittals:

1. Submit in accordance with this section.
2. Submit to Contracting Officer's Representative, Bureau of Reclamation, Yuma Area Office, 7301 Calle Agua Salada, Yuma AZ 85364-9763, unless otherwise specified.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

Table 01330A. - List of Submittals

* Submittal types: A – Approval, I – Information
** CO indicates Contracting Officer, COR indicates Contracting Officer's Representative, and TSC indicates Technical Service Center.

RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	No. of sets to be sent to: **		
						CO	COR	TSC
001	Bonds 52.228-15	Performance and Payment Bonds	Within 15 days of award	A	CO	3	3	0
002	Liability Insurance 1452.228-70	Acceptable certification that the required insurance has been obtained	Submitted and accepted before commencing onsite work	A	CO	1	3	0
003	Personal Identification of Contractor Personnel 52.204-9	Personal Identity Verification	At least 14 days before bringing subject personnel onsite	I	CO	1	3	0
01141-1	Use of Site	Land use and landscape rehabilitation plan	At least 28 days before use of Government land	A	COR	0	5	1
01321-1	Construction Program	Representative information	Within 7 days after receipt of Notice of Award	I	COR	1	5	1
01321-2	Construction Program	Baseline schedule: 1. Blackline prints 2. Reports 3. Data on floppy diskette or CD-ROM	Within 21 days after receipt of Notice to Proceed	A	COR	 0 0 0	 5 5 5	 3 3 1
01321-3	Construction Program	Updated schedule: 1. Blackline prints 2. Reports 3. Data on floppy diskette or CD-ROM	With monthly requests for progress payments.	A	COR	 0 0 0	 5 5 5	 1 1 1

Table 01330A. - List of Submittals

* Submittal types: A – Approval, I – Information
** CO indicates Contracting Officer, COR indicates Contracting Officer's Representative, and TSC indicates Technical Service Center.

RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	No. of sets to be sent to: **		
						CO	COR	TSC
01321-4	Construction Program	Time impact analysis: 1. Blackline prints 2. Reports 3. Data on floppy diskette or CD-ROM	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	COR	 0 0 0	 5 5 5	 1 1 1
01335-1	Material Safety Data Sheets	Complete LHM and MSDS	At least 14 days before jobsite delivery of hazardous material	I	COR	0	5	0
01335-2	Material Safety Data Sheets	Updated LHM and MSDS	At least 14 days before jobsite delivery of hazardous material not previously listed	I	COR	0	5	0
01453-1	Contractor Quality Testing	Resume	At time of preconstruction conference	I	COR	0	5	1
01453-2	Contractor Quality Testing	Contractor quality testing plan	At time of preconstruction conference	A	COR	0	5	1
01510-1	Temporary Utilities	Construction water diversion facility information	At least 28 days before beginning construction water diversion	A	COR	0	5	0
01527-1	Safety and Health	Safety program	Submitted and accepted within 7 days after award and before commencing onsite mobilization. See section 3 of RSHS	A	COR	0	5	0
01527-2	Safety and Health	Monthly accident summary report	First day of each month	I	COR	0	5	0
01527-3	Safety and Health	Job hazard analysis	Before start of work warranted or identified as potentially hazardous	A	COR	0	5	0
01528-1	Contractor's Onsite Safety Personnel	Resumes	Prior to employment	I	COR	0	5	0

Table 01330A. - List of Submittals

* Submittal types: A – Approval, 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	COR	TSC
01528-2	Contractor's Onsite Safety Personnel	Safety inspection reports	At least once each week	I	COR	0	5	0
01529-1	First-Aid	Medical Facilities Plan	Submitted and approved before start of operations	A	COR	0	5	0
01550-1	Vehicular Access and Parking	Access roads and haul routes plan	At least 28 days before beginning use of access roads	A	COR	0	5	1
01550-2	Vehicular Access and Parking	Preconstruction video	At least 28 days before beginning onsite construction activities	I	COR	0	5	1
01550-3	Vehicular Access and Parking	Post Construction video	Within 2 days after completing onsite construction activities	I	COR	0	5	1
01555-1	Traffic Control	Traffic control plan	At least 28 days before affecting public traffic	A	COR	0	5	0
01562-1	Environ-mental Controls	Air Quality dust control plan	At least 35 days before start of onsite construction	A	COR	0	5	1
01562-2	Environ-mental Controls	Authority to construct (ATC)/Permit to operate (PTO)	At least 35 days before start of onsite construction	A	COR	0	5	0
01562-3	Environ-mental Controls	Equipment inventory	At least 35 days before start of onsite construction	A	COR	0	5	0
01562-4	Environ-mental Controls	Air quality conformance	At least 35 days before start of onsite construction	A	COR	0	5	0
01563-1	Water Pollution Control	Pollution prevention plan	At least 28 days before start of onsite construction work	A	COR	0	5	1
01563-2	Water Pollution Control	Spill Prevention Control and Countermeasure Plan (SPCC)	At least 28 days before delivery or storage of oil	A	COR	0	5	0
01568-1	Site Security	Security plan	At least 35 days before start of onsite construction	A	COR	0	5	0

Table 01330A. - 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	COR	TSC
01568-2	Site Security	Information security plan	At least 35 days before start of onsite construction	A	COR	0	5	0
01721-1	Surveying	Surveying plan	At least 35 days before beginning survey work	A	COR	0	5	0
01721-2	Surveying	Resume	At least 35 days before beginning survey work; At least 35 days before personnel change	I	COR	0	5	0
01721-3	Surveying	Accuracy check results	At least 14 days before beginning survey work	I	COR	0	5	0
01721-4	Surveying	Completed and reduced survey notes	Within 2 days of completing and reducing notes	I	COR	0	5	0
01721-5	Surveying	Original field survey books	Within 2 days of completing a book	I	COR	0	5	0
01721-6	Surveying	Quantity survey notes and computations	Accompanying progress payment requests	I	COR	0	5	0
01721-7	Surveying	Workday's survey notes	At conclusion of workday if requested by Government	I	COR	0	5	0
01725-1	Protection of Existing Installations	Plan for protecting existing installations	At least 28 days before commencing on site construction work	A	COR	0	5	0
01726-1	Protection of Existing Utilities	Utility owner acknowledgment	At least 28 days before stringing conductors or overhead ground lines	I	COR	0	5	0
01740-1	Cleaning	Plan for maintaining site	At least 35 days before start of onsite construction work	A	COR	0	5	0
01740-2	Cleaning	Waste production and disposal records	Within 7 days of waste disposal	I	COR	0	5	0
01740-3	Cleaning	Hazardous waste manifest	Within 7 days of hazardous waste disposal	I	COR	0	5	0
01740-4	Cleaning	Environmental consultant resume	At least 35 days before beginning environmental assessment	I	COR	0	5	0
01740-5	Cleaning	Environmental site assessment	Within 14 days of completion of work	I	COR	0	5	0

Table 01330A. - List of Submittals

* Submittal types: A – Approval, 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	COR	TSC
01781-1	Project Record Documents	Progress As-Built Drawings	Within 14 days after construction of a particular structure or work is completed	I	COR	0	5	0
01781-2	Project Record Documents	Final As-built drawings	Within 14 days of completion of work	I	COR	0	5	0
01781-3	Project Record Documents	Warranties	Within 7 days of completion of each feature of work requiring warranty	I	COR	0	5	0
02052-1	Interstate 8 Highway – Section 8-1. Prequalified and tested signing and delineation materials	Certificate of compliance for prequalified and tested signing and delineation material	In conformance with the provisions of Section 6-1.07 "Certificates of Compliance"	I	COR	0	5	1
02052-2	Interstate 8 Highway – Section 10-1. Closure Requirements and Conditions based upon approved closure schedule	Written schedule of closure requirements and conditions based upon approved closure schedule	At least 14 days before proposed closure	A	COR	0	5	1
02052-3	Interstate 8 Highway – Section 10-1. Closure Requirements and Conditions based upon approved closure schedule	Contingency plan for closure requirements and conditions based upon approved closure schedule	At least 14 days before beginning onsite work	A	COR	0	5	1

Table 01330A. - 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	COR	TSC
02052-4	Interstate 8 Highway – Section 10-1. Traffic Plastic Drums	Certificate of compliance for traffic plastic drums	In conformance with the provisions of Section 6-1.07 "Certificates of Compliance"	I	COR	0	5	1
02052-5	Interstate 8 Highway – Section 39-3.03 Hot Mix Asphalt	Hot mix asphalt information	At least 28 days before placement	A	COR	0	5	1
02052-6	Interstate 8 Highway – Section 39-1.04C Asphalt Rubber Binder	Certificate of compliance for asphalt rubber binder	In conformance with the provisions of Section 6-1.07 "Certificates of Compliance"	I	COR	0	5	1
02052-7	Interstate 8 Highway – Section 39-1.04C Asphalt Rubber Binder	Certified weight slips for asphalt rubber binder	Within 7 days after pavement placement	I	COR	0	5	1
02052-8	Interstate 8 Highway – Section 39-1.12C Profilograph	Profilograph	Within 7 days after pavement placement	A	COR	0	5	1
02052-9	Interstate 8 Highway – Section 39-4.03B Quality Control Plan	Written quality control plan	At least 35 days before placement	A	COR	0	5	1

Table 01330A. - 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	COR	TSC
02052-10	Interstate 8 Highway – Section 39-4.03C Quality Control Inspection, Sampling, and Testing	Written test results of quality control inspection, sampling, and testing	Within 7 days of placement	A	COR	0	5	1
02052-11	Interstate 8 Highway – Section 40-1. Material – Silicone Joint Sealant	Certificate of compliance for materials – silicone joint sealant	In conformance with the provisions of Section 6-1.07 "Certificates of Compliance"	I	COR	0	5	1
02052-12	Interstate 8 Highway – Section 40-1. Material – Joint Filler Material	Certificate of compliance for materials – joint filler material	In conformance with the provisions of Section 6-1.07 "Certificates of Compliance"	I	COR	0	5	1
02052-13	Interstate 8 Highway – Section 84-3.02 Materials – Paint for Stripping	Certificate of compliance for materials – paint for stripping	In conformance with the provisions of Section 6-1.07 "Certificates of Compliance"	I	COR	0	5	1
02052-14	Interstate 8 Highway – Section 90-1 Concrete pavement Mix Proportions	Concrete pavement mix proportions	At least 28 days before placing concrete pavement	A	COR	0	5	1
02052-15	Interstate 8 Highway – Section 90-2.01 Cementitious materials	Certificate of compliance for cementitious materials	In conformance with the provisions of Section 6-1.07 "Certificates of Compliance"	I	COR	0	5	1

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02052-16	Interstate 8 Highway – Section 95-1. Materials – Epoxy (Drill and Bond)	Certificate of compliance for materials – epoxy (drill and bond)	In conformance with the provisions of Section 6-1.07 "Certificates of Compliance"	I	COR	0	5	1
02242-1	Removal of Water	Removal of water plan for Coachella Canal modification	At least 28 days before beginning removal of water operations for Coachella Canal modification	A	86-68312	0	3	2
02242-2	Removal of Water	Removal of water plan for steel pipe and outlet canal construction	At least 28 days before beginning removal of water operations for steel pipe and outlet canal construction	A	86-68312	0	3	2
02242-3	Removal of Water	Installation data	Within 2 days after installation	I	COR	0	5	1
02242-4	Removal of Water	Records	Daily	I	COR	0	5	0
02261-1	Diversion and Care of Coachella Canal During Construction	Coachella Canal water control plan	At least 28 days before beginning diversion and care of Coachella Canal	A	COR	0	5	1
02261-2	Diversion and Care of Coachella Canal During Construction	Concrete plug plan	At least 28 days before beginning abandoning and plugging of existing concrete pipe	A	COR	0	5	2
02316-1	Steel Pipe Earthwork	Steel pipe earthwork and pipeline construction sequence plan	At least 35 days before beginning steel pipe trench earthwork	A	COR	0	5	1
02321-1	Excavation from Borrow	Borrow area use plan	At least 35 days before beginning excavation from borrow	A	COR	0	5	1
02322-1	Excavation of Existing Earth Plug	Excavation of existing earth plug plan	At least 28 days before beginning excavation of existing earth plug	A	COR	0	5	1

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02323-1	Controlled Low Strength Material (CLSM)	Approval data	AT least 28 days before furnishing controlled low strength material	A	COR	0	5	1
02344-1	Geomem-brane	Geomembrane installer qualifications and installation plan	At least 42 days before delivery to jobsite	A	86-68180	0	3	1
02344-2	Geomem-brane	Qualifications of manufacturer and fabricator	At least 42 days before delivery to jobsite	A	86-68180	0	3	1
02344-3	Geomem-brane	Notice of start of production	At least 21 days before start of production	I	86-68180	0	3	1
02344-4	Geomem-brane	Certifications	At least 42 days before delivery to jobsite	A	86-68180	0	3	1
02344-5	Geomem-brane	Samples	At least 42 days before delivery to jobsite	A	86-68180	0	0	1
02344-6	Geomem-brane	Warranty	At least 42 days before delivery to jobsite	I	86-68180	0	3	1
02344-7	Geomem-brane	Surveyed as-built drawings	Within 14 days of completion of installation	I	86-68180	0	3	1
02346-1	Geotextile and Geonet Composite	Manufacturer's certification	At least 42 days before delivery to jobsite	A	86-68180	0	3	1
02346-2	Geotextile and Geonet Composite	Geotextile samples	At least 42 days before delivery to jobsite	A	86-68180	0	0	1
02346-3	Geotextile and Geonet Composite	Geonet composite samples	At least 42 days before delivery to jobsite	A	86-68180	0	3	1
02346-4	Geotextile and Geonet Composite	Protection method	At least 42 days before delivery to jobsite	A	86-68180	0	3	1
02346-5	Geotextile and Geonet Composite	Sewn geotextile seams, if used	At least 42 days before delivery to jobsite	A	86-68180	0	3	1
02376-1	Soil-Cement Test Section	Soil-Cement test section placement plan	At least 35 days before beginning soil-cement test section	A	86-68180	0	3	1

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02376-2	Soil-Cement Test Section	Test section placement report	Within 2 days of completing test section	I	86-68180	0	3	3
02377-1	Soil-Cement	Samples	At least 35 days before beginning soil-cement placement	A	86-68180	0	3	1
02377-2	Soil-Cement	Material certifications and supplier data	At least 35 days before beginning soil-cement placement	A	86-68180	0	3	1
02377-3	Soil-Cement	Soil-cement placement schedule	At least 35 days before beginning soil-cement placement	A	86-68180	0	3	1
02377-4	Soil-Cement	Equipment plan	At least 35 days before beginning soil-cement placement	A	86-68180	0	3	1
02460-1	Sheet Pile Wall	Plan for constructing sheet pile wall**s**	At least 28 days before beginning sheet pile wall construction	A	86-68312	0	3	2
02460-2	**Sheet Pile Wall**	**Anchoring system plan**	**At least 28 days before beginning sheet pile wall construction**	**A**	**86-68312**	**0**	**3**	**2**
02460-**3**	Sheet Pile Wall	Quality control, construction records, and operation records	Daily	I	COR	0	5	0
02514-1	Steel Pipe	Shop drawings	At least 56 days before fabricating pipe	A	86-68140	0	3	2
02514-2	Steel Pipe	Purchase orders	Within 2 days of submitting purchase	I	COR	0	5	0
02514-3	Steel Pipe	Pipelaying diagrams	At least 35 days before shipment of pipe	A	86-68140	0	3	2
02514-4	Steel Pipe	Pipe embedment plans	At least 35 days before beginning pipe embedment	A	86-68140	0	3	2
02514-5	Steel Pipe	Welder qualifications	At least 35 days before shipment of pipe	A	COR	0	5	0
02514-6	Steel Pipe	Test reports for hydrostatic testing	Immediately after completing each test	A	COR	0	5	0
02514-7	Steel Pipe	Test reports of field welds	Immediately after completing each test	I	COR	0	5	0

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02722-1	Aggregate Base Course	Certification	At least 28 days before furnishing aggregate base course	I	COR	0	5	1
02732-1	Gravel Surfacing	Certification	At least 28 days before furnishing gravel surfacing	I	COR	0	5	1
02743-1	Asphaltic Concrete Pavement	Mix design data	At least 28 days before placing asphaltic concrete pavement	A	COR	0	5	1
02743-2	Asphaltic Concrete Pavement	Certifications	At least 28 days before furnishing asphaltic concrete pavement	I	COR	0	5	1
02763-1	Painted Traffic Lines and Markings	Certification	At least 28 days before furnishing paint	I	COR	0	5	1
02763-2	Painted Traffic Lines and Markings	Instructions	At least 28 days before furnishing paint	A	COR	0	5	1
02846-1	Metal Beam Guard Railing and Chain Link Railing	Certifications	At least 28 days before furnishing metal beam guard railing or chain link railing	I	COR	0	5	1
03152-1	Sponge Rubber Joint Filler	Certification	At least 28 days before furnishing sponge rubber joint filler	I	COR	0	5	1
03152-2	Sponge Rubber Joint Filler	Instructions	At least 28 days before beginning installation	I	COR	0	5	1
03156-1	PVC Waterstop	Purchase orders	At least 28 days before furnishing PVC waterstop	I	COR	0	5	0
03156-2	PVC Waterstop	Approval samples	At least 28 days before furnishing PVC waterstop	A	86-68180	0	0	1
03156-3	PVC Waterstop	Certifications	At least 28 days before furnishing PVC waterstop	I	COR	0	5	1

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03156-4	PVC Waterstop	Instructions	At least 28 days before furnishing PVC waterstop	I	COR	0	5	1
03157-1	PVC Retro-Fit Waterstop	Approval data and instructions	At least 28 days before furnishing PVC retro-fit waterstop	A	COR	0	5	1
03158-1	PVC Strip Waterstop for Concrete Canal Lining	Purchase orders	At least 28 days before furnishing PVC strip waterstop	I	COR	0	5	0
03158-2	PVC Strip Waterstop for Concrete Canal Lining	Approval samples	At least 28 days before furnishing PVC strip waterstop	A	86-68180	0	0	1
03158-3	PVC Strip Waterstop for Concrete Canal Lining	Certifications	At least 28 days before furnishing PVC strip waterstop	I	COR	0	5	1
03158-4	PVC Strip Waterstop for Concrete Canal Lining	Instructions	At least 28 days before furnishing PVC strip waterstop	I	COR	0	5	1
03200-1	Concrete Reinforce-ment	Reinforcement diagrams and lists	At least 35 days before concrete placement	A	COR	0	5	1
03200-2	Concrete Reinforce-ment	Shop drawings	At least 35 days before concrete placement	A	86-68140	0	3	2
03200-3	Concrete Reinforce-ment	Mill certifications	At least 35 days before concrete placement	I	86-68180	0	3	1
03300-1	Cast-in-Place Concrete	Material approval data	At least 35 days before cast-in-place concrete placement	A	COR	0	5	1
03300-2	Cast-in-Place Concrete	Concrete placement drawings	At least 35 days before cast-in-place concrete placement	A	COR	0	5	1
03300-3	Cast-in-Place Concrete	Concrete placement schedule	At least 35 days before cast-in-place concrete placement	A	COR	0	5	1

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03300-4	Cast-in-Place Concrete	Concrete check out cards	At least 35 days before cast-in-place concrete placement	A	COR	0	5	1
03305-1	Concrete Removal	Concrete removal plan	At least 28 days before beginning removal of concrete	A	COR	0	5	1
03306-1	Removing Existing Coachella Canal Concrete Lining	Concrete canal lining removal plan	At least 28 days before beginning removal of concrete canal lining	A	COR	0	5	1
03306-2	Removing Existing Coachella Canal Concrete Lining	Concrete canal lining repair plan	At least 28 days before beginning removal of concrete canal lining	A	COR	0	5	1
03309-1	Concrete in Canal Lining	Concrete material approval data	At least 35 days before placement of concrete in canal lining	A	COR	0	5	1
03309-2	Concrete in Canal Lining	Elastomeric sealant certification	At least 35 days before placement of concrete in canal lining	I	COR	0	5	1
03309-3	Concrete in Canal Lining	Lining placement procedures	At least 35 days before placement of concrete in canal lining	A	COR	0	5	1
03362-1	Concrete Floor Hardener	Manufacturer's instructions	At least 28 days before applying	A	COR	0	5	1
03622-1	Grouting Mortar for Equipment and Metalwork	Packaged nonshrink grout data	At least 28 days before placing	A	COR	0	5	1
04822-1	Reinforced Concrete Unit Masonry Assemblies	Approval data	At least 56 days before beginning installation	A	86-68120	0	3	1

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04822-2	Reinforced Concrete Unit Masonry Assemblies	Certifications and instructions	At least 28 days before beginning installation	I	COR	0	5	1
04822-3	Reinforced Concrete Unit Masonry Assemblies	Mix designs	At least 28 days before beginning installation	A	86-68120	0	3	1
05315-1	Metal Roof Deck	Approval data	At least 56 days before fabrication or procurement	A	86-68120	0	3	5
05315-2	Metal Roof Deck	Approval drawings	At least 56 days before fabrication or procurement	A	86-68120	0	3	1
05315-3	Metal Roof Deck	Welder qualifications	At least 56 days before fabrication or procurement	A	86-68120	0	3	1
05425-1	Pre-Engineered, Pre-Fabricated Cold Formed Steel Roof Trusses	Approval data	At least 56 days before fabrication or procurement	A	86-68120	0	3	5
05425-2	Pre-Engineered, Pre-Fabricated Cold Formed Steel Roof Trusses	Approval drawings	At least 56 days before fabrication or procurement	A	86-68120	0	3	1
05635-1	Metal Piping	Shop drawings	At least 35 days before fabrication or procurement	A	86-68420	0	3	5
05635-2	Metal Piping	Drawings of vent tee fittings	At least 35 days before fabricating pipe and fittings	A	86-68420	0	3	5
05635-3	Metal Piping	Final drawings	Within 28 days after installation	I	86-68420	0	3	7
07192-1	Silane Water Repellent	Approval data	At least 28 days before applying	A	86-68180	0	3	1

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07192-2	Silane Water Repellent	Instructions and documentation	At least 28 days before applying	I	COR	0	5	1
07213-1	Batt and Blanket Insulation	Approval data	At least 56 days before fabrication or procurement	A	86-68120	0	3	5
07213-2	Batt and Blanket Insulation	Instructions	At least 56 days before fabrication or procurement	I	86-68120	0	3	5
07430-1	Pre-Insulated Metal Roof and Wall Panels	Approval drawings, data, and sample kit	At least 56 days before fabrication or procurement	A	86-68120	0	3	5
07430-2	Pre-Insulated Metal Roof and Wall Panels	Documentation	At least 56 days before fabrication or procurement	I	COR	0	5	5
07612-1	Metal Soffit Panels	Approval drawings, data, and sample kit	At least 56 days before fabrication or procurement	A	86-68120	0	3	5
07612-2	Metal Soffit Panels	Instructions	At least 56 days before fabrication or procurement	I	86-68120	0	3	5
07612-3	Metal Soffit Panels	Documentation	At least 56 days before fabrication or procurement	I	COR	0	5	5
07612-4	Metal Soffit Panels	Warranties	At least 56 days before fabrication or procurement	I	COR	0	5	5
07840-1	Firestopping	Approval data	At least 56 days before fabrication or procurement	A	86-68120	0	3	5
07840-2	Firestopping	Instructions	At least 56 days before fabrication or procurement	I	COR	0	5	5
07920-1	Joint Sealants	Approval data	At least 56 days before procurement	A	86-68120	0	3	5
07920-2	Joint Sealants	Color sample kit	At least 56 days before procurement	A	86-68120	0	3	5
07920-3	Joint Sealants	Certification and instructions	At least 56 days before procurement	I	COR	0	5	5

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08115-1	Bullet-Resistant Steel Doors and Frames	Approval drawings and data	At least 56 days before fabrication or procurement	A	86-68120	0	3	5
08115-2	Bullet-Resistant Steel Doors and Frames	Instructions	At least 56 days before fabrication or procurement	I	COR	0	5	5
08710-1	Door Hardware	Hardware schedule	At least 56 days before fabrication or procurement	A	86-68120	0	3	5
08710-2	Door Hardware	Approval data	At least 56 days before fabrication or procurement	A	86-68120	0	3	5
08710-3	Door Hardware	Instructions	At least 56 days before fabrication or procurement	I	86-68120	0	3	5
09260-1	Gypsum Board Wall Assembly	Approval data	At least 56 days before fabrication or procurement	A	86-68120	0	3	5
09902-1	Coatings	Approval data	At least 28 days before application	A	86-68180	0	3	1
09902-2	Coatings	Documentation	At least 28 days before application	I	86-68180	0	3	1
09902-3	Coatings	Certifications	At least 28 days before application	I	86-68180	0	3	1
09902-4	Coatings	Contractor quality control data	At least 28 days before application	A	86-68180	0	3	1
09980-1	Coatings for Concrete and Masonry	Approval data	At least 28 days before application	A	86-68180	0	3	1
09980-2	Coatings for Concrete and Masonry	Documentation	At least 28 days before application	I	86-68180	0	3	1
10522-1	Fire Extinguishers	Approval data	At least 28 days before fabrication or procurement	A	86-68420	0	3	5
11288-1	Slide Gates	Approval drawings and data	At least 42 days before fabrication or procurement	A	86-68420	0	3	5

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11288-2	Slide Gates	Purchase orders	Within 2 days of submitting purchase	I	COR	0	5	0
11288-3	Slide Gates	Installation procedures	At least 42 days before beginning installation	A	86-68420	0	3	5
11288-4	Slide Gates	Final data	Within 28 days after installation	I	86-68420	0	3	5
11851-1	Safety Cable with Floats	Shop Drawings and Manufacturer's Recommendations	At least 42 days before fabrication or procurement	A	COR	0	5	1
11851-2	Safety Cable with Floats	Approval data	At least 42 days before fabrication or procurement	A	COR	0	5	1
13110-1	Buried Impressed Current Cathodic Protection System	Manufacturers data and preconstruction drawings	At least 28 days before beginning installation	A	**86-68180**	0	**3**	2
13110-2	Buried Impressed Current Cathodic Protection System	As-built drawings	Within 14 days after completing installation	**A**	**86-68180**	0	**3**	2
13111-1	Galvanic Anode Cathodic Protection Systems for Gates and Poles	Manufacturers data and preconstruction drawings	At least 28 days before beginning installation	A	**86-68180**	0	**3**	2
13111-2	Galvanic Anode Cathodic Protection Systems for Gates and Poles	As-built drawings	Within 14 days after completing installation	**A**	**86-68180**	0	**3**	2

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13112-1	Submerged Galvanic Anode Cathodic Protection System – Pipes	Manufacturers data and preconstruction drawings	At least 28 days before beginning installation	A	**86-68180**	0	**3**	2
13112-2	Submerged Galvanic Anode Cathodic Protection System - Pipes	As-built drawings	Within 14 days after completing installation	**A**	**86-68180**	0	**3**	2
13113-1	Submerged Impressed Current Cathodic Protection System – Trashracks	Manufacturer's data and preconstruction drawings	At least 28 days before beginning installation	A	**86-68180**	0	**3**	2
13113-2	Submerged Impressed Current Cathodic Protection System - Trashracks	As-built drawings	Within 14 days after completing installation	**A**	**86-68180**	0	**3**	2
13423-1	Water Level Measuring Devices	Approval data	At least 42 days before procurement	A	86-68410	0	3	5
13423-2	Water Level Measuring Devices	Final data	Before shipment to jobsite	I	86-68410	0	3	5
13424-1	Ultrasonic Flowmeters	Approval data	At least 56 days before procurement	A	86-68410	0	3	5
13424-2	Ultrasonic Flowmeters	Final data	Before shipment to jobsite	I	86-68410	0	3	5
13425-1	Canal Measuring Device	Approval data	At least 42 days before procurement	A	86-68410	0	3	5

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13425-2	Canal Measuring Device	Final data	Before shipment to jobsite	I	86-68410	0	3	5
13455-1	Control and Monitoring System	Approval drawings and data	Within 91 days after notice to proceed	A	86-68430	0	3	1
13455-2	Control and Monitoring System	Test report	Within 35 days after testing	A	86-68430	0	3	1
13455-3	Control and Monitoring System	Operation and maintenance manual	Within 42 days after testing	I	86-68430	0	3	1
14510-1	Hydraulic Trash Rake	Approval drawings and data	At least 42 days before procurement	A	86-68410	0	3	5
14510-2	Hydraulic Trash Rake	Purchase order	Within 2 days of submitting purchase	I	COR	0	5	0
14510-3	Hydraulic Trash Rake	Final drawings and data	Before shipment to jobsite	I	86-68410	0	3	5
14520-1	Trash Rake Conveyors	Approval drawings and data	At least 42 days before procurement	A	86-68410	0	3	5
14520-2	Trash Rake Conveyors	Purchase orders	Within 2 days of submitting purchases	I	COR	0	5	0
14520-3	Trash Rake Conveyors	Final drawings and data	Before shipment to jobsite	I	86-68410	0	3	8
15810-1	Ducts	Approval data	At least 56 days before fabrication	A	86-68410	0	3	5
15810-2	Ducts	Final data	Within 28 days after final installation	A	86-68410	0	3	8
15820-1	Duct Accessories	Approval data	At least 56 days before fabrication	A	86-68410	0	3	5
15820-2	Duct Accessories	Final data	Before shipment to jobsite	A	86-68410	0	3	8
15830-1	Fan	Approval data	At least 56 days before procurement	A	86-68410	0	3	5
15830-2	Fan	Final data	Before shipment to jobsite	A	86-68410	0	3	8
15850-1	Air Outlets and Inlets	Approval data	At least 56 days before fabrication	A	86-68410	0	3	5

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15850-2	Air Outlets and Inlets	Final data	Before shipment to jobsite	A	86-68410	0	3	8
15950-1	Testing, Adjusting, and Balancing – HVAC	Approval data	Not later than 28 days before commencement of testing	A	86-68410	0	3	5
15950-2	Testing, Adjusting, and Balancing - HVAC	Final data	Within 28 days after completion of testing	A	86-68410	0	3	8
16060-1	Grounding and Bonding	Test reports	Within 35 days after testing	A	86-68430	0	3	3
16080-1	Wiring Checkout and Tests	Wiring checkout test plan	Within 56 days after notice to proceed	I	86-68430	0	3	3
16120-1	Conductors and Cables	Shop drawings and manufacturer's data	Within 56 days after notice to proceed	A	86-68430	0	3	3
16120-2	Conductors and Cables	Test reports	Within 35 days after tests are completed	I	86-68430	0	3	3
16130-1	Electrical Conduit	Shop drawings and manufacturer's data	Within 56 days after notice to proceed	A	86-68430	0	3	3
16130-2	Electrical Conduit	As-built drawings	Within 28 days after installation	I	86-68430	0	3	1
16132-1	Automatic Transfer Switch	Approval drawings and data	At least 42 days before procurement	A	86-68410	0	3	3
16132-2	Automatic Transfer Switch	Final drawings and data	Before shipment to jobsite	I	86-68410	0	3	5
16140-1	Wiring Devices	Shop drawings and manufacturer's data	Within 56 days after notice to proceed	A	86-68430	0	3	3
16212-1	Meter Socket and Service Disconnect	Shop drawings and manufacturer's data	Within 56 days after notice to proceed	A	86-68430	0	3	3
16232-1	Engine-Generator Set	Approval drawings and data	At least 42 days before procurement	A	86-68410	0	3	3
16232-2	Engine-Generator Set	Final drawings and data	Before shipment to jobsite	I	86-68410	0	3	5

Table 01330A. - List of Submittals

* Submittal types: A – Approval, I – Information
** CO indicates Contracting Officer, COR indicates Contracting Officer's Representative, and TSC indicates Technical Service Center.

RSN	Clause or Section Title	Submittals required	Due date or delivery time	Type *	Respon-sible code	No. of sets to be sent to: **		
						CO	COR	TSC
16441-1	Distribution Panelboards	Shop drawings and manufacturer's data	Within 56 days after notice to proceed	A	86-68430	0	3	3
16460-1	Lighting and Distribution Transformer	Shop drawings and manufacturer's data	Within 56 days after notice to proceed	A	86-68430	0	3	3
16510-1	Interior Luminaires	Shop drawings and manufacturer's data	Within 56 days after notice to proceed	A	86-68430	0	3	3
16520-1	Exterior Luminaires	Shop drawings and manufacturer's data	Within 56 days after notice to proceed	A	86-68430	0	3	3

END OF SECTION

SECTION 01510 - 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 REFERENCES

A. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE C2-2007 National Electrical Safety Code (NESC)®

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01330 – Submittals.

B. RSN 01510-1, Construction Water Diversion Facility Information

1. Location and capacity of diversion facility.
2. Points of withdrawal for construction water.

1.04 TEMPORARY ELECTRICITY

A. Electric service will be available up to a maximum of approximately 1,000 kilovolt amperes from the Government at the southwest corner of the Drop 2 Storage Reservoir site. This power will be available as three-phase, 60 hertz, alternating current at 480 volts. Transformers for this power may not be available until December, 2008. Contractor may need to provide generators until power is available from this source.

B. Pay all fees for electric power including Government furnished electric power to Imperial Irrigation District.

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

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

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

1.05 TEMPORARY WATER

A. **Coordinate with the appropriate water service provider having jurisdiction for the use of and payment for temporary water.**

1. **Water service providers having jurisdiction in the Project vicinity may include Imperial County, the Imperial Irrigation District, and the Coachella Valley Water District.**

B. Contact and obtain approval from Imperial Irrigation District before use of any water from All-American Canal.

C. Pay all fees to Imperial Irrigation District for use of water from All American Canal.

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

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

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

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01512 - TEMPORARY UTILITIES AND SERVICES FOR GOVERNMENT FIELD OFFICES AND LABORATORY

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 REFERENCES

A. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE C2-2007 National Electrical Safety Code (NESC)

1.03 PROJECT CONDITIONS

A. Government Field Offices and Government Field Laboratory will exist on site at time of award of this contract and will be located in the area shown on drawings.

1.04 TEMPORARY ELECTRICITY

A. Provide electrical service to Government Field Offices and to Government Field Laboratory.

1. Electrical service shall consist of conductors and equipment for delivering electrical energy from the serving utility to the wiring systems of the Government Field Offices and Government Field Laboratory.

B. Electric power for Field Offices:

1. 100 ampere, single-phase, 120/240 volt, three-wire, grounded service.

C. Electric power for Field Laboratory:

1. 200 ampere, single-phase, 120/240 volt, three-wire, grounded service.

D. Obtain power from source in accordance with Section 01510 – Temporary Utilities.

E. Provide transmission lines, distribution circuits, transformers, and other electrical equipment and facilities required for obtaining power and distributing power to Government Field Offices and Government Field Laboratory.

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

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

1.05 TEMPORARY WATER

A. Provide water to Government Field Offices suitable for restroom use including toilet flushing and hand washing to accommodate up to 350 gallons per day.

B. Provide water to Government Field Laboratory suitable for material testing to accommodate up to 200 gallons per day.

C. Install temporary equipment and facilities necessary to provide water for use.

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

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

1.06 DRINKING WATER AND ICE

A. Provide drinking water for Government Field Offices and Government Field Laboratory.

B. Provide drinking water in 5 gallon plastic containers up to 50 gallons per day.

C. Provide three hot/cold water coolers for drinking water use.

D. Provide 250 pounds of ice per day for Government personnel use in addition to ice for use by Contractor personnel.

1.07 SEWAGE FACILITIES

A. Install temporary equipment and facilities necessary for sewage collection and disposal.

B. Provide waste water pumping services for Government Field Offices and Government Field Laboratory.

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

1.08 SERVICES

A. Provide daily janitorial services during normal working hours for Government Field Offices and Government Field Laboratory.

B. **Janitorial services to furnish and maintain all necessary restroom supplies and disposable water cups.**

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

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SECTION 01640 - GOVERNMENT-FURNISHED PRODUCTS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include cost of loading, hauling, processing, 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.

1.02 DELIVERY, STORAGE, AND HANDLING

A. Rockfill is stockpiled on the west side of the reservoir site.

B. Recycled concrete is stockpiled on the reservoir site as shown on drawings.

C. Wood chips are stockpiled at two locations on the reservoir site as shown on drawings.

D. Load and haul products from stockpiles to placement locations.

E. Minimize handling to reduce breakdown of rockfill.

1.03 PROJECT CONDITIONS

A. The quantity of rockfill stockpiled on site is greater than that required for completion of work. Material in excess of the required volume for construction shown on the drawings shall remain in stockpile.

B. Rockfill in stockpile may not meet gradation requirements of Section 02332 – Rockfill. Processing of rockfill in stockpile may be required.

PART 2 PRODUCTS

2.01 PRODUCTS

A. The Government will furnish products listed in Table 01640A - Government-Furnished Products.

Table 01640A – Government-Furnished Products

Item No.	Description	Estimated quantity required	Estimated quantity available
1	Rockfill for reservoir	7,300 yd^3	**17,000** yd^{3*}
2	Rock for Coachella Canal temporary bypass channel	550 yd^3	**17,000** yd^{3*}
3	Recycled Concrete	2,600 yd^3	2,600 yd^3
4	Wood Chips	3,150 yd^3	3,150 yd^3

*Total estimated quantity available for rockfill for reservoir and rock for Coachella Canal temporary bypass channel.

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 02317 - CANAL EARTHWORK

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Excavation for Canal:

1. Measurement: Volume to lines, grades, and dimensions shown on drawings, or as directed by COR.
    a. Excavation for canal includes all canal excavation except for that between canal station 342+00 and canal station 354+75.71, which is included in excavation for reservoir.
2. Payment: Cubic yard price offered in the schedule.
    a. Includes cost of hauling from excavation to construct canal embankments.
    b. Includes procuring and applying water to prewet canal excavations as required.
    c. Overexcavation performed beyond specified or directed paylines and embankment and compaction of embankment for such overexcavation shall be at the expense of the Contractor.

B. Compacted Refill for Lining:

1. Measurement: Volume to lines, grades, and dimensions of final cross section shown on drawings.
    a. Required overbuild will not be included.
2. Payment: Cubic yard price offered in the schedule.
    a. Includes excavating, handling, replacing, moistening, and compacting material in place.
    b. No payment will be made for the removal and reconstruction of defective and nonconforming refill compacted to an insufficient density.

C. Trimming Foundation for Concrete Canal Lining:

1. Measurement: Surface area trimmed.
2. Payment: Square yard price offered in the schedule.

D. Constructing Canal Embankments:

1. Measurement: Volume to lines, grades, and dimensions shown on drawings, or as directed by COR.

a. Constructing canal embankments includes construction of all canal embankments except for that between canal station 342+00 and canal station 354+75.71, which is included in reservoir earthwork.

b. **Constructing canal embankments includes construction of all access road embankments related to the trapezoidal crossing at canal station 172+24.82.**

2. Payment: Cubic yard price offered in the schedule.

a. Includes moistening and handling of material from canal excavation.

b. Includes hauling, moistening and handling of necessary material from reservoir excavation.

c. Material from required excavations used for constructing canal embankments will be paid for both as excavation for canal and/or reservoir when removed from original position and as constructing canal embankments when placed.

d. Includes preparing canal embankment foundation surfaces.

E. Compacting Canal Embankments:

1. Measurement: Volume to lines, grades, and dimensions shown on drawings, or as directed by COR.

a. Compacting canal embankments includes compaction of all canal embankments except for that between canal station 342+00 and canal station 354+75.51, which is included in compacting reservoir embankments.

b. **Compacting canal embankments includes compacting all access road embankments related to the trapezoidal crossing at canal station 172+24.82.**

2. Payment: Cubic yard price offered in the schedule.

a. Includes, handling, placing, moistening, and compacting material in place.

b. Includes procuring and applying water for compacting embankments.

c. No payment will be made for the removal and reconstruction of defective and nonconforming embankment compacted to an insufficient density.

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. Tolerances: Allowable variations from specified lines, grades, and dimensions.

D. Variation: Distance between the actual dimension and grade of the canal cross section or alignment and the specified position in plan for the canal cross section or alignment.

1.03 PROJECT CONDITIONS

A. Required excavation for the canal does not provide sufficient materials for construction of canal embankments. Additional material for construction of the canal embankment shall be obtained from required excavation for the reservoir or from approved borrow source.

B. Excavated materials are predominantly fine- to medium-grained, hard sand composed of quartz and feldspar. Laboratory classifications of materials from explorations were predominantly poorly graded sand (SP). These materials shall be used to construct the embankments. Field investigations do not indicate the presence of extensive quantities of clayey or cohesive soils. Clayey or cohesive soils are not to be used in the compacted embankment portion of the canal embankment. Clayey or cohesive soils can be used in the embankment portion of the canal embankment.

C. To facilitate excavation of the predominantly sandy soils, prewetting has been beneficial on the All American Canal lining project. The addition of water increases the firmness of the soil and allows more efficient operation of equipment.

D. The natural moisture content of material from required excavation averages 2 percent. Application of water prior to and during construction is necessary to obtain compaction of the materials.

PART 2 PRODUCTS

2.01 COMPACTED REFILL FOR LINING

A. Obtain material from required excavation or from approved borrow source.

B. Maximum particle size: 3 inches in maximum dimension.

C. Unsuitable materials:

1. Material containing brush, roots, sod, or other organic materials.
2. Clayey or cohesive soils as determined by the COR.
3. Excavated material that has been improperly handled such that contamination and particle breakdown has occurred to a sufficient degree as being deemed unsuitable by the COR

2.02 COMPACTED EMBANKMENT MATERIAL

A. Obtain material from required excavation or from approved borrow source.

B. Maximum particle size: 3 inches in maximum dimension.

C. Unsuitable materials:

1. Material containing brush, roots, sod, or other organic materials.
2. Clayey or cohesive soils as determined by the COR.

2.03 EMBANKMENT MATERIAL

A. Obtain material from required excavation or from approved borrow source.

B. Maximum particle size: 3 inches in maximum dimension.

C. Unsuitable materials:

1. Material containing brush, roots, sod, or other organic materials.
2. Clayey or cohesive soils as determined by the COR.

PART 3 EXECUTION

3.01 PREPARATION FOR EXCAVATION

A. Clear, grub, and strip areas to be excavated including borrow areas and stockpile areas in accordance with Sections 02232 – Clearing and Grubbing and 02236 – Stripping.

B. Remove and control water in accordance with Section 02242 – Removal and Control of Water.

C. Prior to and during excavation of the canal, prewet materials to the depth of excavation to provide moisture content that readily facilitates excavation and material handling.

3.02 PREWETTING CANAL EXCAVATION

A. Apply moisture by sprinkler irrigation.

B. Control application of water, and check depth of water penetration during application so as to avoid over-irrigation.

C. All material shall be dust-free when excavated, loaded, and hauled.

D. If excessive moisture is encountered take measures to reduce moisture by selective excavation to secure drier material; by excavating and placing in temporary stockpiles

materials containing excessive moisture; by allowing adequate additional time for drying; or by other approved means.

3.03 CANAL EXCAVATION

A. Excavate canal to lines, grades and dimensions shown on drawings or established by COR.

B. Do not excavate beyond depths shown on drawings unless directed by COR.

C. Handle suitable excavated material to minimize contamination and particle breakdown.

D. Where unsuitable material is encountered, the COR will direct performance of additional excavation to remove unsuitable material.

1. Refill additional excavation with material as directed by the COR.

3.04 ADDITIONAL EXCAVATION

A. Perform additional excavation beyond specified lines as directed by the COR.

3.05 OVEREXCAVATION

A. If foundation material is excavated beyond required lines, fill overexcavation with suitable materials and compact in accordance with Compacting Embankments article below.

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 Compacting Embankments article below.

3.06 FOUNDATION INSPECTION

A. The COR will inspect all foundation surfaces.

B. Provide a minimum twenty-four (24) hours notice to the COR before a section of foundation surface is ready for inspection.

C. The Government may require up to twenty four (24) hours to map, inspect, test, and approve a section of foundation.

3.07 REPAIR OF FOUNDATION

A. Repair damage to foundation beyond required excavation lines at Contractor's expense.

3.08 PREPARATION OF SURFACES UNDER CANAL EMBANKMENTS

A. Perform stripping in accordance with Section 02236 – Stripping.

B. Prior to placement of compacted embankment, compact the embankment foundation with four (4) passes of a vibratory roller as specified in Compacting Canal Embankments article below.

C. Add water to aid compaction in accordance with Section 02302 – Compacting Earth Materials.

3.09 CONSTRUCTING CANAL EMBANKMENTS

A. Construct canal embankments to top widths and side slopes as shown on drawings.

B. Canal embankments may be constructed using excavating and hauling equipment or by excavating equipment depositing the material directly from excavation.

C. Construct in lifts of 12 inches maximum thickness.

D. Route equipment over embankments not to be compacted to distribute wheel loading uniformly over the fill section for uniform coverage by the equipment.

E. Place finer materials from excavation in portion of embankment nearest the water and coarser materials towards outer portions of embankment.

F. In conjunction with canal embankment construction, construct operation and maintenance roads adjacent to the canal and structures as shown on drawings.

1. Grade finished surfaces of operation and maintenance road for placement of gravel surfacing in accordance with Section 02732 – Gravel Surfacing.

3.10 COMPACTING CANAL EMBANKMENTS

A. Add water to aid compaction. The moisture content of compacted embankment material prior to and during compaction shall be in accordance with Section 02302 – Compacting Earth Materials.

B. Compaction equipment: Compact with vibrating pad foot rollers, or vibrating smooth drum rollers, single or dual drum.

1. Drums:

a. Static weight at drum dry: Minimum 20,000 pounds.

b. Centrifugal force per drum: Minimum 45,000 pounds when operating between 1,200 and 2,000 vibrations per minute.

2. Provide a vibratory roller with a Compaction Meter Value (CMV) instrumentation system with operator display, or equivalent as approved by the COR, to assist the operator in monitoring compaction.

a. CMV data will not be used as a basis for acceptance or rejection of degree of compaction as required in this article and Section 02302 – Compacting Earth Materials.

3. Operate at constant frequency and at speeds not to exceed 1-1/2 miles per hour.

4. Do not allow roller to remain stationary with the vibrating mechanism operating.

C. Compact embankments in accordance with Section 02302 – Compacting Earth Materials with the following exceptions:

1. Compact by vibratory roller to obtain an in-place density of:

a. Minimum of 98 percent compaction, or

b. Minimum of 80 percent relative density, or

c. Minimum of 98 percent relative compaction.

2. Minimum number of roller passes: 4.

D. One pass is defined as the number of successive trips with overlap to ensure coverage of the entire surface of each layer by the roller drum. Do not make the second and subsequent passes until the previous pass is complete.

3.11 COMPACTED REFILL FOR LINING

A. Place material over excavated surfaces with low ground pressure (LGP) wide track crawler type dozer.

1. Ground pressure, maximum: 5 lb/in^2.

2. Place material in horizontal lifts.

B. Compact material with vibrating pad foot roller or smooth drum vibratory roller in accordance with Section 02302 - Compacting Earth Materials.

C. Overbuild compacted refill slopes above concrete lining at least 6-inches beyond lines shown on drawings.

D. Trim compacted refill for lining to lines shown on drawings.

3.12 TRIMMING FOUNDATION FOR CONCRETE CANAL LINING

A. Do not trim for lining more than 48 hours before placing concrete canal lining.

B. Dimensions and grades of finished trimmed foundation to be in accordance with the following tolerances.

1. Variation in elevation for invert of canal: Plus or minus 0.05 foot.

2. Variation from specified width of section at any height: Plus or minus 0.25 foot.

3. Departure from established horizontal alignment on tangents along the canal: 0.30 foot.

4. Departure from established horizontal alignment on curves along the canal: Plus or minus 0.50 foot.

C. Plus or minus variations indicate a permitted actual position up or down and in or out from the specified position in plan.

D. Variations not designated as plus or minus indicate the maximum deviation permitted between designated successive points on the complete element of construction.

3.13 MAINTAINING CANAL PRISM

A. During time interval between trimming canal prism and placing concrete canal lining, keep surfaces of canal prism wet by sprinkling with a fine spray.

1. Fine spray to keep canal prism continually moist but not to an extent to cause erosion of the canal prism.

2. Method of applying water to canal prism and amounts of water applied subject to approval by COR.

B. Maintain moisture content of trimmed canal sections to 6 inch depths to prevent sloughing or raveling of the slope.

3.14 DISPOSAL

A. Dispose of unsuitable or excess excavated materials in accordance with Section 02324 - Disposal of Excavated Materials.

END OF SECTION

SECTION 02318 - EARTHWORK FOR STRUCTURES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Excavation for Structures:

1. Measurement: Volume to 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. 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. Measurement for payment for excavation for structures will not include materials measured for payment as excavation for other features in accordance with other applicable sections. Where paylines overlap, measurement for payment will be made only once in accordance with this section.

   d. Structures which form a continuation of the canal or pipeline:

      1) Measurement of excavation for structures will include all required excavation for the structure below the original ground surface and between vertical planes at the upstream and downstream ends of the structure. Such measurement will also include any excavation for the structure upstream and downstream of these vertical planes which may be required outside of the paylines for canal excavation and pipe excavation.

      2) Measurement of excavation upstream and downstream of the vertical planes will be made to dimensions 1 foot outside of the foundations of the structures and to slopes of **2**:1.

   e. Structures within Reservoir and Forebay/Afterbay:

      1) Measurement of excavation for structures will include all required excavation for the structure below the excavation limits shown on the drawings for reservoir excavation and forebay/afterbay excavation.

   f. Includes excavation and hauling of clayey or cohesive soils for geomembrane soil cover.

   g. Where excavating in backfill and embankment previously placed under these specifications, no additional payment will be made.

2. Payment: Cubic yard price offered in the schedule.

   a. Includes cost of labor and materials for work necessary to maintain excavations in good order during construction; removing such temporary construction, where required, and disposing the excavated material except as provided below.

   b. Includes cost of excavation and hauling of clayey or cohesive soils to geomembrane soil cover.

   c. The cost of excavating trenches for buried electrical grounding cables, insulated cables or conductors, and conduit shall be included in the prices offered in the schedule for items for which the excavation is required.

   d. Does not include excavation for control building. Refer to Section 02001 – Control Building.

B. Backfill about Structures:

1. Measurement: Volume to paylines shown on the drawings.

2. Payment: Cubic yard price offered in the schedule.

   a. Includes hauling and handling of necessary material. Material from required excavation used for backfill will be paid for both as excavation when removed from original position and as backfill when placed.

   b. Where additional material is obtained from approved borrow pits and used for backfill about structures, payment will be made for backfill only.

   c. Overexcavation performed outside the established paylines for excavation for structures shall be at the expense of the Contractor.

   d. Include cost of backfilling about guard post footings in lump sum price offered in the schedule for miscellaneous metalwork.

   e. Include cost of backfilling in trenches for buried electrical grounding cables, insulated cables or conductors, and conduit in the applicable prices offered in the schedule for items for which compacting backfill is required.

   f. Does not include backfill for control building. Refer to Section 02001 – Control Building.

   g. No payment will be made for the removal and reconstruction of defective and nonconforming backfill compacted to an insufficient density.

C. Compacting Backfill about Structures:

1. Measurement: Volume in place to the lines shown on the drawings, as prescribed in this section, or as directed by the COR and will be made only for the quantities actually compacted within the limits of the established paylines for backfill about structures.

2. Payment: Cubic yard price offered in the schedule.

   a. Compacting refill for overexcavation outside excavation paylines shall be at the expense of the Contractor.

   b. Include cost of compacting backfill about guard post footings in lump sum price offered in the schedule for miscellaneous metalwork.

   c. Include cost of compacting backfill in trenches for steel pipe, buried electrical grounding cables, insulated cables or conductors, and conduit in the applicable prices offered in the schedule for items for which compacting backfill is required.

   d. Does not include compacting backfill for control building. Refer to Section 02001 – Control Building.

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.

1.03 PROJECT CONDITIONS

A. Excavated materials are predominantly fine- to medium-grained, hard sand composed of quartz and feldspar. Laboratory classifications of materials from explorations were predominantly poorly graded sand (SP). These materials will be used to construct the embankments. Field investigations do not indicate the presence of extensive quantities of clayey or cohesive soils. Clayey or cohesive soils are not to be used for backfill about structures. Clayey or cohesive soils can be used for geomembrane soil cover.

B. To facilitate excavation of the predominantly sandy soils, prewetting has been beneficial on the All American Canal lining project. The addition of water increases the firmness of the soil and allows more efficient operation of equipment.

C. The natural moisture content of material from required excavation averages 2 percent. Application of water prior to and during construction will be necessary to obtain compaction of the materials.

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.

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 in backfill or embankments.

2.02 MATERIAL FOR BACKFILL

A. Obtain backfill material from material excavated in required excavation for structures. If sufficient suitable material is not available from this source, obtain additional material from required reservoir excavation or from approved borrow pits.

B. Maximum particle size: 3 inches in maximum dimension.

C. Unsuitable materials:

1. Material containing brush, roots, sod, or other organic materials.
2. Clayey or cohesive soils as determined by the COR.

D. 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. Obtain from required excavation for the reservoir or from borrow source approved by COR.

B. Maximum particle size: 3 inches in maximum dimension.

C. Unsuitable materials:

1. Material containing brush, roots, sod, or other organic materials.
2. Clayey or cohesive soils as determined by the COR.

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, except for pre-wetting.

E. Blasting: Not allowed.

F. Take precautions to preserve material below and beyond established lines of excavation in the soundest possible condition.

1. Damage to foundations 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 and replaced by and at the expense of the Contractor.

3.02 SURFACES OF EXCAVATION

A. Except for bottom surfaces of trenches and surfaces of excavation that are to be covered with concrete or surfacing materials, sharp points of undisturbed material will be permitted to extend within the prescribed excavation lines not more than 2 inches.

3.03 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. To form firm foundations upon or against which will be placed either the structure or concrete protective coating compact the foundation material to inplace density specified in Compacting Backfill article below.

3. Add water to aid compaction in accordance with Section 02302 – Compacting Earth Materials.

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. Backfill additional excavation with compacted backfill in accordance with Compacting Backfill article below.

C. Increase depth of minimum excavation lines for concrete structures shown on drawings by 3 inches to allow concrete protective coatings to be applied.

D. Apply concrete protective coatings in accordance with Section 03300 – Cast-In-Place Concrete.

3.04 OVEREXCAVATION

A. If foundation material is excavated beyond lines required to receive the structure, fill overexcavation with suitable materials and compact in accordance with Compacting Backfill article below.

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 Compacting Backfill article below.

3.05 FOUNDATION INSPECTION

A. The Government will inspect all foundation surfaces.

B. Provide a minimum twenty-four (24) hours notice to the COR before a section of foundation surface is ready for inspection.

C. The Government may require up to twenty four (24) hours to map, inspect, test, and approve a section of foundation.

D. Where additional excavation or overexcavation is performed, the COR will inspect and approve the foundation surface before backfill is placed.

3.06 REPAIR OF FOUNDATION

A. Repair damage to foundation beyond required excavation lines at Contractor's expense.

3.07 TRENCHES FOR BURIED ELECTRICAL GROUNDING CABLES, INSULATED CABLES OR CONDUCTORS, AND CONDUIT

A. Excavate trenches to depths to provide a minimum of 24 inches of cover over the cables, conduits, and conductors.

B. Excavate trenches to provide minimum bottom widths sufficient to place 2 inches of sand between the trench sides and the closest cable, conduit, or conductor.

3.08 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 02324 - Disposal of Excavated Materials.

3.09 PLACING BACKFILL

A. Place backfill to the lines and grades shown on the drawings, or as directed by the COR.

B. Place backfill in accordance with Section 02302 – Compacting Earth Materials.

C. Do not place backfill against concrete, soil cement, or CLSM until design strength is reached.

D. Backfill trenches to the finished lines of adjacent earthwork.

3.10 COMPACTING BACKFILL

A. Add water to aid compaction in accordance with Section 02302 – Compacting Earth Materials.

B. Compact backfill in accordance with Section 02302 – Compacting Earth Materials with the following exceptions:

1. Compact materials to obtain an in-place density of:
    a. Minimum of 98 percent compaction, or
    b. Minimum of 80 percent relative density, or
    c. Minimum of 98 percent relative compaction.

C. Perform special compaction in accordance with Section 02302 – Compacting Earth Materials at locations shown on drawings.

3.11 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

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SECTION 02321 – EXCAVATION FROM BORROW

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in applicable prices offered in the schedule for placement of the materials obtained from borrow.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01330 - Submittals.

B. RSN 02321-1, Borrow Area Use Plan

1. Describe anticipated use, borrow area layout, equipment and operations.

1.03 PROJECT CONDITIONS

A. Based on anticipated materials usages, excavation from borrow should not be required to provide material for embankments. However, should additional embankment material be required, a borrow area has been designated on the drawings.

B. The approximate limits of the borrow areas are shown on the drawings.

C. The exact limits will be approved by the COR.

D. Borrow pits adjacent to the embankment provide the potential for instability. Therefore, borrow should be filled to the original ground surface with material from stripping.

E. Excavated materials are predominantly fine- to medium-grained, hard sand composed of quartz and feldspar. Laboratory classifications of material from explorations were predominantly poorly graded sand (SP). These materials will be used to construct the embankments. Field investigations do not indicate the presence of extensive quantities of clayey or cohesive soils. Any clayey or cohesive soils are **not** to be used for compacted embankments. **Clayey or cohesive soils can be used for geomembrane soil cover in the reservoir or wasted within the borrow pit.**

F. To facilitate excavation of the predominantly sandy soils, prewetting has been beneficial on the All American Canal lining project. The addition of water increases the firmness of the soil and allows more efficient operation of equipment.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 EXCAVATION OPERATIONS

A. Do not operate outside of borrow area boundaries shown on drawings.

B. Perform borrow area operations in accordance with all applicable federal, state, and local regulations.

C. Prior to and during excavation of borrow material, prewet materials to the depth of excavation to provide moisture content that readily facilitates excavation and material handling.

D. Perform clearing, grubbing, and stripping in accordance with Section 02232 - Clearing and Grubbing and Section 02236 - Stripping in such manner to leave sites in a condition for future use.

E. Unless approved by the COR, do not excavate beyond 10 feet depth below the original ground surface.

F. Utilize suitable materials obtained from required excavation before obtaining materials from borrow areas.

G. Excavate sufficient suitable materials from borrow areas to complete required work.

H. Dispose of unsuitable excavated earth materials or selectively excavate and leave unsuitable material in place.

3.02 BORROW PIT COMPLETION

A. Fill with material from stripping.

B. Place in approximately 12 inch lifts.

C. Compact with uniform distribution of equipment travel.

D. Add water as required to facilitate dust abatement and compaction.

END OF SECTION

SECTION 02324 - DISPOSAL OF EXCAVATED MATERIALS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include cost in prices offered in the schedule for excavation.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 DISPOSAL OF EXCAVATED MATERIALS

A. Dispose of material from required excavation which is not suitable for backfill or embankment or is in excess of that required for backfill or embankment.

B. Deposit waste excavated material in waste banks in **the northwest corner of the reservoir site** as shown on drawings or as directed by COR.

C. Do not waste material by dumping from top of slope.

D. Grade waste banks to reasonably even and uniform surfaces that blend with natural terrain.

1. Minimum slope: 2 percent.
2. Maximum slope: 4:1.

E. Leave surface in a condition that will facilitate natural revegetation.

F. Spread topsoil over disposal areas in accordance with Section 02236 – Stripping.

END OF SECTION

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SECTION 02332 - ROCKFILL

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Rockfill:

1. Measurement: Volume to lines, grades, and dimensions shown on drawings.
2. Payment: Cubic yard price offered in the schedule.
   a. Includes processing to break oversize material to required dimensions for rock placed in the reservoir and for rock placed in the Coachella Canal temporary bypass channel.
   b. Does not include hauling and placing rock for the Coachella Canal temporary bypass channel. Refer to Section 02261 – Diversion and Care of Coachella Canal During Construction.

PART 2 PRODUCTS

2.01 ROCK

A. Obtain from Government-Furnished stockpile located on west side of reservoir site in accordance with Section 01640 – Government-Furnished Products.

B. **Estimated rockfill gradation by volume of material in stockpile is shown in Table 02332A – Estimated Rockfill Gradation.**

Table 02332A – Estimated Rockfill Gradation

Size	Percent Passing
3 – foot	**90 – 95**
2 – foot	**30 - 50**
1 – foot	**15 - 25**
6 – inch	**0 - 5**

C. The rockfill stockpile contain**s** material larger than 2-foot maximum size. Processing **is** required to reduce the maximum size of the material to specified limits. **Based on the estimated gradation, screening of the material by itself may not produce sufficient quantities of material within the specified limits for rockfill and rock.**

D. **Based on the estimated gradation, the** Contractor shall determine the extent of processing required to obtain the specified range of material size.

E. Reasonably well graded in accordance with the following:

1. Minimum size: 6 inches.
2. Maximum size: 24 inches.
3. Rock may contain material less than 6 inches in maximum size provided that the quantity shall not exceed an amount which fills the voids in the larger material.

PART 3 EXECUTION

3.01 PROCESSING

A. Process the material using a hoe-ram or other approved mechanical means to break oversize material to the required dimensions.

B. Process a sufficient quantity of material from the Government furnished stockpile to meet the requirements for rockfill in the reservoir and for rock used in the Coachella Canal temporary bypass in accordance with Section 02261 – Diversion and Care of Coachella Canal During construction.

3.02 PLACING

A. Place in continuous, approximately horizontal layers.

B. Place rockfill to the lines, grades, and thickness shown on the drawings.

C. Place rocks so that larger rocks are evenly distributed and small rock fragments fill the spaces.

D. Dump and smooth by moving rocks into position so that material when in place is stable.

E. Placing rockfill on geosynthetics:

1. Drop height, maximum: 1-foot.
2. Before placing rockfill, demonstrate that placing technique will not damage geotextile or underlying geomembrane.
    a. If the demonstration does not show that rockfill can be installed without damaging geosynthetic materials, modify rockfill placing technique.
    b. Possible modifications to placing technique include reducing drop height.

F. Begin rockfill placement at soil cement weir.

G. Do not compact rockfill.

END OF SECTION

SECTION 02344 – GEOMEMBRANE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Geomembrane:

1. Measurement: Surface area required to be covered including geomembrane placed in anchor trench, except no allowance will be made for seam overlap, repair, or waste.
2. Payment: Square yard price offered in the schedule.
   a. Includes boots, batten attachments, and anchoring accessories.

1.02 REFERENCES

A. ASTM International (ASTM)

1.	ASTM D 638-03	Tensile Properties of Plastics
2.	ASTM D 792-00	Density and Specific Gravity (Relative Density) of Plastics by Displacement
3.	ASTM D 1004-07	Tear Resistance (Graves Tear) of Plastic Film and Sheeting
4.	ASTM D 1505-03	Density of Plastics by the Density-Gradient Technique
5.	ASTM D 1603-06	Carbon Black Content in Olefin Plastics
6.	ASTM D 3895-07	Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
7.	ASTM D 4437-99	Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes
8.	ASTM D 4833-07	Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
9.	ASTM D 5199-01(2006)	Measuring the Nominal Thickness of Geosynthetics
10.	ASTM D 5397-07	Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
11.	ASTM D 5596-03	Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
12.	ASTM D 5721-95(2002)	Air-Oven Aging of Polyolefin Geomembranes

13.	ASTM D 5885-06	Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry
14.	ASTM D 7238-06	Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Flouorescent UV Condensation Apparatus

B. Geosynthetics Institute (GSI) – Geosynthetic Research Institute (GRI)

1.	GRI GM 12 - 1998	Asperity Measurement of Textured Geomembranes Using a Depth Gage
2.	GRI GM 13 - 2006	Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes
3.	GRI GM 19 - 2005	Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembrane.
4.	GRI GM 24 - 2007	Nondestructive Air Channel Evaluation and Acceptance Criteria of Polyethylene Dual Track Seamed Geomembranes

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01330 - Submittals.

B. RSN 02344-1, Geomembrane Installer Qualifications and Installation Plan.

1. Qualifications of installation company.
    a. Name and address.
    b. Documentation of previous experience with specified geomembrane.
        1) Names of facility owner(s).
        2) Person to contact at facilities who can discuss projects listed.
        3) Project manager, designer, manufacturer, fabricator (if any).
        4) Locations, thicknesses, and area in square feet of geomembrane installed.
        5) Types of seaming and patching equipment used.
        6) Dates of installation.
2. Onsite personnel experience.
    a. Resumes, including dates and duration of employment and pertinent experience.
3. Manufacturer's technical representative(s).

a. Resume(s), including dates and duration of employment and pertinent experience.

4. Manufacturer's instructions for delivery, storage, and handling of geomembrane materials.

5. Geomembrane installation plan.

a. Work schedule.

b. Location, size, orientation, and identification (including whether textured or smooth) of panels and continuous seams.

c. Sequencing of panel installation.

d. Equipment and procedures for handling and installing panels.

e. Equipment and procedures for continuous seaming.

f. Equipment and procedures for geomembrane boots around reservoir penetrations.

g. Equipment and procedures for field testing adequacy of seaming equipment and seams.

h. Details of equipment, products, and procedures for cleaning, protecting, and repairing geomembrane and seams.

i. Equipment and procedures for geomembrane attachment to concrete structures.

j. Number of crews and crew size.

k. Contractors Quality Control (QC) Plan

C. RSN 02344-2, Qualifications of Manufacturer and Fabricator:

1. Name and address of geomembrane manufacturer.

2. Name and address of panel fabricator, if different from manufacturer.

3. Evidence of manufacturer experience

a. Name, location, owner, and purpose of completed facility.

b. Name and telephone number of contact at facility who can discuss project.

c. Geomembrane type and thicknesses, total square footage of installation, installation date, project manager, designer, fabricator (if any), and installer.

4. Descriptive documentation of manufacturer's quality control program.

D. RSN 02344-3, Notice of Start of Production.

E. RSN 02344-4, Certifications:

1. Certified test results of physical properties tests listed in Tables 02344B - HDPE Geomembrane Physical Properties, Submit at frequency specified in GRI GM-13. Identify with production date, roll goods number, and quantity represented
2. Manufacturer's certification that resin used in manufacture of geomembrane being furnished meets requirements of these specifications.
3. Copies of quality control certificates issued by resin supplier.
4. Certification that geomembrane and extrusion welding rod or pellets produced for use under this contract have the same properties and are compatible.

F. RSN 02344-5, Samples:

1. Submit samples from rolls of geomembrane to be furnished.
2. Sample the number of rolls as required in Table 02344A - Geomembrane Sampling Requirements.
3. Take 12-inch long samples from entire roll width.
4. Mark samples with contract name and number, product identification, lot number, roll number, machine direction, and quantity represented.
5. Sampling frequency may be increased if test results show that geomembrane does not meet specifications requirements.

Table 02235A - Geomembrane Sampling Requirements

Number of rolls To be furnished	Number of rolls to be sampled
1 – 2	1
3 – 8	2
9 – 27	3
28 – 64	4
65 – 125	5
126 – 216	6
217 – 343	7
344 – 512	8
513 – 729	9
730 – 1000	10

G. RSN 02344-6, Warranty:

1. The Contractor shall warrant the geomembrane installation workmanship to be free of defects for a period of 2 years.

2. Provide manufacturer's warranty that geomembrane material to be free of defects or failure for a period of 20 years.

H. RSN 02344-7, Surveyed As-Built Drawings.

1. Surveyed panel layout drawings.

2. Locations of patches, repairs, and destructive samples.

3. Deviations from panel layout drawings submitted as part of geomembrane installation plan.

1.04 QUALIFICATIONS

A. Onsite Geomembrane Installation Supervisor:

1. Installed or supervised installation and seaming of a minimum of 2,000,000 square feet of specified geomembrane.

B. Onsite Geomembrane Master Welder (Seamer);

1. Completed within the last 5 years, a minimum of 2,000,000 square feet of specified geomembrane seaming work using type of seaming apparatus proposed for use on this project. The master welder (seamer) may also be the installation supervisor/field engineer.

C. Other Onsite Geomembrane Welders (Seamers):

1. Seamed, within the past 3 years, a minimum of 100,000 square feet of specified geomembrane.

D. Geomembrane Manufacturer:

1. Completed facilities totaling at least 5,000,000 square feet of specified geomembrane.

E. Manufacturer's Technical Representative:

1. Qualified to provide technical advice on materials and procedures for installation.

F. Installer:

1. At least three separate and satisfactory installations totaling at least 2,000,000 square feet of specified geomembrane.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Ship, handle, store, and care for geomembrane in accordance with manufacturer's instructions.

B. Pack geomembrane in snug-fitting containers having smooth, abrasive-free interior to prevent damage to geomembrane during transit and handling.

1. Use containers having structurally sound bottoms designed for lifting with forklift-type trucks or approved cables or slings.

2. Mark each container of geomembrane with name of material, approved roll good numbers, specifications number, quantity contained, name of Contractor, and order or purchase number.

C. Do not stack rolls more than 3 rolls high.

D. Cover rolls of geomembrane with tarp if onsite for more than 30 days.

E. Protect geomembrane from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat or cold, direct sunlight or other damage.

1.06 PROJECT ENVIRONMENTAL REQUIREMENTS

A. Do not perform field seaming when geomembrane is wet or when wind is displacing geomembrane panels.

B. Seam only when air temperature is above 35 degrees F and below 104 degrees F.

C. Expect wind and extreme temperature variations.

1.07 SAFETY

A. Take precautions against “snowblindness” of personnel when working on white-colored geomembrane.

PART 2 PRODUCTS

2.01 GEOMEMBRANE

A. HDPE-white geomembrane meeting requirements of GRI GM-13.

1. Virgin HDPE resin with no more than 10 percent rework.

2. Co-extruded, light reflective HDPE geomembrane with a UV-stabilized, white upper surface. White surface 3 to 5 mils thick.

3. Geomembrane boots fabricated from the same HDPE geomembrane. Boots custom fabricated at the HDPE geomembrane factory and shipped to the jobsite for installation

4. Conform to requirements of Table 02344B – HDPE Geomembrane Physical Properties. Unless otherwise indicated, required values are minimum average roll values (MARV) when tested in weaker principle direction.

5. **Textured geomembrane shall be textured on both sides.**

Table 02344B – HDPE Geomembrane Physical Properties

Property	Test Method	Smooth	Textured
Thickness, minimum average Lowest individual, 8 of 10 Lowest individual of 10 values	ASTM D 5199	60 mils --- 54 mils	57 mils 54 mils 51 mils
Asperity Height	GRI GM-12	---	**15** mils
Density (minimum)	ASTM D 1505 ASTM D 792	0.940 g/cc	0.940 g/cc
Tensile properties (MARV) Yield strength Breaking strength Yield Elongation Breaking Elongation	ASTM D 638 Type IV	 126 lbs / inch 228 lbs / inch 12 percent 700 percent	 126 lbs / inch 90 lbs / inch 12 percent 100 percent
Tear strength (MARV)	ASTM D 1004	42 lbs	42 lbs
Stress Crack Resistance	ASTM D 5397 Appendix	300 hours	300 hours
Carbon black content – range	ASTM D 1603	2.0 – 3.0 %	2.0 – 3.0 %
Carbon black dispersion	ASTM D 5596	Category 1 or 2 (9 of 10)	Category 1 or 2 (9 of 10)
Puncture resistance (MARV)	ASTM D 4833	90 lbs	90 lbs
Oxidative Induction Time MARV (a) Standard OIT Or (b) High Pressure OIT	 ASTM D 3895 ASTM D 5885	 100 minutes 400 minutes	 100 minutes 400 minutes
Oven aging @ 85°F Percent retained @ 90 days (a) Standard OIT Or (b) High Pressure OIT	ASTM D 5721 ASTM D 3895 ASTM D 5885	 55 % 80 %	 55 % 80 %
UV Resistance High pressure OIT (MARV) (% retained after 1600 hrs)	ASTM D 7238 ASTM D 5885	 50 %	 50 %

Table 02344B – HDPE Geomembrane Physical Properties

Property	Test Method	Smooth	Textured
Factory and Field Seams	GRI GM 19		
Hot Wedge Seams			
Shear Strength [1]		120 lbs / inch	120 lbs / inch
Shear Elongation		50 percent	50 percent
Peel Strength [1]		91 lbs / inch	91 lbs / inch
Peel Separation		25 percent	25 percent
Extrusion Seams			
Shear Strength [1]		120 lbs / inch	120 lbs / inch
Shear Elongation		50 percent	50 percent
Peel Strength [1]		78 lbs / inch	78 lbs / inch
Peel Separation		25 percent	25 percent

[1]Seam Strengths – 4 of the 5 specimens must meet the listed values. The 5th specimen must demonstrate 80 percent of the listed values.

2.02 ACCESSORIES

A. Batten Strips and Anchors

1. **Stainless Steel: SS 316.**
2. **Other details** in accordance with geomembrane manufacturer's recommendations.

2.03 SOURCE QUALITY ASSURANCE

A. The COR reserves the right to inspect and obtain samples for testing during factory manufacture/fabrication at beginning of production and subsequently.

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

A. Prepare surface upon which geomembrane is to be placed to a firm surface, reasonably even and smooth, and free of abrupt indentations and protruding materials (offsets) greater than 3/4 inch.

B. Remove gravel over 1-inch, vegetative matter, brush, large roots, or other objectionable foreign matter.

C. Obtain COR approval of subgrade before installing geomembrane.

D. Prepare subgrade in accordance with Section 02319 – Reservoir Earthwork.

3.02 INSTALLATION

A. Install geomembrane in accordance with this section, as shown on drawings, and in accordance with approved geomembrane installation plan.

B. Install 60-mil textured HDPE white geomembrane on the sideslopes, and 60-mil smooth HDPE white geomembrane on the invert as shown on the drawings.

C. Install geomembrane with the white surface facing up.

D. Have manufacturer's technical representative(s) onsite during geomembrane installation.

1. Manufacturer's technical representative(s) shall exercise technical control of installation, observe the work, instruct and/or make recommendations to the installers as required, and report unsatisfactory conditions to the COR.

E. Properly protect and maintain any completed geomembrane installations during periods of geomembrane installation inactivity in accordance with approved installation plan.

F. Install geomembrane rolls with the seams running up and down the slopes. Seams perpendicular to the sideslopes are not allowed unless approved by the COR.

G. Anchor geomembrane in anchor trench as shown on drawings. Hold in place by using sandbags or other approved means until ready for backfill.

H. Place lining in a slackened condition so as to conform to subgrade contour without becoming taut when covered with soil cement cover material.

I. Ballast to prevent relocation of compensating slack by wind and to prevent uplift by wind at edges, ends, and other locations as required.

J. Install geomembrane boots as shown on the drawings and in accordance with the approved geomembrane installation plan. Boots shall be watertight.

K. Attach geomembrane to concrete structures using batten strips and anchor bolts as shown on the drawings and in accordance with approved geomembrane installation plan.

L. Wrinkles:

1. Install geomembrane and cover materials so to minimize geomembrane wrinkles.
2. Cut-out and repair wrinkles in geomembrane and geomembrane seams during coolest part of day as determined by COR before covering.
3. Install geomembrane and cover materials to achieve intimate contact (pressed-fit) between subgrade, geomembrane and cover material.
4. Work geomembrane wrinkles upslope into the anchor trench.
5. Install cover material over geomembrane during coolest part of the day.

6. Take special care to prevent wrinkles on south-facing slopes.

3.03 FIELD SEAMS

A. Perform continuous field seaming in strict accordance with the approved geomembrane installation plan and this section.

B. Acceptable processes for field seaming are fusion welding and extrusion welding. Extrusion welding is restricted to repairs and welding applications not possible by fusion welding.

C. Field seams shall form a continuous, homogeneous connection between geomembrane panels.

D. Field seams shall be continuous from the downstream edge of the top geomembrane runout (top) to the upstream edge of the bottom geomembrane runout (bottom).

E. Install and field seam the geomembrane under the direct guidance of the geomembrane manufacturer's technical representative and in the direct presence of the installer's geomembrane installation supervisor/field engineer and/or master welder.

F. Contact surfaces to be field seamed shall be dry and thoroughly cleaned of all dirt, dust, grease, oil, and other foreign materials.

G. Where seaming of geomembrane panels is required to fabricate the connection between separate portions of the geomembrane installation, the Contractor shall remove any protective materials used, such as tape, and shall thoroughly clean the geomembrane surface(s) to be seamed, using appropriate cleaning agents.

H. Joining adjacent panels:

1. Overlap geomembrane according to manufacturer's recommendations.
2. Fusion weld using only approved methods for primary field seaming method.
3. Finished overlap, minimum: 4 inches, provided, that overlap sufficient to allow peel tests to be performed on seam.

I. Fishmouths or Wrinkles

1. Place geomembrane rolls to minimize wrinkles, especially differential wrinkles between adjacent rolls. Place geomembrane rolls to obtain intimate contact between the geomembrane and subgrade.
2. Cut fishmouths or wrinkles along the ridge of the fishmouth (wrinkle) to achieve a flat overlap. Seam the cut fishmouth or wrinkle and patch any portion where the overlap is insufficient.

J. Patching geomembrane:

1. Rounded or Oval patches

2. Finished overlap, minimum: 6 inches, provided, that overlap sufficient to allow peel tests to be performed on seam.

3.04 REPAIRS

A. Repair field seams and other damaged areas according to manufacturer's recommendations and as approved in geomembrane installation plan.

B. Repair geomembrane with oval or rounded patch, which overlaps undamaged geomembrane not less than 6 inches.

C. Test repairs using vacuum method.

D. Repair and retest unbonded areas detected by air pressure testing and by vacuum testing.

3.05 CONTRACTOR FIELD QUALITY TESTING

A. General:

1. Perform all testing in presence of COR.

2. Perform tests at locations and frequencies specified in this section and at other locations and times as determined by the COR.

B. Test equipment:

1. Furnish a portable tensiometer with a load readout device.

2. Vacuum chamber (box): Apparatus manufactured by American Parts and Service Co., 2201 West Commonwealth Avenue, PO Box 702, Alhambra CA 91802, or equal, having the following essential characteristics:

a. Vacuum box assembly consisting of rigid housing, transparent viewing window, soft neoprene gasket attached to the bottom, port hole or valve assembly, and gauge to indicate chamber vacuum.

b. Steel vacuum tank and pump assembly equipped with pressure controller and pipe connections.

c. Rubber pressure/vacuum hose with fittings and connections.

C. Test seams.

1. Prepare test seams using excess geomembrane material to verify that field seaming conditions are satisfactory.

a. Conduct test seams at the beginning of each seaming shift, at a change of weather conditions, and at least once each 4-hour period during operation for each seaming crew.

b. If a test seam fails to meet seam specifications listed in Table 02344B - HDPE Geomembrane Physical Properties, the seaming apparatus and seaming crew shall not be accepted and shall not be used for field seaming

until the deficiencies are corrected and two consecutive successful test seams have been achieved.

2. Test seam:

   a. At least 3 feet in length with the seam centered lengthwise.

   b. Specimens for testing:

      1) Series of 1-inch-wide specimens cut from opposite ends of test seam.

      2) Not obtained from the first or last 6 inches of test seam.

3. Test five specimens in peel and five specimens in shear in accordance with GRI GM-19.

D. Field seams:

1. Remove 12-inch by 24-inch samples at locations selected by the COR, or when conditions indicate concern for integrity of field seams.

   a. Standard testing frequency shall be every 500 feet of seam length. Testing frequency may be decreased at discretion of COR after sufficient and continued history of successful tests.

   b. Testing locations will be selected by COR.

   c. Repair resulting holes in geomembrane with rounded patches and vacuum test.

2. Test 5 shear and 5 peel specimens from each sample per GRI GM-19.

E. Air pressure test – double wedge welds

1. Double wedge welds shall be non-destructively tested, evaluated and approved in accordance with GRI GM-24.

2. Demonstrate procedure for air pressure testing to the COR for approval before testing is begun.

3. Test procedures:

   a. Pressurize channel between the two wedge welds.

   b. Minimum Channel Pressure: 22 psi.

   c. Minimum Dwell Time: 5 minutes

   d. Allowable pressure drop: 4 psi

4. Weld cap-strip over entire length of double wedge welds that fail the air pressure test.

F. Vacuum Testing.

1. Non-destructively test extrusion weld seams by vacuum method in accordance with ASTM D 4437.
2. Demonstrate procedure for vacuum seam testing to the COR for approval before testing is begun.
3. Test procedures:
    a. Perform vacuum test with soapy solution.
    b. Maintain at least 5 psi vacuum for at least 15 seconds, without bubbles appearing from seam.
    c. Overlap 3 inches of seam with vacuum box between tests to ensure that all sections of seam are tested.

G. Recording Results:

1. Record results of test seam and field seam testing and make available to the COR at end of each shift.
2. Identify field seams, by panel and location where applicable, that initially failed seam testing.
3. Include evidence that field seams or welding equipment were repaired and successfully retested.

END OF SECTION

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SECTION 02346 – GEOTEXTILE AND GEONET COMPOSITE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Geotextile:

1. Measurement: Surface area required to be covered including geotextile placed in anchor trench, except no allowance will be made for seam overlap, repairs, or waste.

2. Payment: Square yard price offered in the schedule.

B. Geonet Composite:

1. Measurement: Surface area required to be covered, except no allowance will be made for seam overlap, repairs, or waste.

2. Payment: Square yard price offered in the schedule.

1.02 REFERENCES

A. ASTM International (ASTM)

1.	ASTM D 1505-03	Density of Plastics by the Density-Gradient Technique
2.	ASTM D 1603-06	Carbon Black Content of Olefin Plastics
3.	ASTM D 3786-06	Hydraulic Bursting Strength of Textile Fabrics – Diaphragm Bursting Strength Tester Method
4.	ASTM D 4355-07	Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon-Arc Type Apparatus
5.	ASTM D 4491-99a(2004)	Water Permeability of Geotextiles by Permittivity
6.	ASTM D 4533-04	Trapezoid Tearing Strength of Geotextiles
7.	ASTM D 4632-91(2003)	Grab Breaking Load and Elongation of Geotextiles
8.	ASTM D 4716-07	In-Plane Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
9.	ASTM D 4751-04	Determining Apparent Opening Size of a Geotextile
10.	ASTM D 4833-07	Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
11.	ASTM D 5035-06	Breaking Force and Elongation of Textile Fabrics
12.	ASTM D 5199-01(2006)	Nominal Thickness of Geosynthetics

13. ASTM D 5261-92(2003) Measuring Mass per Unit Area of Geotextiles

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01330 – Submittals.

B. RSN 02346-1, Manufacturer's certification:

1. Geotextile and Geonet Composite furnished meets specified chemical, physical, and manufacturing requirements.

C. RSN 02346-2, Geotextile Samples:

1. Include manufacturer's certified test results covering properties listed in Table 02346B - Geotextile Physical Properties.
2. Samples: One yard in length from entire roll width.
3. Mark samples:
   a. Project name and contract number.
   b. Product identification.
   c. Lot number.
   d. Roll number.
   e. Machine direction.
   f. Quantity represented.
4. Number of samples: Table 02346A - Geotextile Sampling Requirements. Frequency of sampling may be increased if a geotextile sample does not meet specification requirements.

Table 02346A – Geotextile Sampling Requirements

Number of rolls to be furnished	Number of rolls to be sampled
1 – 2	1
3 – 8	2
9 – 27	3
28 – 64	4
65 – 125	5
126 – 216	6
217 – 343	7
344 – 512	8
513 – 729	9
730 – 1000	10

D. RSN 02346-3, Geonet Composite samples

1. Three 8 inch x 10 inch samples of the Geonet composite to be used on this project

E. RSN 02346-4, Protection method:

1. Method to protect exposed geotextile and geonet composite, when covering is not possible within 14 days.

F. RSN 02346-5, Sewn geotextile seams, if used:

1. Certification stating that polymeric threads to be used for sewing have chemical resistance properties equal to or exceeding those of geotextile.

2. Include data showing that sewn seams have tensile strength of not less than specified percent of parent geotextile material.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Wrap geotextile and geonet composite rolls in relatively impermeable and opaque protective covers.

B. Mark or tag rolls of geotextile and geonet composite with manufacturer's name, product identification, lot number, roll number, and roll dimensions.

C. Protect geotextile and geonet composite from ultraviolet light exposure, temperatures greater than 140 degrees F (60 degrees C), precipitation or other inundation, mud, dirt, dust, puncture, cutting, or other damaging or deleterious conditions.

D. Elevate and cover material stored outside with waterproof membrane.

1.05 SAFETY

A. If white colored geotextile is used, take precautions against “snowblindness” of personnel.

PART 2 PRODUCTS

2.01 GEOTEXTILES

A. Needle-punched, nonwoven geotextile comprised of long-chain polymeric filaments composed of at least 85 percent, by weight, polyolefins. **Polyester geotextile is not allowed.**

B. **Color: White or light gray. Black or dark gray geotextile is not allowed.**

C. Orient filaments into stable network which retains its structure during handling, placement, and long-term service.

D. Stabilizers or inhibitors added to filament base material: Resist deterioration due to ultraviolet or heat exposure.

E. Geotextile edges: Selvaged or otherwise finished to prevent outer material from pulling away.

F. Conform to roll values listed in Table 02346B - Geotextile Physical Properties.

1. Values listed are minimum average roll values (MARVs), unless otherwise noted.

2. Test results for weaker principal direction shall meet or exceed minimum values listed in the table.

3. Mass per unit area is a nominal value and is provided for information purposes only.

G. Direct exposure to sunlight: Withstand fourteen (14) days with no measurable deterioration.

Table 02346B – Geotextile Physical Properties

Property	Test Method	Required Values
Mass per unit area, nominal	ASTM D 5261	16 oz/yd^2
Grab tensile	ASTM D 4632	380 lbs
Elongation at break	ASTM D 4632	50 percent
Trapezoidal tear	ASTM D 4533	140 lbs
Puncture strength	ASTM D 4833	230 lbs
Burst strength	ASTM D 3786	700 lb/in^2
Permittivity	ASTM D 4491	0.5 sec^{-1}
Apparent opening size (minimum US Sieve No./ maximum opening size)	ASTM D 4751	100 US Sieve
UV resistance – tensile strength retained at 500 hours, minimum	ASTM D 4335	70 percent

2.02 GEONET COMPOSITE

A. Consists of a geonet with needle-punched non-woven geotextile bonded to each side.

B. **Color: White or light gray. Black or dark gray geotextile is not allowed.**

C. The geotextile shall meet all the requirements of Geotextiles article above, except the physical properties shall conform to the requirements of Table 02346C. – Physical Properties of Geotextile for Geonet Composite. Unless otherwise noted, values are Minimum Average Roll Values (MARV) when tested in weaker principle direction.

Table 02346C – Physical Properties of Geotextile for Geonet Composite

Property	Test Method	Required Values
Mass per unit area, nominal	ASTM D 5261	6 oz/yd^2
Grab tensile	ASTM D 4632	160 lbs
Elongation at break	ASTM D 4632	50 percent
Trapezoidal tear	ASTM D 4533	60 lbs
Puncture strength	ASTM D 4833	85 lbs
Permittivity	ASTM D 4491	1.2 sec^{-1}
Apparent opening size (minimum US Sieve No./ maximum opening size)	ASTM D 4751	70 US Sieve
UV resistance – tensile strength retained at 500 hours, minimum	ASTM D 4335	70 percent

D. Geonet comprised of High Density Polyethylene (HDPE).

E. Geonet manufactured by extruding two or three sets of strands to form a three dimensional structure to provide planar flow.

F. Geonet shall conform to minimum property values shown in Table 02346D – Geonet Physical Properties. Unless otherwise noted, values are Minimum Average Roll Values (MARV) when tested in weaker principle direction.

Table 02346D – Geonet Physical Properties

Property	Test Method	Required Values
Transmissivity (Gradient = 0.1, Pressure = 209 psf	ASTM D 4716	9 gal/min/ft
Thickness	ASTM D 5199	200 mils
Density	ASTM D 1505	0.94
Tensile Strength	ASTM D 5035	45 lbs/inch
Carbon Black	ASTM D 1603	2.0 percent

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

A. Where geotextile is to be placed on soil, prepare surface upon which geotextile is to be placed to a firm surface, reasonably even and smooth, and free of offsets, abrupt indentations, and protruding materials greater than 1-1/2 inches.

B. Where geotextile or geonet composite is to be placed on geomembrane, remove loose soil.

C. Obtain COR approval of subgrade before installing geotextile and geonet composite.

3.02 INSTALLATION

A. Place geotextile and geonet composite in the manner and at locations shown on drawings.

B. Lay geotextile and geonet composite smoothly, free of tension, stress, folds, wrinkles, or creases so far as is practical and except where required in these specifications.

C. Shingle overlaps on slopes with uphill roll placed over downhill roll.

D. On slopes steeper than 5H:1V, roll out geotextile and geonet composite up or down slope.

E. Do not damage underlying geomembrane.

F. Staking or pinning of geotextile and geonet composite through underlying geomembrane is not allowed.

G. Anchor terminal ends of geotextile with key trenches or aprons at crest of slopes, and with aprons at toe of slopes.

H. In the presence of wind, weight geotextile and geonet composite with sandbags or equivalent until cover material placed.

I. Do not entrap stones, soil, excessive dust, or moisture in geotextile or geonet composite that could damage materials or hamper subsequent seaming.

J. Do not drive or operate equipment directly on geotextile or geonet composite.

1. Cover material depth required for equipment travel over geotextile and geonet composite, minimum: 9 inches.

K. Drop height of cover material on to geotextile and geonet composite, maximum: 1 foot.

L. Cover geotextile and geonet composite within 14 days after placement.

1. If covering with specified material is not possible within 14 days, protect exposed geotextile with suitable cover approved by the COR.

2. Replace geotextile and geonet composite not protected at Contractor’s expense.

M. Place soil-cement over geotextile and geonet composite in accordance with Section 02377 – Soil-Cement.

N. After installation, examine entire geotextile surface to ensure that potentially harmful foreign objects (such as needles) are not present.

O. Remove foreign objects or replace geotextile.

3.03 SEAMING

A. Join adjacent sheets of geotextile by overlapping, sewing, or thermal welding.

B. Sewn Seams:

1. Interlocking or sewn twice.
2. Thread:
    a. Contrasting color.
    b. Chemical resistance: Equal to geotextile.
3. Sew geotextiles continuously. Spot sewing is not allowed.
4. Sewn seam strength: Not less than 70 percent of parent material strength.

C. Overlapped Seams:

1. Overlap minimum: 12 inches.
2. Upstream/upslope roll placed over the downstream/downslope roll.
3. Weight on 3-foot centers to secure the overlap during placement of cover material.
    a. Do not use pins when installed over geomembrane.

D. Join adjacent sheets of geonet composite with plastic ties or by sewing or thermal welding the top layer of geotextile.

E. Join geotextile to adjacent geonet composite by overlapping and thermal welding geotextile to top layer of geotextile on the geonet composite.

F. Use additional thermal welding and weighting with sandbags as needed to keep geotextile and geonet composite in place during placement of cover materials.

3.04 REPAIRS

A. At placement, geotextile and geonet composite will be rejected if it has defects, rips, holes, flaws, deterioration, contamination, or damage.

B. Replace or repair geotextile or geonet composite damaged during installation or placement of cover in the following manner:

1. Remove cover from damaged area of geotextile or geonet composite.
2. Remove any soil or other material which may have penetrated torn geotextile or geonet composite.
3. Repair damaged geotextile or geonet composite by placing additional layer of geotextile or geonet composite to cover damaged area and either sew or thermal

weld the patch to undamaged geotextile according to requirements stated above or overlap undamaged geotextile by at least 3 feet on all sides.

END OF SECTION

SECTION 02377 - SOIL-CEMENT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Soil-Cement:

1. Measurement: Volume of soil-cement furnished, placed, compacted, and cured to the specified lines and grades shown on drawings.
2. Payment: Cubic yard price offered in the schedule.
   a. Includes furnishing, placing, and compacting soil-cement.
   b. Does not include excavation of the foundation for soil-cement. Refer to Section 02319 - Reservoir Earthwork.
   c. Does not include furnishing, placing, and compacting earthfill for the foundation of the soil-cement. Refer to Section 02319 – Reservoir Earthwork.

B. Cementitious Materials for Soil-Cement:

1. Measurement: Weight of materials used in soil-cement based on batch weights and batch counts at batch plant measured in most practical manner.
2. Payment: Ton price offered in the schedule.
   a. No payment will be made for cementitious materials in wasted soil-cement.

1.02 REFERENCES

A. ASTM International (ASTM)

1.	ASTM D 558-04	Moisture-Density (Unit Weight) Relations of Soil-Cement Mixtures
2.	ASTM D 698-07	Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
3.	ASTM D 1140-00(2006)	Amount of Material in Soils Finer Than the No. 200 (75-µm) Sieve
4.	ASTM D 1556-07	Density and Unit Weight of Soil in Place by the Sand-Cone Method
5.	ASTM D 1633-00	Compressive Strength of Molded Soil-Cement Cylinders (Method A)
6.	ASTM D 2216-05	Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

7.	ASTM D 4959-07	Determination of Water (Moisture) Content of Soil By Direct Heating
8.	ASTM D 5080-08	Rapid Determination of Percent Compaction
9.	ASTM D 5982-07	Determining Cement Content of Fresh Soil-Cement (Heat of Neutralization Method)
10.	ASTM D 6236-98(2004)	Coring and Logging Cement - or Lime-Stabilized Soil
11.	ASTM D 6938-08	In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
12.	ASTM D 7382-07	Determination of Maximum Dry Weight and Water Content Range for Effective Compaction of Granular Soils Using a Vibratory Hammer

1.03 DEFINITIONS

A. Stair Step Method: Soil-cement placed in successive horizontal layers adjacent to the slope in a step-like profile.

B. Plating Method: Soil-cement slope protection consisting of one or more layers of soil-cement placed parallel to the slope face.

C. Bonding Agent: Mortar placed between layers of soil-cement to improved bond between lifts when the Stair Step method or more than one layer of Plating is required.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01330 - Submittals.

B. RSN 02377-1, Samples.

1. Submit samples of the stockpiled soil from reservoir excavation and job cement to the Government for determination of a typical moisture-density curve (ASTM D 558) that will be used to make check compression specimens to determine the maximum density and optimum moisture content.

   a. Soil sample: 50 pounds, minimum.

   b. Cement: 50 pounds, minimum.

C. RSN 02377-2, Material Certifications and Supplier Data:

1. Portland cement.

D. RSN 02377-3, Soil-Cement Placement Schedule:

1. Complete, detailed soil-cement placement schedule showing the Contractor's plan for placement of individual features of soil-cement work.

2. Detail as necessary to show location, sequence, haul ramps, and date of soil-cement placements scheduled for each item of soil-cement work.

E. RSN 02377-4, Equipment Plan

1. Batch Plant Set Up.

a. Detailed proposal of equipment to be used and layout.

b. Plan for monitoring feed and calibrations.

2. Describe materials handling process and equipment to be used.

a. Include equipment for hauling, placing and compacting.

b. Include watering equipment details for wet curing operations.

1.05 QUALIFICATIONS

A. Provide experienced soil-cement construction personnel under supervision and direction personnel with minimum 3 years of construction experience for soil-cement construction similar in nature to that required by this work.

1.06 PROJECT CONDITIONS

A. Stair-step soil cement placement transitions from 8-foot to 2.4-foot widths over a 25-foot length at four locations as shown on the drawings. Specialized equipment may be required to facilitate placing and compaction in transitions and against structures.

B. To prevent damage to the geomembrane, careful operation of rollers used to compact stair-step soil-cement is necessary at the geomembrane/soil-cement interface. Special compaction techniques may be required.

PART 2 PRODUCTS

2.01 MATERIALS

A. Portland cement and water for soil-cement and bonding agent:

1. In accordance with Section 03300 - Cast-in-Place Concrete.

B. Soil:

1. Use on-site material from area designated on drawings with a fines content between 15 and 40 percent. Refer to Section 00321 – Geologic Investigations. Fines content defined as materials passing the minus 200 sieve as determined by ASTM D 1140.

a. As the soil is stockpiled, demonstrate that proper fines content is achieved by testing at a frequency as outlined in the Contractor Quality Testing article of this section.

2. COR reserves right to sample the soil source at any time during the execution of this contract.

3. Blend stockpiled materials to achieve fines distribution and to ensure uniform moisture content and minimize segregation.

4. Maximum size of any clay balls in soil: 1-inch.

5. Maximum percentage of clay balls, by wet weight of the soil, not to exceed 10 percent.

6. Maximum particle size: 3 inches.

2.02 PROPORTIONING

A. General:

1. Measure soil, cement, and water accurately and convey them into the mixer in the proportionate amounts necessary to meet the specified requirements.

2. Mix all ingredients for at least thirty (30) seconds or longer as may be necessary to ensure a thorough, uniform, and intimate mix of the soil, cement, and water.

3. COR will require additional mixing, or require the batch of soil-cement to be wasted if the soil-cement is not homogeneous and uniform in appearance.

B. Soil-Cement Mixture.

1. Cement Content:

a. Minimum cement content of 14 percent by dry weight of soil.

b. The COR reserves the right to adjust mix proportions when need for adjustment is indicated by results of materials testing.

2. Water Content:

a. Determine the initial required moisture content of the soil-cement daily. Initial moisture content at batch plant: between minus 1-percent to plus 2-percent of optimum as related to the maximum density.

b. Adjust the moisture content as required to achieve proper degree of compaction.

3. Compressive Strength:

a. Seven (7) days age: 675 pounds per square inch minimum.

b. Twenty-eight (28) days age: 1,000 pounds per square inch minimum.

C. Bonding Agent:

1. Portland cement and water with a water-cement ratio of 0.70.

2. Mix long enough to suspend all cement and to ensure a uniform and homogenous mixture.

2.03 EQUIPMENT

A. General:

1. Soil-cement may be constructed with any machine or combination of machines that will produce completed soil-cement meeting the requirements for soil pulverization, cement and water application, mixing, transporting, placing, compacting, finishing, and curing, as provided in these specifications.

B. Mixing Plant:

1. Perform mixing in a central mixing plant or other facility in accordance with approved plan.
2. Mixer: Twin-pugmill type or a continuous-mixing type capable of 200 cubic yards per hour capacity and designed for either weight or volume proportioning.
3. Design, coordinate, and operate mixing plant so as to produce a uniform mixture within the limits required by these specifications.
4. Provide facilities for efficiently storing, handling, and proportioning unmixed materials at the plant.
5. Make proportioning checks at various plant operating speeds to cover the range of planned operating speeds.
6. Perform daily proportioning checks at the plant during construction and as required by the COR.
7. Perform all proportioning checks and plant adjustments in the presence of the COR.
8. Provide means to obtain and control the proper amount of cement, soil aggregate, and water introduced into the mix.
9. All measuring devices shall be sensitive to a 2 percent variation above or below the actual weight in pounds required.
10. Proportioning may be on the volume basis; provided, that the sensitivity specified for the weight basis is maintained.
11. Equip plant with a positive, adjustable governor for controlling the mixing time of each batch. The mixing time is considered as the interval between the time the cement contacts the soil and water and the time the mixture leaves the mixing unit.
12. Actual batch weight tickets are required for each soil-cement batch. Submit to the COR at the construction site. Include on the batch weight tickets the time the material leaves the mixing unit and is loaded into/onto the transportation equipment.

PART 3 EXECUTION

3.01 PREPARATION

A. Preparation of Earth Foundation:

1. Before soil-cement processing begins, grade, shape, and compact the area to place the soil-cement to lines and grades shown on the drawings or as directed by the COR.
2. Remove any unstable soil or material as determined by the COR.
    a. Excavate the foundation in accordance with Section 02318 -Earthwork for Structures and Section 02319 – Reservoir Earthwork.
    b. Place any backfill required for soil-cement fill in accordance with Section 02318 – Earthwork for Structures and Section 02319 – Reservoir Earthwork.
3. Prewet compacted earth surfaces that are to receive an overlying layer of soil-cement but not to the extent of eroding soils.
4. Foundation to be firm and able to support, without yielding or subsequent settlement, the construction equipment and the compaction of the soil-cement.
5. Remove soft or yielding material as directed by the COR before placement of soil-cement.
6. If previously compacted and accepted foundation work becomes frozen or overly wet, resulting in a decrease in the dry density of the compacted material as determined by the COR, rework the foundation as directed until approved densities are obtained. Reworking may include removing, rehandling, reconditioning, recompacting, or a combination of these procedures.
7. The Contractor is entitled to no additional allowance above the price offered in the schedule by reason of any additional work required to achieve the in-place densities as specified in this section.

B. Preparation for Placement on Geomembrane or Geotextile and Geonet Composite:

1. Place geomembrane, geotextile, and geonet composite materials prior to soil-cement placing as indicated on the drawings and as specified in Section 02344 – Geomembrane and Section 02346 – Geotextile and Geonet Composite.
2. Do not allow equipment to damage geomembrane, geotextile, and geonet composite materials during soil-cement placement.
3. Prewet geotextile and geonet composite directly prior to soil-cement placement.
4. Remove any loose material from geomembrane, geotextile or geonet composite prior to soil-cement placement.

C. Obtain COR approval before placing soil-cement.

3.02 CONSTRUCTION

A. General:

1. Perform work in accordance with approved Test Section Placement Report required by Section 02376 – Soil-Cement Test Section.
2. A continuous operation including cement application, mixing, spreading, compacting, and finishing to be complete and kept within two (2) hours maximum.
3. The total elapsed time between the addition of water to the soil and cement and the start of compaction not to exceed 60 minutes.
4. Do not leave soil-cement undisturbed for longer than thirty (30) minutes after being placed on the fill and prior to being compacted and finished.
5. Any placement of soil-cement not meeting these requirements shall be removed from the fill and wasted as directed by the COR.
6. Where haul ramps are constructed, protect soil-cement with a minimum 2-foot layer of earth or of sufficient thickness to prevent damage to underlying soil-cement. Haul ramps not permitted over soil-cement plating.
7. The Contractor is entitled to no additional allowance above the price offered in the schedule by any reason of work required to achieve the requirements as specified in this section.

B. Mixing:

1. Do not mix or place soil-cement when the soil aggregate or the foundation contains frost, or when the air temperature is below 45 degrees F.
2. Temperature of soil-cement at placement: 90-degrees F maximum, or as directed by the COR to achieve density and to prevent drying of the soil-cement prior to compaction.
3. Moisture in the soil at the time of cement application to not exceed the quantity that will permit a uniform and intimate mixture of the soil and cement during mixing operations.
4. Mix soil-cement in approved mixer as required above.
5. Mixing time: Sufficient to secure an intimate uniform mixture of the soil, cement, and water and for at least thirty (30) seconds.
6. Monitor moisture and cement content as required to assure proper mixture.

C. Equipment:

1. Transportation Equipment:
   a. Trucks, conveyor systems, or other transport methods shall have tight, clean, and smooth beds or belts, and protective covers.

b. Provide sufficient numbers and types of equipment to ensure continuous operations to transport the soil-cement for placement.

2. Placing Equipment:

a. Conveyor systems, pump trucks, buggies, skid steers, dump trucks or other equipment used to place the soil-cement shall have tight, clean, and smooth beds or belts, and protective covers.

b. Provide sufficient numbers and types of equipment to ensure continuous operations to place the soil-cement into its final position.

c. **Equipment for placing soil cement over geomembrane shall be low ground pressure (LGP) wide-track crawler type dozer with maximum track pressure of 5.5 lb/in^2.**

3. Compaction Equipment:

a. Compact soil-cement with one or a combination of the following: pneumatic-tire roller, steel-wheel roller, vibratory roller, or vibrating-plate compactor.

b. If using vibratory rollers, they should be equipped with a Compaction Meter Value (CMV) instrumentation system with operator display, or equivalent as approved by the COR, to assist the operator in monitoring compaction.

1) CMV data will not be used as a basis for acceptance or rejection of degree of compaction.

4. Watering Equipment:

a. Watering equipment shall be approved by the COR and shall consist of pumps, water tanks, sprinklers, foggers, or other equipment furnished.

b. Provide adequate equipment available at all times to provide water as required for curing and for moistening compacted surfaces that are to receive an overlying layer of soil-cement.

c. Equip water trucks or sprinklers with fog sprayers for adding water to in-place layers of soil-cement.

D. Transporting:

1. Protect the soil-cement mixture whenever it is transported during unfavorable weather. Any soil-cement wet or dried excessively, whether during transport or after it has been spread, will be rejected by the COR.

2. Haul time, maximum: Thirty (30) minutes.

a. Haul time is the time elapsed from the time the material leaves the mixer until the same material is placed and spreading operations begin. Any load of soil-cement not meeting this time requirement will be rejected by the COR.

3. The Contractor is entitled to no additional allowance above the price offered in the schedule by any reason for rejected soil-cement as specified in this paragraph.

E. Placing:

1. Stair-step method:

a. Place mixture with equipment that will produce horizontal layers of such widths and thicknesses as are necessary for compaction to the specified dimensions as shown on drawings.

2. Plating method:

a. Place mixture as shown on drawings.

3. Bonding Agent:

a. Place bonding agent between successive layers of soil-cement, stair step or plating.

b. The surface of the soil-cement shall be cleaned off and wetted immediately prior to placement of the bonding agent.

c. Place the bonding agent immediately ahead of the spreading operation no further than the distance covered by one truck (haul unit) or no more than 30 minutes from the addition of water to the cement.

d. Place the bonding agent uniformly across the width of the soil-cement lift.

e. Place the bonding agent at an application rate of 1 pound of dry cement per 1 square yard of surface area.

4. Moisture content shall be no more than 2-percent above the optimum moisture content for the soil-cement mixture at the point of placement.

5. Take all necessary precautions to avoid damage to the underlying geomembrane and geocomposite materials by the equipment.

6. Take all necessary precautions to avoid damage to completed soil-cement by the equipment.

F. Compaction:

1. Special compaction efforts are required overtop or within 3-feet of concrete structures or in confined space.

a. Use hand held impact tampers, vibrating plate tampers, or small tamping equipment.

2. Start compaction no later than sixty (60) minutes after the addition of water to the soil and cement.

3. Moisture content at the time of compaction:

a. Less than that quantity that will cause the soil-cement to become unstable during compaction and finishing operations.

b. Between 1 percentage points below to 2 percentage points above optimum.

4. Uniformly compact soil-cement to a minimum of 97 percent of maximum density.

5. Determine moisture content and density by tests on representative samples of soil-cement obtained from the area being placed. Use test methods listed in Contractor Quality Testing and Government Quality Assurance articles of this section.

6. At start of compaction, soil-cement mixture shall be in a loose condition for its full depth.

7. Compacted lift thickness: 9 inches, plus 1 inch to minus 1/2 inch.

8. Do not leave section uncompacted for longer than thirty (30) minutes during compaction operations.

9. Compaction equipment for plating operations to run vertically up and down the embankments, not horizontally along the slope.

G. Finishing:

1. As compaction nears completion, shape the surface of the soil-cement to the specified lines, grades, and cross sections. During the finishing process keep the surface moist by means of fog sprays.

2. Perform compaction and finishing in such a manner as to produce, in not longer than two (2) hours, a dense surface free of compaction planes, cracks, ridges, or loose material.

H. Curing:

1. After completion of each lift of soil-cement, cure the construction joint surfaces until the next lift is placed by continuously keeping the surfaces moist with a fog water spray that will not erode the surface of the soil-cement.

2. Cure the surfaces at final grade after being shaped to the specified lines and grades with a fog water spray that will not erode the surface of the soil-cement, for a period of seven (7) days after placement.

3. Protective coverings of moist earth may be used for curing at the Contractor's option to protect the soil-cement surface from wind and sun exposure provided:

a. Minimum thickness of earth cover: 6 inches.

b. Keep soil-cement moist until protective earth cover is applied.

c. Earth cover to remain moist for a period of seven (7) days after soil-cement placement.

d. No damage to the soil-cement is permitted due to the placing or removal of sand.

e. Remove sand from top surface of soil-cement after maximum 60 days.

3.03 CONSTRUCTION JOINTS AND LIFT LINES

A. At the end of each day's work, or whenever construction operations are interrupted for more than one (1) hour, prepare both horizontal and vertical construction joints, and lift lines between stair stepped placements.

1. Prepare the vertical construction joints to full-depth vertical joints with roughened faces. Roughness to be approved by COR.
2. Prepare the horizontal construction joints by scratching the surface to provide 1/8-inch to 1/4-inch deep grooved surfaces for the next lift of soil-cement.
3. Prior to placement of the next lift, remove all loose material to provide a clean surface.
4. Moisten the grooved, cleaned surface lightly just prior to placing the subsequent lift. However, no ponding or pooling of free water is allowed.
5. Place bonding agent in between successive layers of soil-cement directly ahead of the soil-cement placing operations.

B. The Contractor is entitled to no additional allowance above the price offered in the schedule by reason of work required by this section to prepare and clean construction joints as specified in this section.

3.04 CONTRACTOR QUALITY TESTING

A. The following testing is required during construction of the test section in accordance with Section 02376 – Soil-Cement Test Section and during other soil-cement placements as necessary to ensure proper compaction.

1. In-place density shall be determined by ASTM D 1556 or ASTM D 6938.
   a. Results of in-place density determined by ASTM D 6938 shall be checked with results from ASTM D 1556.
2. Laboratory maximum density shall be determined by ASTM D **558** and ASTM D 5080.
   a. Compaction site moisture shall be determined by ASTM D 2216 and ASTM D 4959.
   b. ASTM D 6938 will require a moisture correction with ASTM D 2216 as determined by the COR.

B. Stockpiling of soil materials: Test fines content of materials being stockpiled in accordance with ASTM D 1140 every 250 yd^3 or as directed by the COR.

C. Monitor and test materials at the pugmill or batch plant including:

1. Moisture content in accordance with ASTM D 4959 calibrated to ASTM D 2216.
2. Cement content in accordance with ASTM D 5982.

3. Fines content in accordance with ASTM D 1140.

D. Frequency of testing for materials at the pugmill or batch plant.

1. Minimum frequency is daily.
2. Every 500 yd^3 of material produced.
3. If there is any change to the plant equipment.
4. Test if plant operations are stopped and resumed.
5. Test whenever it appears the soil-cement product has changed in soil feed, water, or cement, e.g. any change in material properties.

E. Make test reports available to the COR.

3.05 GOVERNMENT QUALITY ASSURANCE

A. General:

1. The Government or its representative may perform tests to verify that soil gradation, cement type, soil-cement placement, compaction and compressive strength of soil-cement conforms to contract requirements.
2. Notify the COR 24 hours before soil-cement placement begins and 24 hours before significant change in soil-cement operations (major change in equipment or procedure used).
3. Notify the COR immediately of any change in soil-cement operations.

B. Tests:

1. Standard test methods will be used by the COR for testing soil-cement for conformance with specification requirements. Substitution or modification of standards is allowed only with concurrence of all parties.
2. A variety of tests can be used for quality assurance. The appropriate tests will be determined by the COR from both the Contractor Quality Testing and the Government Quality Assurance tests performed on the soil-cement test section (Section 02376 – Soil-Cement Test Section). The COR reserves the right to use the tests that give the highest quality product. Some test methods may be changed for expediency.
3. Degree of Compaction: The degree of compaction will be determined as the ratio of either wet or dry in-place density to laboratory maximum density:
    a. In-place density will be determined by ASTM D 1556 or ASTM D 6938.
        1) Results of in-place density determined by ASTM D 6938 will be checked with results from ASTM D 1556 at a frequency determined by the COR.

4. Laboratory maximum density will be determined by ASTM D **558**, ASTM D 5080, or ASTM D 7382.

5. Moisture content:

   a. Compaction site moisture will be determined by ASTM D 2216, ASTM D 4959 or ASTM D 6938.

      1) ASTM D 6938 will require a moisture correction, which will be developed and periodically checked with ASTM D 2216 as determined by the COR.

      2) ASTM D 5080 will be used to determine the difference between optimum compaction moisture and moisture at the site of compaction.

   b. Batch plant moisture will be determined by ASTM D 4959 calibrated to ASTM D 2216.

6. Compressive strength: ASTM D 1633 (Method A).

   a. COR may elect to use the vibrating hammer to consolidate compression test specimens.

7. The COR may check the required thickness during placement as necessary. Thickness measurements may be performed with a blunt edge ruler or similar as necessary to prevent damage to the underlying geomembrane.

8. Coring (ASTM D 6236) may be used to verify thickness and compressive strength. Core samples will not be taken from areas where the geomembrane, geotextile, or geonet composite is directly under soil-cement. Use extreme caution to prevent puncturing the geomembrane, geotextile, or geonet composite liners.

9. Cement content will be checked using batch tickets or ASTM D 5982.

C. Testing Frequency:

1. Frequency of testing is at discretion of the Government.

2. Greater frequency of testing is normally performed at beginning of new work, new work crew, or new equipment.

3. After a successful work operation pattern is established, testing frequency is normally performed at these minimum guidelines.

   a. At least one test per day or for each shift for each soil-cement placement.

   b. Compacted soil-cement: One test for every 500 yd^3, or once per shift.

   c. Compressive strength: One test for every 500 yd^3, or once per shift.

   d. Additional tests may be performed at sites considered questionable by a COR; 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.

D. Contractor Support:

1. Provide timely access to areas for density and compression testing
2. When density is being measured by a sand-cone device (ASTM D 1556), cease construction activity in immediate vicinity of testing.
3. Provide warning lights, flags, or other safety devices as needed by testing personnel.
4. Provide adequate lighting for performing test if required because of darkness.

3.06 MAINTENANCE AND REPAIR

A. Maintain the soil-cement in good condition until all work is completed and accepted at the Contractor's expense.

B. Immediately repair any defects that may occur. If it is necessary to replace any soil-cement, the replacement shall be full depth using either soil-cement or concrete with beveled cuts so that the base is larger than the surface to key in the repair.

C. Minimum repair: 2-foot by 2-foot, or sufficient to encompass the defect, or as directed by COR.

D. No skin patches will be permitted.

END OF SECTION

SECTION 02460 – SHEET PILE WALL

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Sheet Pile Wall:

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

a. Includes all materials, equipment and labor to furnish, install, and remove temporary sheet pile walls.

b. Includes designing, constructing anchoring system, and maintaining it during excavation and construction of Coachella Turnout modification.

1.02 REFERENCES

A. ASTM International (ASTM)

1.	**ASTM A 36/A 36M-05**	**Carbon Structural Steel**
2.	**ASTM A 307-07b**	**Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength**
3.	**ASTM A 325-07a**	**Structural Bolts, Steel Heated, 120/105 ksi Minimum Tensile Strength**
4.	ASTM A 328/A 328M-07	Steel Sheet Piling
5.	**ASTM A 416/A 416M-99**	**Steel Strand, Uncoated Seven-Wire for Prestressed Concrete**
6.	**ASTM C 109/C 109M-07**	**Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)**
7.	**ASTM C 150-07**	**Portland Cement**
8.	**ASTM C 494/C 494M-08**	**Chemical Admixtures for Concrete**
9.	**ASTM C 1602/C 1602M-06**	**Mixing Water Used in the Production of Hydraulic Cement Concrete**

B. United States Bureau of Reclamation (USBR)

1.	**USBR RSHS-2001**	**Reclamation Safety and Health Standards**

1.03 SUMITTALS

A. Submit in accordance with Section 01330 – Submittals.

B. RSN 02460-1, Plan for Constructing Sheet Pile Walls:

1. Sheet pile manufacturer's concurrence with plan, setting, installing, and pulling sheet piling.
2. Describe equipment, materials, and methods to treat interlocks.
3. Sheet pile wall plan and design. Include as a minimum the following:
   a. Plan, pile manufacturer's size and section properties, and equipment and installation method.
   b. Design calculations by registered professional engineer.
4. Installation equipment. Crane, leads, heads, shoes, and caps.
5. Quality Control Representative:
   a. Resume.

C. RSN 02460-2, Anchoring System Plan.

1. Design Details. Include, as a minimum, the following:

a. Design calculations.

b. Material property assumptions.

2. Shop Drawings. Include, as a minimum, the following:

a. Layout of walers.

b. Tie back anchors.

c. Construction details.

3. Work Plan. Include, as a minimum, the following:

a. Details of the procedures and equipment to be used.

b. Details and specifications for any special equipment or techniques anticipated being utilized by the Contractor.

c. Details of work access, including temporary access road.

4. Waler Plan. Include, as a minimum, the following:

a. Proposed waler type and location.

b. Attachment detail to sheet pile wall.

5. Drilling Plan. Include, as a minimum, the following:

a. Proposed drill hole diameters.

b. Drilling equipment and drilling procedure.

c. Proposed method for maintaining open drill holes.

d. Sequence of drilling and schedule.

6. Anchor Plan. Include, as a minimum, the following:

a. Anchor bond length.

b. Anchor data and anchorage hardware: Manufacturer, product cut sheets, centralizer, anchor plate, wedge, wedge plate, and other relevant items.

c. Certified mill test report: Specified minimum ultimate tensile strength, yield strength, modulus of elasticity, diameter, weight per linear foot, and net cross sectional area.

d. Anchor stressing equipment, and testing equipment.

e. Manufacturer's installation instructions.

f. Details for installing anchor plate.

7. Grouting Plan. Include, as a minimum, the following:

a. Equipment and methods for grouting along anchors which will ensure complete encapsulation of bond length.

b. Mix design of grout including mix proportions and strength data.

c. Results of field grout strength testing.

D. RSN 02460-3, Quality Control, Construction Records, and Operation Records.

1. Daily records for sheet pile and anchoring system installation.

1.04 DEFINITIONS

A. Aspect Ratio: Length to thickness.

B. Shear Modulus of Elasticity: Ratio of shear stress to shear strain.

C. Anchor Head: The means by which the prestressing force is permanently transmitted from the prestressing steel to the anchor plate. Includes wedge and wedge plate.

D. Bond Length: Anchor zone in which the tendons are fixed in grout; zone through which the stressing load is transferred to the surrounding soil.

E. Design Load: The anticipated final effective load in the anchor after allowance for time-dependent losses and other load changes.

F. Free Length: Anchor zone in which the tendons are free to elongate elastically.

G. Proof Test: Single cycle test loading of an anchor with elongation measurements.

H. Tendon: The complete anchor assembly consisting of steel strands, spacers, and centralizers. Does not include grout.

I. Wedge: The device that transfers the prestressing force in the strand to the wedge plate.

J. Wedge Plate: The device that holds the wedges of multistrand tendons and transfers the anchor force to the anchor plate.

1.05 QUALIFICATIONS

A. Employ Quality Control Representative(s) with 5 years minimum experience in sheet piling work similar to requirements of this specification.

B. Have Quality Control Representative present at all times with each crew for the following work activities:

1. Setting sheet piling.
2. Installing sheet piling.
3. Installation and testing of anchoring system.
4. **Pulling sheet piling.**

C. Quality Control Representative is responsible for measurement and preparing and submitting records upon completion of installation, and any other work activity associated with quality control.

1.06 PROJECT CONDITIONS

A. Maintain safe work access in accordance with USBR RSHS.

B. Refer to Section 00322 – Records of Geologic and Subsurface Investigations for soil explorations.

C. The end of the sheet pile wall adjacent to the Coachella turnout structure will need to be field located. To prevent damage to the concrete the Contractor shall excavate to locate the structure prior to driving sheet pile.

D. During sheet pile wall installation adjacent to the existing Coachella Canal turnout structure, keep vibrations to a minimum to avoid damaging the structure.

E. Caving conditions in drill holes are possible.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Ship, handle, and store anchors and accessories in such manner to prevent damage to them and prevent dirt, water, and rust from affecting them in the field until they are installed.

B. Store materials in a dry, ventilated location to prevent accumulation of moisture on the materials.

C. Do not store on the ground surface or in areas exposed to weather.

D. Immediately prior to installation, inspect each anchor for damage and repair or replace in accordance with the manufacturer's instructions if damaged and as directed by the COR.

PART 2 PRODUCTS

2.01 SHEET PILING

A. Steel Sheet Piling:

1. Hot or cold rolled Z-shaped sections.
2. ASTM A 328.

B. Physical Properties:

1. Section Modulus, minimum: 31 in^3/ft of wall.
2. Thickness, minimum: 3/8-inch.

C. Tolerances:

1. Camber, maximum: 0.8 percent length of pile. Camber is the simple regular curve measured at the midpoint between the ends of a full length sheet pile in the direction parallel to the plane of the web.
2. Replace any installed sheet pile not within tolerances.

2.02 ELASTOMERIC SEALANT

A. Sonolastic 2-part polysulfide sealant manufactured by Sonneborn Building Products, a division of BASF Construction Chemicals – Building Systems, 889 Valley Park Drive, Shakopee, MN 55379, (952) 946-6000, (800) 433-9517; or equal with the following essential characteristics:

1. Two-part, multi-component, medium modulus elastomeric polymer sealant.
2. Gun-grade.
3. Cures to a firm, flexible, resilient, tear-resistant rubber.

2.03 WALERS

A. Materials in accordance with ASTM A 36.

B. Meet minimum design loads as shown on drawings.

2.04 ANCHORS

A. Anchors shall be eight (8) strand, manufactured by Con-Tech Systems, Ltd., 8150 River Road, Delta, British Columbia Canada V4G 1B5; or equal having the following essential characteristics:

1. Meets ASTM A 416 unless otherwise specified.

2. Minimum design load as shown on drawings.

3. Minimum free length as shown on drawings.

B. Anchor plates, wedges, and wedge plates shall be provided by the same manufacturer of the anchor, and shall be compatible with the anchor proposed.

C. Centralizers shall be either steel or plastic, recommended by anchor manufacturer.

2.05 ANCHOR GROUT

A. One day compressive strength not less than 3,500 pounds per square inch measured in accordance with ASTM C 109 at time of stressing each anchor.

B. Cement: Portland cement in accordance with ASTM C 150, Type II, low-alkali. Use fresh cement with no lumps or other indication of hydration.

C. Water: In accordance with ASTM C 1602.

D. Plasticizer: An approved high range water reducing additive (HRWRA) conforming to ASTM C 494 for type F chemical admixture.

1. The water content shall be the minimum necessary to provide the proper consistency for pumping the grout and to meet the specified strength requirement. The water to cement ratio (by weight) shall not exceed 0.45 (or 5 gallons per 94-pound bag of cement).

PART 3 EXECUTION

3.01 EQUIPMENT

A. Crane:

1. Capacity: Sufficient to maintain proper alignment of leads and piling.

2. Equip crane with rigid leads to support piling to within 2 feet of ground surface.

3.02 CONSTRUCTION

A. Construct sheet pile wall as indicated on drawings.

B. Construct wall into foundation to tip elevations and to unsupported top elevations indicated on drawings.

C. Construct piling in a plumb position with each pile interlocked with adjoining piles for its entire length to form a continuous diaphragm.

D. Installation:

1. Install individual or sets of two-interlocked piles to depth indicated on drawings.
2. Use installation methods to not damage piles and to ensure proper interlocking throughout length of sheet piles.
3. Do not weld or splice pile sections.
4. Water jetting is not allowed.
5. Keep piles in alignment. Do not allow twisting or rotating.
6. Engage interlocks as recommended by manufacturer.
7. When making a socket to socket interlock, engage the interlock with the thumb of the pile gripped by the thumb and finger of the adjacent pile.
8. One-point pickup permitted for sheet piling provided this method does not damage piling.
9. Replace damaged sheet piles at no additional cost.

E. Treatment of Interlocks:

1. Treat interlocks in accordance with approved submittal.

3.03 DRILLING HOLES FOR ANCHORS

A. Drill anchor holes in accordance with the details and at the locations shown on the drawings.

B. Maintain a clean and open hole for installation and grouting of the anchors. Thoroughly clean drill holes of all drill cuttings, sludge, debris, and other material that could interfere with bonding of the grout to the drill hole walls.

C. Inform COR by letter 10 days before start of drilling of the first hole. This notification is to allow the Government adequate time to inspect the condition of the holes or the material removed. This may be performed by either examination of removed material or by viewing the hole.

D. Check alignment of each drill hole on the drill mast with a digital angle indicator.

E. Check each drill hole alignment down the hole at maximum intervals of 20 feet.

F. Do not install anchors or place grout for any hole until approval is provided by COR.

3.04 ANCHOR INSTALLATION AND GROUTING

A. Probe each hole just prior to inserting anchor in the hole to verify that the hole is free of obstructions, debris, grout or any other materials that could interfere with anchor insertion or bonding to the drill hole walls.

B. Prior to inserting the anchor into the hole, each anchor will be inspected and accepted by the COR. The COR will be present during each anchor insertion.

C. Insert anchors into the holes in accordance with the procedures outlined in the Anchor Plan submittal. Handle and protect the anchors during insertion in a manner that prevents physical damage.

D. Measure HRWRA by either weighing or by volumetric admixture dispensers constructed and located so that the full-batch quantity can be observed in a visual gauge by the operator.

E. Amount of HRWRA used in grout to be no more than 1/2 percent by weight of cement.

F. Discharge HRWRA separately into the mixed cement and water.

G. Do not add HRWRA directly into the mix water.

H. COR reserves the right to adjust quantities of HRWRA or eliminate its use.

I. Grout the bond length of each anchor from the bottom of the hole in one, single stage after insertion of the anchors by pumping grout through a tremie tube at the bottom of the drill hole. The grout shall fully encapsulate the bond length of the anchor.

J. If grout losses occur, add grout to fill the hole and check grout content again.

3.05 ANCHOR STRESSING AND TESTING

A. Prior to stressing and testing any anchor, the anchor shall be grouted and cured for at least 1 day.

B. Install anchor plate perpendicular to drill hole.

C. Anchor stressing and testing methods and equipment shall be in accordance with the approved Anchor Plan submittal.

D. During the tensioning and prior to lockoff, proof-stress each anchor. Tension all proof-stressed anchors to 133 percent of the design load and lock off to 100 percent of the design load.

E. If the design load of an anchor is not met, the anchor will be subject to one of the following actions by the COR.

1. The anchor will be left in place, and locked off to a load to be determined by the COR.

2. The anchor embedment lengths or installation procedures will be adjusted to achieve the required anchor design load.

3. Additional anchors may be ordered by the COR at the Contractor's expense.

***F*. Leave anchors in place.**

3.06 TOLERANCES

A. Drilled holes: Plus or minus 2 degrees from the design alignment shown on drawings.

B. Anchor head center: Locate anchor head center within - inch of the design location shown on drawings.

3.07 RECORDS

A. Quality Control, Construction Records and Operation Records:

1. Keep and maintain records of quality control and construction for all construction operations including, but not limited to, the following.

a. Additional materials (including type and strength).

b. Installation line and grade.

c. Interlocks inspection.

d. Placing (include alignment and location).

e. Cutting.

f. Welding.

2. Keep operation records log during installation of each pile at each site.

3.08 REMOVAL

A. Remove entire sheet pile by pulling when no longer required as determined by COR.

B. Removed sheet pile to remain property of the Contractor and be removed from the work site area.

END OF SECTION

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SECTION 02514 - STEEL PIPE

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Steel Pipe:

1. Measurement: Length along pipe centerline between ends of pipe in place.
   a. Continuous through fittings.
   b. No allowance for lap at joints.
   c. Includes the connections into structure walls as shown on drawings.
2. Payment: Linear foot price offered in the schedule.
   a. Includes cost of furnishing materials; manufacturing and laying pipe; welding joints; furnishing and installing warning tape; inspecting welds; furnishing and placing concrete and concrete reinforcement in vent blocking; and furnishing maintenance warranty bond.
   b. **Includes cost of furnishing and installing steel supports for submerged galvanic anode cathodic protection system.**
   c. Does not include steel vent pipes. Refer to Section 05635 – Metal Piping.
   d. Does not include electrical conduit. Refer to Section 16130 – Electrical Conduit.

B. Pipe Outlets:

1. Measurement: Number of outlets installed for the Group No.
2. Payment: Outlet price offered in the schedule.
   a. Payment will be made in accordance with the group listing in table 02514A - Steel Pipe Outlets.
   b. Dimensions D_1 and D_2 correspond to dimensions on the drawings.

Table 02514A – Steel Pipe Outlets

Group No.	Group Description	Diameter Dimensions, inches		Number of Outlets Required
		Steel Pipe Size (D_1)	Outlet Size (D_2)	
I	Outlets for vents from steel pipe	108	18	4

3. Payment for pipe outlets includes the following:

a. Vent: Opening in steel pipe shell for pipe outlet with required steel wrapper plate, steel collar, or single steel cylinder, nozzle, welding flange, lining, and accessories required for the pipe outlet connection.

1.02 REFERENCES

A. ASTM International (ASTM)

1.	**ASTM A 36/A 36M-05**	**Carbon Structural Steel**
2.	ASTM A 139/A 139M-04	Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
3.	ASTM A 283/A 283M-03(2007)	Low and Intermediate Tensile Strength Carbon Steel Plates
4.	**ASTM A 572/A 572M-07**	**High-Strength Low-Alloy Columbium-Vanadium Structural Steel**
5.	ASTM A 1011/A 1011M-07	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
6.	ASTM A 1018/A 1018M-07	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
7.	ASTM E 165-02	Liquid Penetrant Examination

B. American Water Works Association (AWWA)

1.	AWWA C 200-05	Steel Water Pipe - 6 In. (150mm) and Larger
2.	AWWA C 206-03	Field Welding of Steel Water Pipe
3.	AWWA C 207-07	Steel Pipe Flanges for Waterworks Service – Sizes 4 in. Through 155 in. (100 mm Through 3,600 mm)
4.	AWWA C 208-01	Dimensions for Fabricated Steel Water Pipe Fittings

1.03 DEFINITIONS

A. Unless specific reference is made to the outside diameter of pipe, pipe diameters shown on drawings and used in these specifications are inside diameters.

B. Pipe designations shown on drawings and in these specifications establish minimum requirements for pipe allowed under these specifications.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01330 - Submittals.

B. RSN 02514-1, Shop Drawings.

1. Provide checked, detailed drawings showing all dimensions, tolerances, material data, joint details, welding requirements, and lining and coating requirements.

C. RSN 02514-2, Purchase Orders.

1. Copies of purchase orders for steel pipe.

D. RSN 02514-3, 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.
3. Include field lining and coating repair methods.

E. RSN 02514-4, Pipe Embedment Plans.

1. Show methods used to prevent flotation and movement.
2. Include flotation calculations. Use safety factor of at least 1.1.

F. RSN 02514-5, Welder Qualifications.

1. Resume.

G. RSN 02514-6, Test Reports for Hydrostatic Testing.

H. RSN 02514-7, Test Reports of Field Welds.

1. Test reports for nondestructive testing of field welds.

1.05 WARRANTY

A. Furnish extended warranty for steel pipe in accordance with the clause at FAR 52.246-21 – Warranty of Construction.

1. Extended maintenance warranty period of 3 years after steel pipe commences operation or 5 years after acceptance of the work, whichever comes first.

1.06 QUALIFICATIONS

A. Qualify welding procedures and welders in accordance with the code under which welding is specified to be accomplished.

1.07 DELIVERY, STORAGE, AND HANDLING

A. During loading, transporting, unloading, storing, and laying, prevent damage to steel pipe, linings, and coatings.

B. Maintaining circularity of pipe:

1. After lining operations are completed and prior to handling, shipping, laying, and backfilling pipe sections in trench; furnish and place internal supports to maintain circularity.

2. Supports:

a. Three members at 60 degrees to each other.

b. Minimum member cross section: Nominal 4 by 4, with padded ends and wedges.

3. Place supports at 5 feet from ends of each pipe section and at pipe mid-section.

4. Orient support legs in same axis along pipe centerline.

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. Tightly close open ends of lined pipe with plastic wrap for protection of lining during shipment.

1. Plastic wrap:

a. At least two thicknesses of 6-mil sheet polyethylene plastic.

b. Remain on pipe until installation.

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.

1.08 PROJECT CONDITIONS

A. Steel pipe crossing extends from siphon inlet structure to siphon outlet structure.

B. Groundwater is expected to be encountered during excavation.

C. Provide cathodic protection in accordance with Section 13110 – Buried Impressed Current Cathodic Protection System and Section 13112 – Submerged Galvanic Anode Cathodic Protection System – Pipes.

PART 2 PRODUCTS

2.01 STEEL PIPE

A. Steel pipe:

1. Electric-Fusion- (Arc-) Welded Spiral-Seam Steel Pipe: ASTM A 139, grade B, C, D, or E.

2. Fabricated in accordance with AWWA C 200, except:

a. Steelplate: ASTM A 283, grade C or D**, or ASTM A 572 grade 42, or ASTM A 36.**

b. Steel Sheet: ASTM A 1011, designation SS, grade 40, 45, or 50; or ASTM A 1018, designation SS, grade 40.

B. Pipe diameter: To inside of pipe.

C. Minimum steel wall thickness of pipe:

1. As shown in table 02514B - Minimum Steel Wall Thickness for Symbol Pipe, or as otherwise shown on the drawings.

Table 02514B. - Minimum Steel Wall Thickness for Symbol Pipe

Pipe Diameter Inches	Minimum Steel Wall Thickness, Inches
108	0.5*****

***Conform to AWWA C200 for thickness allowances**

D. Except for structure connections and closure joints, lap joints shall be furnished.

E. Prepare pipe ends for field welding.

F. Furnish butt straps and joints for closure sections.

2.02 FITTINGS

A. Vent Flanges:

1. Flange: AWWA C 207.

a. Class: Working pressure meets or exceeds head class of attached pipe

2. Flange gasket: AWWA C 207

B. Tees:

1. Fabricate tees for vents as shown on drawings.

2. Tee length, minimum: As shown on drawings, or as required for blocking.

3. Ends: Fit type of joint in adjacent pipeline.

C. Bends: In accordance with AWWA C 208.

2.03 COATING AND LINING

A. Notify COR 24 hours before coating and lining steel pipe.

B. Coat and line steel pipe in accordance with Section 09902 – Coatings.

2.04 CONCRETE

A. Concrete in blocking and pads: Section 03300 - Cast-in-Place Concrete.

2.05 PIPE ACCESSORIES

A. Warning Tape:

1. Polyethylene tape.

2. Thickness: 6 mils.

3. Non-detectable.

4. Width, minimum: 6 inches.

5. Color: Purple.

6. Legend repeated at least every 3 feet: BURIED WATERLINE

2.06 ELECTRICAL CONDUIT

A. 4-inch diameter PVC electrical conduit in accordance with Section 16130 – Electrical Conduit.

2.07 STEEL SUPPORTS FOR SUBMERGED GALVANIC ANODE CATHODIC PROTECTION SYSTEM

A. **For materials and fabrication of steel supports, see Section 05500 – Metal Fabrications.**

2.08 CONTRACTOR SOURCE QUALITY TESTING

A. Steel pipe and fittings:

1. Hydrostatic test for pipe: Perform shop hydrostatic test on pipe which stresses steel **in accordance with AWWA C200.**

a. Test sections with formed or welded-on ends after ends have been formed or welded on.

b. Repair defects and retest section before applying lining and coating.

2. Hydrostatic test for fittings

a. Test fittings fabricated from steelplate under hydrostatic pressure sufficient to stress the steel to 23,000 lb/in^2

b. Hold pressure long enough to allow a thorough inspection of welded joints, and repair leaks by rewelding and retest fittings.

c. Fittings fabricated from tested steel pipe do not require hydrostatic testing if girth butt welds are complete penetration welds.

1) Perform dye penetrant test on welds in accordance with ASTM E 165.

d. 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.

3. Notify Technical Service Center, Attn 86-68140, and COR at least 14 days before hydrostatic testing.

4. Provide test reports of hydrostatic tests for fittings.

B. Joint test:

1. Assemble one joint to check the bell and spigot to check fit prior to coating or lining.

2.09 SOURCE QUALITY ASSURANCE

A. Basis for approval for shipment:

1. Pipe approval will be determined by inspection, during and after manufacture, 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 COR 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 by the COR.

4. Further inspection of pipe units will be in accordance with the clause at FAR 52.246-17 "Inspection of Construction."

PART 3 EXECUTION

3.01 LAYING PIPE

A. Keep pipe trench free of water during pipelaying operations.

B. Excavate pipe trench in accordance with Section 02316 – Steel Pipe Earthwork.

1. Grade pipe trench to provide uniform slope along the bottom of pipe.
2. Foundation for pipe trench shall meet minimum foundation requirements prior to laying pipe sections.
3. 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.
4. Lower the pipe into the trench and place pipe in position such that no soil gets inside the pipe and pipe is not damaged.
5. Joints shall meet minimum requirements in accordance with approved details.

C. Joints for pipe: Field weld in conformance with AWWA C 206.

1. Seal weld outside of pipe joint minimum 3/16-inch fillet weld.

D. Changes in alignment and grade:

1. Where shown on the drawings, make changes in alignment and grade with miter bends.
    a. Where miter bends are not required, maximum deflection angle between adjacent pipe sections: 1 degree.
2. Lay ends of each section of steel line pipe on the theoretical centerline of the curve and to the grade shown on the drawings within the laying tolerances prescribed below.

E. Connections at Structures and Encasements.

1. Where steel pipe adjoins a concrete structure or is fully encased in concrete, except at concrete collars and encasements, provide a closure joint at or adjacent to the nearest face of such structure or encasement.
    a. Maximum distance from closure joint to concrete face:
        1) One-half pipe diameter.

F. Closure Sections.

1. Use closure sections where necessary as determined by the Contractor, subject to the approval of the COR.

2. Cover pipe with controlled low strength material to within 25 feet of closure joint and to at least 1 foot over top of pipe, then allow a minimum of 24 hours before welding.

3. Weld closure sections during coolest time of day and when sun is not directly shining on pipe.

G. Lay pipe on soil pads consisting of any material such as sand bags that is weaker than controlled low strength material.

H. Welding Sequence Requirements:

1. Weld inside and outside of pipe.

2. Repair lining and coating.

3. Complete welding procedures before placing controlled low strength material for embedment and backfill.

I. Repair lining and coating after making welded joints and closures in accordance with Section 09902 – Coatings.

J. After pipelaying and joining operations are completed, clean inside of pipe and remove debris. When pipelaying is not in progress, keep ends of pipeline 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 EMBEDMENT AND BACKFILL

A. Prevent flooding the pipe trench before embedment and backfilling operations.

B. Embed pipe in accordance with Section 02323 – Controlled Low Strength Materials (CSLM) and backfill pipe in accordance with Section 02316 – Steel Pipe Earthwork.

1. Place embedment and backfill about pipe carefully to avoid lateral displacement of the pipe and damage to joints.

2. In certain pipe 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 controlled low strength materials and backfilling operations.

C. Keep internal supports in place until embedment has been placed above the bottom of the pipe to a minimum height of 1 foot over the top of pipe.

D. Backfill above pipe in accordance with Section 02316 – Steel Pipe Earthwork.

3.04 WARNING TAPE

A. Install warning tape over center of each pipe at least 18 inches below ground and at least 18 inches above each pipe except up to a maximum of 36 inches below finished ground surface.

3.05 ELECTRICAL CONDUIT

A. Install electrical conduit above pipe in accordance with Section 16130 – Electrical Conduit.

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.

1. Remove interior bracing before making measurements.

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.

3.07 CONTRACTOR FIELD QUALITY TESTING

A. Nondestructive testing of field welds:

1. Test welds in accordance with AWWA C206 and this section.
2. Visual inspection: Visually inspect all welds following procedures, techniques, and standards of AWS D1.1.
3. Test all partial penetration joint field welds and fillet field welds by magnetic particle or dye penetrant.
    a. Technique and procedure for magnetic particle testing: ASTM E 709.
    b. Technique and procedure for dye penetrant: ASTM E 165.
    c. Standards of acceptance for both types: AWS D1.1.
4. Complete inspections and tests as work progresses in presence of a COR inspector and in accordance with AWS D1.1.
5. 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.

B. Provide test reports for nondestructive testing of field welds.

END OF SECTION

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SECTION 03305 - CONCRETE REMOVAL

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Saw Cutting Existing Concrete:

1. Measurement: Length of saw cuts made as shown on the drawings or directed by the COR for removal.

    a. **Deleted.**

2. Payment: Linear foot price offered in the schedule.

    a. Includes saw cutting Interstate 8 Highway for pipe trench, Evan Hewes Highway for pipe trench, and Drop 2 Inlet canal for wasteway construction.

B. Concrete Removal:

1. Measurement: Volume of concrete removed.

2. Payment: Cubic yard price offered in the schedule.

    a. Includes concrete removal for Interstate 8 Highway for pipe trench, Evan Hewes Highway for pipe trench, and Drop 2 Inlet canal for wasteway construction.

1.02 SUBMITTALS

A. Submit the following in accordance with Section 01330 - Submittals.

B. RSN 03305-1, Concrete removal plan:

1. Describe methods and equipment to be used to locate embedded metalwork and reinforcement within concrete to be removed.

2. Describe methods, equipment, and sequence to be used for cutting and removing concrete.

1.03 PROJECT CONDITIONS

A. Concrete to be removed consists of cement, sand, and broken rock or gravel.

1. Maximum aggregate size: 1-1/2-inch.

2. Design compressive strength: 4,000 lb/in^2 at 28 days.

3. Actual compressive strength of existing concrete may be in excess of 2 times the original design compressive strength.

B. Information drawings provide general locations of embedded reinforcement, pipe, conduit, and metalwork. Actual locations of these items may vary from what is shown on the drawings.

C. Cease operations immediately if concrete removal operations come in contact with electrical conduit containing energized circuits and notify the COR. Do not resume operations until directed by the COR.

D. Cease operations immediately if concrete removal operations cause cracking of remaining concrete structure and notify COR. Do not resume operations until directed by COR.

E. Coordinate performance of noisy, malodorous, or dusty work with the COR.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 EXAMINATION

A. Locate and mark exact locations of embedded reinforcement, pipe, conduit, and metalwork within concrete removal areas before beginning concrete removal.

3.02 REMOVAL

A. Produce surfaces and edges suitable for required construction.

B. Clean loose concrete from surfaces on which new concrete or grout will be placed.

C. Use methods which will not damage concrete or reinforcement to remain in place.

D. Do not line drill perimeters of large openings.

E. Blasting not permitted.

F. Where more than 1/3 of the diameter of a reinforcing bar is exposed by removal of concrete to required depth, remove additional concrete to minimum depth of the maximum size of aggregate of the replacement concrete plus 1/4-inch below the bar.

G. When removing concrete in and around reinforcing steel that will remain in place, use 15-pound or smaller chipping hammers, or high or ultra-high pressure water jetting.

H. All damaged, deteriorated, loosened, or unbonded portions of existing concrete shall initially be removed by:

1. High and ultra-high pressure water jetting, jack hammering, or any other approved method, with approved equipment.

    a. Bush hammering will not be permitted.

I. The remaining concrete surfaces shall then be prepared by:

1. Contained shotblasting, wet sandblasting, or low pressure water cleaning to remove any weakened or damaged concrete surfaces resulting from the initial removal process.

2. If low pressure water cleaning is used, pressures sufficiently high to prepare the surface shall be used. Pressures up to 5,000 psi may be needed, depending on the condition of the concrete surface.

J. Clean and allow surfaces to dry thoroughly, unless the specific repair technique requires application of materials to a saturated surface.

K. Concrete removal processes involving the use of jack hammers in excess of 30 pounds, dry sandblasting, or scabblers shall not be used without approval by the COR.

L. The use of acids for cleaning or preparing concrete surfaces for repair will not be permitted.

3.03 REPAIR

A. Repair concrete and reinforcement outside of prescribed removal lines which is damaged or loosened during cutting and removal operations.

1. Repair or replace as directed by COR.

2. Repair or replace in accordance with applicable sections of these specifications.

3.04 DISPOSAL

A. Dispose of removed concrete materials as directed by COR at approved waste area.

END OF SECTION

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SECTION 05500 - METAL FABRICATIONS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Miscellaneous metalwork:

1. Payment: Lump-sum price offered in the schedule.
2. Does not include miscellaneous concrete slabs and concrete foundations for mounting poles and electrical equipment supports. Include cost of miscellaneous concrete slabs and concrete foundations for mounting poles and electrical equipment supports in cubic yard price offered in the schedule for concrete structures. Refer to Section 03300 – Cast-In-Place Concrete.
3. Does not include safety ladders for concrete-lined canals. Refer to Section 05518 – Safety Ladders for Concrete-Lined Canals.
4. **Does not include supports for submerged galvanic anode cathodic protection system. Refer to Section 02514 – Steel Pipe.**

1.02 REFERENCES

A. American Institute of Steel Construction (AISC)

1.	AISC 316-89	Manual of Steel Construction - Allowable Stress Design - 9th Edition

B. American Society of Mechanical Engineers (ASME)

1.	ASME B18.2.1-1996(2005)	Square and Hex Bolts and Screws (Inch Series)

C. ASTM International (ASTM)

1.	ASTM A 36/A 36M-05	Carbon Structural Steel
2.	ASTM A 53/A 53M-07	Pipe, Steel, Black and Hot-dipped, Zinc-Coated Welded and Seamless
3.	ASTM A 108-07	Steel Bar, Carbon and Alloy, Cold-Finished
4.	ASTM A 123/A 123M-02	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
5.	ASTM A 153/A 153M-05	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
6.	ASTM A 193/A 193M-05	Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
7.	ASTM A 307-07b	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

8.	ASTM A 385-05	Providing High-Quality Zinc Coatings (Hot-Dip)
9.	ASTM A 500/A 500M-07	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
10.	ASTM A 501-07	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
11.	ASTM A 563-07a	Carbon and Alloy Steel Nuts
12.	ASTM A 992/A 992M-06a	Structural Steel Shapes
13.	ASTM F 436-04	Hardened Steel Washers
14.	ASTM F 844-07a	Washers, Steel, Plain (Flat), Unhardened for General Use

D. American Welding Society, Inc. (AWS)

1.	AWS D1.1/D1.1M-06	Structural Welding Code - Steel

E. Commercial Item Description (CID)

1.	CID A-A-1923A	Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)

F. International Code Council (ICC)

1.	IBC – 2006	International Building Code
2.	AC308 – 2008	Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements

G. Military Specifications (MIL)

1.	MIL-DTL-24441C/19B	Paint, Epoxy-Polyamide, Zinc Primer, Formula 159, Type III

H. National Association of Architectural Metal Mfrs. (NAAMM)

1.	NAAMM 531-00	Metal Bar Grating Manual

1.03 DEFINITIONS

A. Miscellaneous metalwork: Where either shown on the drawings or specified elsewhere in this section or these specifications, “miscellaneous metalwork” means metal fabrications as used in this section.

1.04 QUALIFICATION OF WELDERS

A. Qualify welders in accordance with AWS D1.1 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.

1.06 PROJECT CONDITIONS

A. Metal fabrications covered by this section include:

1. Grated walkways.
2. Embedded angles.
3. Pipe guardrails.
4. Mounting poles and anchor bolts for water level sensors.
5. Electrical equipment supports.
6. Ladders.
7. Guard posts, metal frames, and grille frames for the control building.

PART 2 PRODUCTS

2.01 MATERIALS

A. 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.
3. Use filler metal with a minimum tensile strength of 70,000 pounds per square inch for steel.

B. Bolts, Nuts, Washers, and Lockwashers.

1. Nuts: ASTM A 563.
2. Washers:
   a. Unhardened for general use: ASTM F 844.
3. Bolts:
   a. ASTM A 307, except anchor bolts and studbolts.
   b. Anchor bolts as shown on drawings.
   c. ASTM A 36 steel.

d. Length of bolt threads: ASME B18.2.1.

e. Thread class: 2 free-fit, American National coarse-thread series.

4. Studbolts:

a. Suitable for end welding to steel with automatically timed stud-welding equipment.

5. Anchor bolts:

a. ASTM A 36 steel, galvanized.

C. Grating: NAAMM MBG 531 galvanized steel.

1. Banding bar: Same size as bearing bars, where required.

D. 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.

E. Structural steel:

1. Shapes except wide flange sections: ASTM A 36.

2. Wide flange sections: ASTM A 992/A 992 M.

F. Square or Rectangular Hollow Structural Shapes (HSS):

1. HSS 2 inches and larger: ASTM A 500 or A 501, Grade B.

G. Metal Safety Steps for Ladders:

1. "Tread-Grip" No. 11-gauge sheet steel ladder rungs as manufactured by Morton Manufacturing Co., PO Box 640, Libertyville IL 60048; "One Diamond Ladder Rung" as manufactured by GS Metals Corp., PO Box 7, Pinckneyville IL 62274; 1-inch-square "Mebac" solid ladder rungs as manufactured by IKG Industries, 270 Terminal Avenue, Clark NJ 07066; 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.

H. Safety Rail:

1. Design:

a. Working load: 250 pounds.

b. Permit user to ascend or descend hands free.

c. Maximum possible fall length: 6 inches.

2. Main support rail:

a. Continuous.

b. Notched.

c. Mount permanently to ladder.

d. Provide stop for rail at top.

3. Slide or safety sleeve: Equipped with locking mechanism for making connection between rail and safety belt.

4. Components: Non-corrosive, i.e. fiberglass, aluminum, or stainless steel.

I. Splice Locks:

1. Model No. 923, as manufactured by Julius Blum Co., PO Box 816, Carlstadt NJ 07072; TFCO splice lock No. SL-1 as manufactured by Thompson Fabrication Co., PO Box 170160, Birmingham AL 35217; splice locks as manufactured by Tri Tech, Inc., 5710 Harrison Avenue, Austell GA 30001; or equal, having the following essential characteristics:

a. Weldless end-to-end connection of pipe guardrail.

b. Internal expansion-type lock expanded by use of a set screw.

J. Anchors:

1. Seismic qualified per ICC IBC and ICC AC308 for seismic design category A through F and cracked concrete conditions.

a. Adhesive: HIT-RE 500-SD epoxy adhesive manufactured by HILTI, PO Box 21148, Tulsa OK 74121; or equal having the following essential characteristics:

1) Injectable two-component epoxy adhesive.

2) Dual packaging system designed for automatic mixing during injection.

3) Weathering resistant.

4) Resistant against high temperatures.

5) Suitable for use in diamond cored or pneumatic drilled holes.

6) Extended temperature range from 41 degrees F to 120 degrees F.

b. Threaded carbon steel anchor rod: HAS Super rod manufactured by HILTI, PO Box 21148, Tulsa OK 74121; or equal having the following essential characteristics:

1) Rod material: ASTM A 193, Grade B7.

2) Thread: ASME B1.1, continuously threaded (all-thread).

3) Fabricate with 45-degree chisel point on one end to facilitate insertion into adhesive-filled hole.

4) Hot-dip galvanized.

c. Standard steel nuts: ASTM **A** 563, Grade DH.

1) Hot-dip galvanized.

d. Standard steel washers: ASTM F 436, Type 1.

1) Hot-dip galvanized.

2. Expansion anchors: CID A-A-1923, Type 4, galvanized steel, except stainless steel anchors when submerged in water.

a. Bolt length: As shown on drawings. If not shown, provide bolt length with 3-1/2 inch minimum embedment.

3. Headed Concrete Anchors: ASTM A 108.

a. Flux-filled ends suitable for end welding to steel with automatically timed stud-welding equipment.

K. **Steel supports for Submerged Galvanic Anode Cathodic Protection System:**

1. **Plates:**

a. **ASTM A 36 steel.**

b. **Coated in accordance with Section 09902 – Coatings.**

L. Electrical equipment supports:

1. Combination channels as manufactured by Globe Strut, United Gypsum Corp., 101 South Wacker Drive, Chicago IL 60606; Unistrut Corp, 35660 Clinton Street, Wayne MI 48184; B-Line Systems Inc., 509 West Monroe Street, Highland IL 62249; or equal, having the following items and essential characteristics:

a. Combination channels: Globe Strut No. G7612A; B-Line Systems 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.

b. Connection plates: Globe Strut G2057; B-Line Systems B532; Unistrut P1726, or equal and Globe Strut G2068; B-Line Systems B568; Unistrut P1950 or equal.

c. Bolts, nuts, and washers with electro-galvanized finish.

2. Plates:

a. ASTM A 36 steel, galvanized.

3. Concrete footings:

a. In accordance with the applicable requirements of Section 03300 – Cast-In-Place Concrete.

b. Maximum size aggregate: 3/4-inch.

c. Minimum compressive strength: 2,500 pounds-per-square-inch at 28 days.

M. Guard posts:

1. Steel Pipe: ASTM A 53, type E or S, grade B.

a. Unless otherwise shown on drawings, provide standard-weight, black, steel pipe.

b. Government inspection at the mill and hydrostatic tests will not be required.

2. Concrete:

a. In accordance with the applicable requirements of Section 03300 – Cast-In-Place Concrete.

b. Maximum size aggregate: 3/4-inch.

c. Minimum compressive strength: 2,500 pounds-per-square-inch at 28 days.

3. Painting: In accordance with Section 09902 – Coatings.

2.02 FABRICATION

A. Fabricate metalwork in accordance with AISC 316 and these specifications.

1. Perform welding and related work in accordance with AWS D1.1.

2. Grind all welds on ladders and pipe guardrails 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. Fabricate ladders and pipe guardrails from standard weight pipe with diameter shown on drawings.

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 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 zinc primer.

   b. If the galvanized coating becomes damaged after being dipped twice, material will be rejected.

   c. Repair procedure where local paint repair is authorized:

      1) Clean damaged areas by wiping with clean rags saturated with mineral spirits or xylene, followed by wire brushing.

      2) Reclean areas with solvent to remove residue.

      3) Apply two or more coats of zinc primer:

         a) Total minimum dry-film thickness: 4 mils.

         b) Zinc primer: MIL-DTL-24441/19.

PART 3 EXECUTION

3.01 PREPARATION

A. Where locations and dimensions of miscellaneous metalwork shown on drawings are tentative or subject to change dependent upon 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.

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. Galvanizing Repair:

1. Repair in accordance with Section 09902 – Coatings.

D. Grout:

1. Where shown on drawings, fill spaces under metalwork completely as required with nonshrink grout in accordance with Section 03622 - Grouting Mortar for Equipment and Metalwork.

2. Clean surfaces of metalwork to be in contact with or embedded in concrete or grouting mortar in accordance with method B of Section 09902 - 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; in accordance with Section 09902 - Coatings.

END OF SECTION

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SECTION 09902 - COATINGS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include cost in prices offered schedule for items of work requiring coatings.

1.02 REFERENCES

A. ASTM International (ASTM)

1.	ASTM A 780-01(2006)	Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
2.	ASTM B117-07a	Operating Salt Spray (Fog) Apparatus
3.	ASTM D 522-93a(2001)	Mandrel Bend Test of Attached Organic Coatings
4.	ASTM D 870-02	Testing Water Resistance of Coatings Using Water Immersion
5.	ASTM D 1141-99(2003)	Preparation of Substitute Ocean Water
6.	ASTM D-2240-05	Rubber Property – Durometer Hardness
7.	ASTM D 2244-07	Calculation of Color Differences From Instrumentally Measured Color Coordinates
8.	ASTM D 3359-08	Measuring Adhesion by Tape Test
9.	ASTM D 3363-05	Film Hardness by Pencil Test
10.	ASTM D 4060-07	Abrasion Resistance of Organic Coatings by the Taber Abraser
11.	ASTM D 4214-07	Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
12.	ASTM D 4285-83(2006)	Indicating Oil or Water in Compressed Air
13.	ASTM D 4541-02	Pull-Off Strength of Coatings Using Portable Adhesion Testers
14.	ASTM D 4587-05	Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water-Exposure Apparatus
15.	ASTM G 8-96(2003)	Cathodic Disbonding of Pipeline Coatings

16.	ASTM G 154-06	Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

B. American Water Works Association (AWWA)

1.	AWWA C 203-02	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines, Enamel and Tape, Hot-Applied
2.	AWWA C 222-99	Polyurethane Coatings for the Interior and Exterior of Steel Pipe and Fittings

C. National Association of Pipe Fabricators (NAPF)

1.	NAPF 500-03-05-06	Abrasive Blast Cleaning of Cast Ductile Iron Fittings

D. The Society for Protective Coatings (SSPC)/NACE International (NACE)

1.	SSPC-AB1-04	Mineral and Slag Abrasives
2.	SSPC-AB2-04	Cleanliness of Recycled Ferrous Metallic Abrasives
3.	SSPC-AB3-04	Newly Manufactured or Re-Manufactured Steel Abrasives
4.	SSPC-PA2-04	Measurement of Dry Paint Thickness with Magnetic Gages
5.	SSPC-QP1-04	Evaluating Painting Contractors (Field Application to Complex Industrial Structures)
6.	SSPC-QP3-04	Evaluating the Qualifications of Shop Painting Contractors
7.	SSPC-SP1-04	Solvent Cleaning
8.	SSPC-SP3-04	Power Tool Cleaning
9.	SSPC-SP11-04	Power Tool Cleaning to Bare Metal
10.	SSPC-SP6/NACE 3-04	Commercial Blast Cleaning
11.	SSPC-SP7/NACE 4-04	Brush-Off Blast Cleaning
12.	SSPC-SP10/NACE 2-04	Near-White Blast Cleaning
13.	SSPC-VIS1-02	Guide and Reference Photographs for Steel Surfaces Prepared by Abrasive Blast Cleaning
14.	SSPC-VIS3-04	Visual Standard for Power- and Hand-Tool Cleaned Steel
15.	NACE SP 0188-06	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

16.	NACE RP 0287-02	Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces Using a Replica Tape
17.	NACE TM 0174-02	Laboratory Methods for the Evaluation of Protective Coatings and Lining Materials on Metallic Substrates in Immersion Service

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 “Items to be coated” including sub-letter and sub-number listed in Coating Tabulations.

B. RSN 09902-1, Approval Data:

1. For each coating material:

a. Manufacturer’s product data and application sheets.

b. 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 09902-2, Documentation:

1. Written evidence of applicator’s qualifications.

D. RSN 09902-3, Certifications:

1. Current SSPC-QP1 certification for field application to complex industrial structures.

2. Current SSPC-QP3 certification for shop application.

E. RSN 09902-4, Contractor quality testing data

1. Date of work

2. Description of areas and work performed

3. Surface preparation

4. Surface cleanliness

5. Ambient conditions

6. Dry film thickness

F. "Equal" Products:

1. For coating materials proposed as "equal" products to specified brand name products in Coating Categories, submit following with specified approval data:

a. 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 and service environment.

3) Owner's name, address, and telephone number.

4) Application dates.

b. 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.

c. 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.

1.04 QUALIFICATIONS

A. Coating Applicators Qualifications:

1. Qualified to apply specified coating materials by one of following:

a. Successfully completed training in use of coating material on applications similar to those specified in these specifications. List as a minimum, three completed projects using specified materials.

b. Skilled and experienced in application of coating materials similar to materials specified in these specifications under conditions similar to conditions of this project. List as a minimum, three completed projects using specified materials.

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 temperature and humidity conditions to meet specified requirements during, surface preparation, coating application, and curing period by use of indirect fired heater and dehumidification equipment.

PART 2 PRODUCTS

2.01 MATERIALS

A. General

1. Materials required by these specifications and not listed in Coating Categories are subject to certification and testing in accordance with this section.
2. Provide compatible products of same manufacturer for coating system components.

B. Abrasives:

1. Mineral and slag abrasives: Meets SSPC-AB1 for type I (natural minerals) and type II (slags), class A, except following are not permitted:
   a. Flint minerals.
   b. Nickel slags.
2. Mineral abrasives: Meets SSPC-AB1 for type I, natural minerals, class A, except flint minerals are not permitted.
3. 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.
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 exceed maximum permitted by Federal, State, and local air pollution control regulations.
   b. Do not exceed maximum permitted 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. Following chemical products are not permitted unless approved by Contracting Officer:
   a. Accelerators.
   b. Corrosion inhibitors.

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 Contracting Officer.
   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.

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. Method A: SSPC-SP1.
    b. Method B (steel): SSPC-SP6/NACE 3.
    c. Method B-1 (steel): Repair of defective or damaged coated areas.
        1) To metal substrate:
            a) SSPC-SP6/NACE 3.
            b) SSPC-SP11 where abrasive blasting is impractical.
        2) To prime or intermediate coat:
            a) Method A.
            b) Feather abrupt edges and around repair area by hand or power tool with non-woven pad.
            c) Roughen or abraded surface in accordance with manufacturer’s recommendations.
            d) Achieve matted or lusterless finish.
    d. Method C (steel): SSPC-SP10/NACE 2.
    e. Method C-1 (steel): Repair of defective or damaged coated areas.
        1) To metal substrate:
            a) SSPC-SP10/NACE 2.
            b) SSPC-SP11 where abrasive blasting is impractical.
        2) To prime or intermediate coat:
            a) Method A.
            b) Feather abrupt edges and around repair area by hand or power tool with non-woven pad.
            c) Roughen or abraded surface in accordance with manufacturer’s recommendations.
            d) Achieve matted or lusterless finish.

f. Method F (cast iron): NAPF 500-03-05, Blast Clean No. 4.

g. Method I (galvanized): Repair of defective or damaged galvanized surface. Use following:

1) To steel substrate:

a) SSPC-SP7/NACE 4.

b) SSPC-SP3, where abrasive blast cleaning is impractical.

2) Galvanized surface:

a) Method A and treat with conditioner specific for galvanized substrate in accordance with manufacturer's instructions. Rinse surface with potable water.

b) Sweep blast.

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 dry film thickness of first applied coat.

b. Burial and immersion service environments: Angular profile between 2 and 3-mils minimum and less than specified dry film thickness of first applied coat.

3. Perform tests in accordance with surface profile inspection procedures specified.

D. Re-clean or perform additional surface preparation of completed metallic or coated surfaces that become contaminated before coating application.

E. Prepare surface free of moisture, frost, and ice. Heat substrate surface which is not thoroughly dry to remove moisture before coating application.

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.

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. Primer Coats:

1. Cover peaks of surface profile by specified dry film thickness.

2. Apply stripe coats to edges, boltheads, 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.

3.07 SHOP FABRICATOR COATING INSPECTION

A. Allow 14 days notice to COR for factory inspection of surface preparation and coating application.

3.08 CONTRACTOR FIELD QUALITY TESTING

A. Equipment: 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.

B. 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.

C. 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.

D. 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 4.3.1: Minimum thickness of 90 percent of specified minimum thickness.

2) Section 4.3.2: Maximum thickness of 150 percent of specified maximum thickness.

b. Acceptance criteria: No single spot measurement in any 100 square foot area less than 90 percent of minimum specified thickness or greater than 150 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 SP 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) 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

A.

<table>
<tr><td colspan="3">Tabulation No. 01</td></tr>
<tr><td colspan="3">Items to be coated:
a. Slide gate motor-operators, ultraviolet UV-stable material required.
b. Engine generator set
c. Fuel tank
d. HVAC control equipment, chiller, and cabinets
e. Wall mounted fan
f. Hydraulic trash rake
g. Hydraulic trash rake conveyor
h. Automatic transfer switch
i. Stationary louvers</td></tr>
<tr><td>Coating materials</td><td>Number and thickness of coats</td><td>Surface preparation method</td></tr>
<tr><td colspan="3">Factory’s coating system:
1. Factory's standard surface preparation and permanent coating system.
2. Color and gloss: Factory’s standard color unless a specific color is otherwise specified in the color schedule.
3. Unless otherwise specified, unexposed surfaces that require coatings, such as interior of cabinets, enclosures, and equipment, are 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. All repair coating materials shall meet Local or State Air Quality VOC Regulations.</td></tr>
</table>

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Tabulation No. 02

Items to be coated:

a. Guard posts (manufacturer's standard safety yellow).
b. Control building bullet resistant doors and frames.

Coating materials Epoxy/polyurethane	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Base coats: Category options: IE-1A1 IE-1G	2 or more base coats. Apply at 3 to 4 mils DFT, per coat, plus stripe coats.	B Uncoated surfaces
Finish coats: Category options: AE-1ATV over IE-1A1 AE-1GTV over IE-1G Color and gloss: To be determined by COR	1 or more compatible manufacturer's finish coats. Apply at 4 mils DFT, minimum, per coat. Total system, excluding stripe coats: 10-mil DFT, minimum 12-mil DFT, maximum	B Uncoated surfaces B-1 Damaged coated surfaces Follow manufacturer's surface preparation and application instructions to apply subsequent coats.

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Tabulation No. 03		
Items to be coated: a. Stem guides b. Motor operator support pedestals c. Supports for cast iron slide gates. d. Instrument deployment bars e. Trashracks and seats. f. Stoplogs. g. Stoplog guides. h. Stoplog lifting beams. i. Water level sensor equipment and mounting poles. j. Ladders.		
Coating materials Epoxy/polyurethane	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Base coats: Category options: IE-1A1 IE-1G	2 or more base coats. Apply at 6 to 8 mils DFT, per coat, plus stripe coats.	C
Finish coats: Category options: IE-1ATV over IE-1A1 AE-1GTV over IE-1G Color and gloss: To be determined by COR	1or 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.

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Tabulation No. 04		
Items to be coated: a. Cast iron slide gates. b. Wall thimbles		
Note: 1. Do not coat stainless steel, nonmetallic, or valve and gate seat bearing surfaces. 2. At contractor's option, above items may be coated with fusion bonded epoxy in accordance with Coating Tabulation No. 31.		
Coating materials – Option 1 Epoxy	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Base coats: Category options: IE-1A1 IE-1G Color: manufacturer's standard white	2 or more base coats. Apply at 6 to 10 mils DFT, per coat, plus stripe coats. Total system, excluding stripe coats: 12-mil DFT, minimum 20-mil DFT, maximum	F
Coating materials – Option 2 Fusion-bonded epoxy	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Fluidize bed method using: Scotchkote 206N* or Scotchkote 6233 or equal Color: (a) 206N; manufacturer's standard blue-green (b) 6233: manufacturer's standard green	Apply 1 coat only, redipping is not permitted. System range: 12 to 30 mil DFT	F For ferrous surfaces Round sharp corners and edges to 1/8-inch radius, minimum For aluminum surfaces follow manufacturer's surface preparation instructions
Field repair: 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.

Tabulation No. 04		
Coating materials – Option 3 Fusion-bonded epoxy	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Electrostatic hot flock spray method using: Scotchkote 134* or equal Color: manufacturer's standard blue-green	Apply 1 or more coats. System range: 12 to 30 mil DFT	F For ferrous surfaces Round sharp corners and edges to 1/8-inch radius, minimum For aluminum surfaces follow manufacturer's surface preparation instructions
Field repair: Repair material: Scotchkote 314* or equal Ambient temperature cured, two component, 80 percent solids minimum, 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		

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Tabulation No. 05		
Items to be coated: a. Buried exterior surfaces of 108-inch steel pipe. b. Buried exterior surfaces of 108-inch steel pipe field welded joints. c. Buried exterior surfaces of ferrous piping not tabulated herein. d. Exterior of vent piping.		
Coating materials – Option 1 Coal-Tar Epoxy	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Base coats: Category options: IE-2AA IE-2AB Color: Manufacturer's standard black	2 or more base coats. Apply at 8 to 10 mils DFT per coat, plus stripe coats. Total system, excluding stripe coats: 16-mil DFT, minimum 20-mil DFT, maximum	C Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Repair of field joints, weld hold back areas, or damaged areas in the field: Base coats: 2-component, polymer epoxy Category: IE-1E Use either hand applied kits or hot spray applied product types. Color: Manufacturer's standard brown	2 or more base coats, apply at 18 to 20 mils per coat, plus stripe coats. Total system measured to steel substrate: 36-mil DFT, minimum 40-mil DFT, maximum	C-1 Repair of damaged coated surfaces and field joints, weld holdback areas. Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Coating materials – Option 2 Coal-Tar Enamel	Number and thickness of coats	Surface preparation method

Tabulation No. 05		
For ferrous surfaces: Coal-tar enamel: Meets AWWA C 203 and following: 1. Materials: a. Primer: Type B (fast-drying synthetic) liquid adhesion. b. Coal-tar enamel: Type II. c. Embedded woven glass outerwrap: Type II. d. Whitewash: Water-emulsion latex paint. 2. System thickness: 3/32-inch, plus or minus 1/32-inch plus outerwrap excluding whitewash thickness.		C For uncoated surfaces
Repair of field joints, weld hold back areas: Base coats: 2-component, polymer epoxy Category: IE-1E Use either hand applied kits or hot spray applied product types. Color: Manufacturer's standard brown	2 or more base coats over beveled coal-tar enamel system and bare substrate, apply at 18 to 20 mils per coat, plus stripe coats. Total system measured to steel substrate: 36-mil DFT, minimum 40-mil DFT, maximum	C-1 Repair of damaged coated surfaces and field joints, weld holdback areas. Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Coating materials – Option 3 Polyurethane	Number and thickness of coats	Surface preparation method
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}{blue}{green}{off-white}{red}{tan}]		C For uncoated surfaces Achieve 4-mil surface profile, minimum

Tabulation No. 05	
For repair of damaged and defective polyurethane areas: Category: BE-5AR Material option: Areas 1-inch square or less, use of polyethylene melt stick is permitted. Thickness: Achieve thickness equal to surrounding undamaged polyurethane in 1 or more coats.	C-1 Follow manufacturer's surface preparation and application instructions to apply subsequent coats.
Repair of field joints, weld hold back areas: Base coats: 2-component, polymer epoxy Category: IE-1E Use either hand applied kits or hot spray applied product types. Color: Manufacturer's standard brown	2 or more base coats, apply at 18 to 20 mils per coat, plus stripe coats. Total system measured to steel substrate: 36-mil DFT, minimum 40-mil DFT, maximum

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Tabulation No. 06
Items to be coated: a. Gratings, beams, and supports. b. Pipe guardrails. c. Embedded angles. d. W-beam guardrails and posts. e. Metal frames and grille frames for the control building. f. Electrical equipment supports. g. Damaged galvanized surfaces not otherwise tabulated.
Note: Repair damaged galvanized surface areas for above listed items.
Repair damaged galvanized surfaces in accordance with ASTM A 780, except repair materials containing cadmium and lead are not permitted.

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Tabulation No. 07		
Items to be coated: a. Buried interior surfaces of 108-inch steel pipe. b. Buried interior surfaces of 108-inch steel pipe field welded joints. c. Interior surfaces of vent piping. d. Buried interior surfaces of ferrous piping not tabulated herein. e. **Supports for cathodic protection system on interior of pipes.**		
Coating materials – Option 1 High Solids Epoxy	Number and thickness of coats	Surface preparation method
For ferrous surfaces: Base coats: Category options: IE-1A1 IE-1G Color and gloss: manufacturer's standard beige, gray, off-white, or other light color	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	C For uncoated surfaces C-1 For repair of damaged coated surfaces 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
For ferrous surfaces: Base coats: Category: IES-6D2(pw) Color: manufacturer's standard white	1 or more primer coats, apply at 4 to 8 mils DFT, per coat, plus stripe coats. 1 or more topcoats, apply at 10 to 12 mils DFT, per coat. Total system, excluding stripe coats: 14-mil DFT, minimum 20-mil DFT, maximum	C For uncoated surfaces C-1 For repair of damaged coated surfaces 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. 07		
For ferrous surfaces: Base coats: Category: IES-6D3(pw) Color: manufacturer's standard white	1 or more primer coats, apply at 16 to 20 mils DFT, per coat, plus stripe coats. Total system, excluding stripe coats: 16-mil DFT, minimum 20-mil DFT, maximum	C For uncoated surfaces C-1 For repair of damaged coated surfaces Material amine blushes, multiply coat systems need to be prepared in accordance with manufacturers' instructions to apply subsequent coats

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3.11 COATING CATEGORIES

Category IE-1A1	
Amerlock 400 or Amerlock 400/2; as manufactured by: Ameron International, 13010 Morris Road, Suite 400, Alpharetta GA 30004 (678) 393-0653, www.ameroncoatings.com	
or equal, having following essential characteristics:	
COMPOSITION:	
Self-priming, two component, polyamide epoxy Lead and chromate free.	
PHYSICAL CHARACTERISTICS:	
Solids by volume:	80 percent, minimum
VOC (as supplied):	1.4 pounds per gallon (168 grams per liter), maximum
Mix ratio (resin:hardener):	1:1
Mixed usable pot life at 70 degrees F:	2.5 hours, minimum
Ambient application temperature:	50 degrees F, minimum 120 degree F, maximum
Surface application temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	10 mils
Recoat time at 70 degrees F and 50 percent humidity:	3 months, maximum
Full cure time before immersion at 70 degrees F and 50 percent humidity:	7 days, minimum
Application methods:	Brush, roller, or spray
Color/finish:	Variety of colors/semigloss
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):	100 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-1A1

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 AE-1ATV

Amershield VOC; as manufactured by:

Ameron International, 13010 Morris Road, Suite 400, Alpharetta GA 30004
678-393-0653, www.ameroncoatings.com

or equal, having following essential characteristics:

COMPOSITION:

Topcoat – Two-component, aliphatic polyurethane

Lead and chromate free.

PHYSICAL CHARACTERISTICS, PRIMER:	
Solids by volume:	79 percent, minimum
VOC, as supplied:	1.5 pounds per gallon (185 grams per liter), maximum
Mix ratio - resin: hardener:	4:1
Mixed usable pot life at 50 degrees F:	5 hours, minimum
Ambient application temperature:	50 degrees F, minimum 120 degree F, maximum
Surface application temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	5 mils
Recoat time at 50 degrees F and 50 percent humidity:	48 hours, minimum
Application methods:	Brush, roller, or spray
Color/finish:	Variety of colors/gloss

PERFORMANCE REQUIREMENTS:	
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, minimal chalking ASTM D 4214 or color difference ASTM D 2244.
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:	equal to 4A or better

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Category IE-1G

Carboguard 691; 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, phenalkamine epoxy

Lead and chromate free.

PHYSICAL CHARACTERISTICS:

Solids by volume:	80 percent, minimum
VOC, as supplied:	1.42 pounds per gallon (170 grams per liter) mixed, maximum
Mix ratio - resin: hardener:	1:4
Mixed usable pot life at 75 degrees F:	1.5 hours, maximum
Ambient application temperature:	50 degrees F, minimum 100 degrees F, maximum
Surface application temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	8 to 20 mils
Recoat time at 60 degrees F:	14 days, maximum
Full cure time before immersion at 60 degrees F and 50 percent humidity:	14 days, minimum
Application methods:	Brush, roller, or spray
Color/finish:	Beige (0200), Red (0500) and Gray (0700) in a Semi-gloss.

PERFORMANCE REQUIREMENTS:

Immersion Test, NACE mod TM-01-74:	
75 degree F:	Grade: 99/100
130 degree F	Grade: 97/100
Salt Spray Test, ASTM B117	1400 hour test single coat, NE in plane, VSL undercutting @scribe, #2, MD blisters @scribe
Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	249 milligram loss or less
Flexibility, ASTM D 522, 180 degree bend over ¼-inch mandrel:	Passes

Category IE-1G

Pencil hardness, ASTM D 3363:	2B, minimum
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	1700 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 AE-1GTV

Carbothane 134 VOC; 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:

Topcoat – Two-component, aliphatic acrylic polyurethane

Lead and chromate free.

PHYSICAL CHARACTERISTICS, PRIMER:

Solids by volume:	70 percent, minimum
VOC, as supplied:	1.58 pounds per gallon (190 grams per liter), maximum
Mix ratio - resin: hardener:	4:1
Mixed usable pot life at 75 degrees F:	4 hours, maximum
Ambient application temperature:	50 degrees F, minimum 95 degrees F, maximum
Surface application temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	2 to 2.5 mils
Recoat time at 50 degrees F and 50 percent humidity:	16 hours, minimum
Application methods:	Brush, roller, or spray
Color/finish:	Variety of colors/gloss

PERFORMANCE REQUIREMENTS:

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, minimal chalking ASTM D 4214 or color difference ASTM D 2244.
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:	2500 psi or greater
Pulloff tape, ASTM D 3359:	equal to 4A or better

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Category IE-1E

Powercrete J; as manufactured by:

Covalence Corrosion Protection Group, 11010 Wallisville Road, Houston TX 77013
713-676-0085, www.covalencecpg.com

or equal, having following essential characteristics:

COMPOSITION:

Self-priming, two component, polymer epoxy

Lead and chromate free.

PHYSICAL CHARACTERISTICS:

Solids by volume:	100 percent, minimum
VOC, as supplied:	Zero
Mix ratio - resin: hardener:	4.8:1
Mixed usable pot life at 73 degrees F:	20 minutes, minimum
Ambient application temperature:	50 degrees F, minimum 140 degrees F, maximum
Surface application temperature above dew point:	5 degrees F, minimum
Maximum DFT per coat:	20 mils
Recoat time at 70 degrees F:	50 minutes, maximum; see manufacturer's recoat and curing chart
Full cure time before burial or immersion at 70 degrees F:	24 hours, minimum
Application methods:	Trowel or hot airless spray
Color:	Brown

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:	1 mil loss per 1250 cycles

Category IE-1E

Flexibility, ASTM D 522, 180 degree bend over 1-inch mandrel:	Passes
Pencil hardness, ASTM D 3363:	2B, minimum
Pulloff adhesion from ferrous substrate, ASTM D 4541, annex A2, type II tester:	500 psi or greater
Pulloff adhesion from coal-tar enamel substrate, ASTM D 4541, annex A2, type II tester:	320 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 IES-6D2(pw)

Dura-Plate UHS Epoxy Primer; Dura-Plate UHS Epoxy, intermediate coat and topcoat; as manufactured by:

Sherwin-Williams, 101 Prospect Avenue NW, Cleveland OH 44115
216-566-2000, www.sherwin-williams.com

or equal, having following essential characteristics:

COMPOSITION:

Primer – Two-component, ultra high solids, amine, epoxy

Intermediate coat and topcoat – Two-component, ultra high solids, amine, epoxy

Lead and chromate free.

PHYSICAL CHARACTERISTICS, PRIMER:

Solids by volume:	96 percent, minimum
Solids by weight:	96 percent, minimum
Weight per gallon:	10.5 pounds per gallon, minimum
VOC, as supplied:	0.66 pounds per gallon (80 grams per liter), maximum
Mix ratio – resin:hardener:	4:1
Pot life at 55 degrees F	45 minutes, maximum
Ambient application temperature:	50 degrees F, minimum 110 degrees F, maximum
Maximum DFT per coat:	8 mils
Recoat time at 55 degrees F:	48 hours, minimum
Application methods:	Brush, roller, spray
Color:	Gold

PHYSICAL CHARACTERISTICS, INTERMEDIATE COAT AND TOPCOAT:

Solids by volume:	96 percent, minimum
Solids by weight:	96 percent, minimum
VOC, as supplied:	0.66 pounds per gallon (80 grams per liter), maximum
Mix ratio – resin:hardener:	4:1
Pot life at 55 degrees F:	45 minutes, maximum
Maximum DFT per coat:	12 mils for 2-coat system
Recoat time at 55 degrees F:	21 days, maximum
Full cure before immersion service at 55 degrees F and 50 percent humidity:	14 days, minimum

Category IES-6D2(pw)

Application methods:	Brush, roller, spray
Color/finish:	Gray-green and white/gloss
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:	21 milligram loss or less
Flexibility, ASTM D 522, 180 degree bend over 1/2-inch mandrel:	passes
Pencil hardness, ASTM D 3363:	3H, minimum
Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	500 psi or greater
Cathodic disbondment, ASTM G 8:	Passes 90 day test

099XC_IES6D2pw.DOC

Category IES-6D3(pw)

Plasite 4500 S; as manufactured by:

Carboline, 350 Hanley Industrial Court, St. Louis MO, 63144
314-644-1000, www.carboline.com

or equal, having following essential characteristics:

COMPOSITION:

Primer – Two-component, 100% solids, amine, epoxy

Intermediate coat and topcoat – Two-component, ultra high solids, amine, epoxy

Lead and chromate free.

PHYSICAL CHARACTERISTICS, PRIMER:

Solids by volume:	100 percent, minimum
Solids by weight:	100 percent, minimum
VOC, as supplied:	0.04 pounds per gallon (18 grams per liter), maximum
Mix ratio – resin:hardener:	4:1
Pot life at 75 degrees F	45 minutes
Ambient application temperature:	50 degrees F, minimum 90 degrees F, maximum
DFT per coat:	20-60 mils
Application methods:	Brush, roller, spray
Color:	Light gray, tile red, or white

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:	100 milligram loss or less
Flexibility, ASTM D 522, 180 degree bend over 1/2-inch mandrel:	passes
Pencil hardness, ASTM D 3363:	3H, minimum

Category IES-6D3(pw)

Pulloff adhesion, ASTM D 4541, annex A2, type II tester:	500 psi or greater
Cathodic disbondment, ASTM G 8:	Passes 90 day test

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Category IE-2AA

Amercoat 78HB; as manufactured by:

Ameron International, 13010 Morris Road, Suite 400, Alpharetta GA 30004, 678-393-0653, www.ameroncoatings.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 120 degrees F, maximum
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.

Category IE-2AA

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
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 100 degrees F, maximum
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

Category IE-2AB

	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
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 BE-5A

Corropipe II Omni; as manufactured by:

Madison Chemical Industries Inc., 490 McGeachie Drive, Milton, Ontario, Canada L9T 3Y5, 905-878-8863, www.madisonchemical.com

or equal, having following essential characteristics:

COMPOSITION:

Self-priming, two component, aromatic polyether urethane

PHYSICAL CHARACTERISTICS:

Solids by volume:	98 percent, minimum
VOC, as supplied:	13.25 grams per liter, maximum
Mix ratio:	1:1
Ambient application temperature:	40 degrees F, minimum 150 degrees F, maximum
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
Full cure time at 70 degrees F:	7 days, minimum
Application method:	Heated plural-component airless spray
Color:	Limited colors

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.
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.
Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	75 milligram loss or less
Flexibility, ASTM D 522, 180 degree bend over 1-inch mandrel at 20-mil DFT:	passes
Hardness, ASTM D 2240 Shore D::	70 plus/minus 5
Pulloff adhesion, ASTM D 4541:	1,800 psi or greater
Cathodic disbondment, ASTM G 8:	passes 90 day test

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Category BE-5AR

GP II (E) Touch-Up; as manufactured by:

Madison Chemical Industries Inc., 490 McGeachie Drive, Milton, Ontario, Canada L9T 3Y5, 905-878-8863, www.madisonchemical.com

or equal, having following essential characteristics:

COMPOSITION:

Self-priming, two component, aromatic, pyrolysis, epoxy

PHYSICAL CHARACTERISTICS:

Solids by volume:	100 percent
VOC, as supplied:	zero
Mix ratio, resin-to-hardener:	1:1
Mixed useable pot life at 70 degrees F:	30 minutes, maximum
Ambient application temperature:	50 degrees F, minimum 150 degrees F, maximum
Surface application temperature above dew point:	5 degrees F, minimum
Recoat time at 50 degrees F:	2 days, maximum
Full cure time at 50 degrees F:	7 days, minimum
Application method:	Brush, spatula, or double barrel caulking gun, if tube packaged
Color:	Limited colors

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.
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.
Abrasion resistance, ASTM D 4060, CS-17 wheel, 1,000 cycles, 1-kg load:	200 milligram loss or less
Hardness, ASTM D 2240 Shore D::	65 plus/minus 5
Pulloff adhesion, ASTM D 4541:	1,300 psi or greater
Cathodic disbondment, ASTM G 8:	passes 90 day test

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END OF SECTION

SECTION 13110 – BURIED IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Buried Impressed Current Cathodic Protection System:

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

1.02 REFERENCES

A. ASTM International (ASTM)

1.	ASTM C 33-03	Concrete Aggregates

B. Bureau of Reclamation (USBR)

1.	USBR M-47	Standard Specification for Repair of Concrete, August 1996

C. NACE International (NACE)

1.	NACE **S**P0169-200**7**	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

D. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250-2003	Enclosures for Electrical Equipment (1000 Volts Maximum)

1.03 DEFINITIONS

A. Structure: The pipe, gate, trashrack, tank, or other metalwork being monitored or cathodically protected.

B. Foreign Structure: Any metallic structure that is not intended to be electrically continuous with the structure requiring corrosion monitoring and/or cathodic protection.

C. Bonded Dielectric Coating: A protective barrier coating system with high electrical resistivity bonded directly to the underlying metal and for the most part physically and electrically isolating the metal from the electrolyte.

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. Structure-to-Electrolyte Potential:

1. Also referred to as structure-to-soil, pipe-to-soil, fitting-to-soil, and structure-to-water potentials.

2. The potential, or voltage difference, developed by a structure in an electrolyte when compared with a stable reference electrode.

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 period. Also referred to as native structure-to-electrolyte potential.

4. Polarized structure-to-electrolyte potential: The structure-to-electrolyte potential determined after an external current, as from a cathodic protection system, has been flowing, but immediately after it has been interrupted. Also referred to as "instant off" structure-to-electrolyte potential, it is an IR-free reading.

5. 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 also sometimes called a protective potential and may contain significant IR drop error.

6. Polarization: The change from the static or native potential as a result of current having flowed across the electrode/electrolyte interface for some time. Also considered the difference between polarized and static potentials.

F. 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. Should have a minimum input impedance of 10 megohm.

2. Should be capable of measuring DC voltages between + or – 0.1 millivolts and + or – 100 volts.

3. When measuring structure potentials using a digital instrument, the structure is typically connected to the positive terminal of a voltmeter and the reference electrode to the common (negative) terminal of the voltmeter. Polarity and voltage magnitude are then read 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 are required.

G. Stray Current Interference: Corrosion resulting from current through paths other than the intended circuit - e.g., corrosion occurring on a protected structure caused by the cathodic

protection system on a foreign structure, or some other source of current, either AC or DC.

H. Cable: All metallic conductors other than the protected structures and the anodes; sometimes called wires.

I. Shunt: Calibrated resistor placed within a circuit to determine the current flow within the circuit. Calibration is typically expressed in ohms or amperage/voltage.

J. Reference Electrode: An electrode whose open circuit potential is constant under similar conditions of measurement, which is 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 for such a purpose.

K. Rectifier: An electrical/electronic device that converts an AC input to a DC output. The rectifier typically includes a step-down transformer section to reduce the incoming AC voltage as well as a rectification section that converts current to DC, along with meters fuses, lightning arresters, and other accessories.

L. Test Station: A location for conducting tests on a protected structure, normally having an enclosure containing terminals of cables from one or more structures.

M. Junction Box: An enclosure containing the terminals from multiple anodes along with accessories such as calibrated shunts and variable resistors. From the junction box, a single anode header cable is fed to a rectifier.

N. Rectifier: An instrument capable of converting AC power to DC power for use with anodes for an impressed current cathodic protection system.

1.04 QUALIFICATIONS

A. The Contractor shall employ the services of an individual having a NACE International Cathodic Protection Technician certification or higher to ensure cathoidc protection systems are properly installed.

B. Testing will be conducted by or under the direction of a Cathodic Protection Specialist. Testing personnel may be assisted by other qualified individuals.

1.05 SYSTEM DESCRIPTION

A. Provide impressed current cathodic protection and monitoring system for the exterior of the two pipes **and vents.**

B. Provide all materials and engineering services to furnish, install, and energize the corrosion monitoring and impressed current cathodic protection system.

1. Include electrical continuity joint bonds, test stations, junction box, rectifier, anodes, and accessory equipment and features as directed in this specification or as otherwise indicated.

C. Impressed current system shall 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 (i.e. above) the structure:

a. A polarized structure-to-electrolyte potential of at least -0.850 volts on steel having a high quality bonded dielectric coating.

b. Alternately, -0.100 volts of polarization if **Reclamation determines** criteria in a. cannot be obtained (e.g on bare or poorly coated steel structures).

c. A polarized potential at any point on a dielectrically coated structure not exceeding -1.100 volts in all instances.

D. NACE SP-0169 and NACE TM0497 shall apply to any issues not specifically addressed by this specification.

1.06 SUBMITTALS

A. Submit the following in accordance with Section 01330 – Submittals.

B. RSN 13110-1, Manufacturers Data and Preconstruction Drawings:

1. Manufacturers Data. Include catalog data sheets when available, for:

a. Cable.

b. Anode.

c. Junction box.

d. Rectifier.

e. Test station.

f. Permanent reference electrode.

g. Adjustable resistor and calibrated shunt resistor.

h. Exothermic metallurgical bond system (include instructions).

i. **Coating for metallurgical bonds.**

2. Preconstruction drawings:

a. Intended location of anodes, rectifier, junction box, permanent reference electrode, and test station.

b. Details of intended placement and bedding of anodes, including sand bedding of cables.

c. Typical details of intended junction box and test station wiring.

C. RSN 13110-2, As-Built Drawings:

1. Actual location of anodes, rectifier, junction box, permanent reference electrode, and test stations.

2. Details of actual placement and bedding of anodes, including sand bedding of cables.

3. Typical details of actual junction box and test station wiring.

PART 2 PRODUCTS

2.01 GENERAL

A. 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. Dual insulation consisting of Kynar™ or Halar™ with a secondary layer of high-molecular-weight polyethylene (HMWPE) for anode cables running underground.

3. Alternately, black HMWPE insulation with minimum thickness of 0.100 inch for other underground or above ground applications.

C. Unspliced lengths to permit installation from terminus to terminus (e.g. anode to junction box) free of splices and without stress.

D. Gauge:

1. No. 2 AWG or larger for bonding between pipes.

2. No. 6 AWG or larger for carrying current between structures and anodes.

3. No. 12 AWG or larger for determining of structure-to-electrolyte potentials.

2.03 IMPRESSED CURRENT ANODES

A. Anodes: 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. Minimum weight:

a. 62 pound

2. Wax or resin treated graphite anode material specifically designed for cathodic protection systems and the intended environment.

3. 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.

C. Anode bed filled with carbonaceous backfill.

2.04 RECTIFIER

A. Constant voltage type with a rated output of at least 17 V – 6 A.

B. Air cooled.

C. Capable of continuous operation at 120 percent of rated output **at** ambient temperature of 50 degrees C.

D. Fitted with a heavy duty transformer with at least 15 percent over design capacity.

E. Of the silicon diode type.

F. Fitted with switchable meter(s) for determining output voltage and current, and which is (are):

1. Accurate within 2 percent of full scale.

2. Marked with a red line designating rated capacity.

G. Such that the output voltage is adjustable in 18 or more equal increments using quick-change knobs, or continuously from 0 to 100 percent rated output.

H. Energized by 120-volts, single phase AC.

I. Equipped with AC and DC lightning arrestors and protective fuses or circuit breakers.

J. Equipped with solderless, pressure-type terminals for anode and cathode cables.

K. Equipped with a single slide out rack for easy access to internal components during maintenance. The rack shall slide out the front of the cabinet.

L. Equipped with an accessible shunt on the front panel for determining current output. The shunt shall be stamped with the amperage per millivolt rating.

M. Engraved panel.

N. Fitted with a bracket for mounting in a NEMA 250, Type 4 box.

O. Properly grounded.

2.05 JUNCTION BOXES

A. Junction box specifically constructed for cathodic protection system installations:

1. NEMA 250, Type 1, hinged, vented for heat dissipation.
2. Engraved 1/4-inch minimum NEMA grade C phenolic panel.
3. Solderless, pressure-type terminals.
4. Brackets: Suitable for pole or wall mounting.

B. Identify terminals and cables.

C. Equip with 0.01 ohm calibrated shunts of adequate electrical rating for each anode.

D. Equip with variable resistors of adequate electrical rating to adjust the current flow of each anode.

E. Protect as required for permanency.

2.06 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, 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.

B. Test station cables in accordance with cable requirements of this Section.

C. A permanent reference electrode shall be provided near the midway point of the pipes to allow potential monitoring at that location without entering the interstate 8 right of way.

1. The permanent reference electrode must have a minimum 20 year service life.
2. The reference electrode cable must meet the cable requirements of this section.

2.07 EXOTHERMIC METALLURGICAL BONDS

A. Exothermic metallurgical bond system by ThermOweld, 4102 South 74th East Ave., Tulsa, OK 74145-4700, or equal, having the following essential characteristics:

1. Specifically designed for cathodic protection systems.
2. The exothermic reaction produces molten copper alloy, which produces a permanent, high conductivity connection.

3. Uses a special alloy to provide minimum heat effect on the steel.

4. Current carrying capacity equal to that of the conductor.

2.08 DIELECTRIC METALLURGICAL BOND COATING

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.

2.09 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 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

A. Cable:

1. Inspect for insulation defects prior to backfilling.

   a. Repair defects using approved methods or replace the cable.

   b. COR will inspect and approve all repairs prior to installation.

2. Install without kinks, stresses, and/or splices.

3. Buried applications:

   a. Minimum burial depth: 24 inches.

   b. Surround cable with 6 inches of sand backfill.

c. Place warning tape approximately 12 inches above cable for the entire length.

d. 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. Factory printed letters on self-adhesive strips attached to the cables clearly visible within the enclosure.

b. Encase printed labels in clear heat shrink tubing.

B. Electrical continuity joint (jumper) bonds:

1. Provide metallurgical bonds between **steel** pipes **and vents** as indicated in this specification section or as necessary to ensure electrical continuity.

2. A minimum of two cables per location.

3. Allow for at least 1 foot of movement.

4. Jumper bond locations:

a. Between **steel** pipes on both the upstream and downstream ends, minimum.

b. **Vents.**

C. Structure connections:

1. One test cable and one bond cable per **steel** pipe at each test station.

2. **One current carrying cable returning to the rectifier.**

3. Connect cables and jumper bonds to structures by exothermic metallurgical bond.

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; 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 **system**.

e. Allow dielectric material to cure before repair of the damaged structure coating or lining.

1) Repair dielectric coatings/linings in accordance with Section 09902 – Coatings

D. Impressed Current Anodes:

1. Install vertically as follows and as directed by the COR:

a. Number of anodes: Six anodes.

b. Approximate size of each anode: 80 inches x 4 inches, minimum 62 pounds.

c. Size of **shafts for** each anode: 9 feet x 10 inches diameter.

d. Anodes centered in the anode bed and surrounded with carbonaceous backfill.

e. Depth of anode bed: 50 feet from the top of the carbonaceous backfill to **original** ground level.

f. Spacing between anode beds: 20 feet on center.

g. Anode beds installed between the new road and outlet structure **on the west side** approximately 125 to 300 feet from **steel pipes**; avoiding the fiber optic cable **(see drawing 423-D-694)**.

2. Energizing the system will be done at time of testing.

E. Anode Junction Box:

1. Connect individual anode cables to anode header cable through calibrated 0.01 ohm shunts inside the anode junction box.

2. Include a 5 ohm variable resistor in series with the calibrated shunt for each individual anode.

F. Electrical isolation:

1. All structures to be cathodically protected shall be electrically isolated from rebar or other extraneous metal.

G. Test Stations:

1. Locations:

a. Where test stations are not likely to be damaged or interfere with personnel and/or equipment (e.g., adjacent to above ground structures). Exact location is subject to approval of COR.

b. As close to each current carrying structure connection as possible and convenient.

c. One to monitor each end of **the** pipe**s** and **a third one to monitor** approximately the middle.

d. No test station is to be located within the interstate 8 right of way.

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. Bond cable from the protected structure.

   b. Cable from the protected structure for determining structure to soil potentials.

   c. **Cable for a permanent reference electrode if one is present.**

3.02 ENERGIZING, ADJUSTING, AND TESTING

A. Energizing, adjusting, and testing will be performed by the Government under the direction of **their** NACE certified Cathodic Protection Specialist.

END OF SECTION

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SECTION 13111 – GALVANIC ANODE CATHODIC PROTECTION SYSTEMS FOR GATES AND POLES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Galvanic Anode Cathodic Protection Systems for Gates and Poles:

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

1.02 REFERENCES

A. ASTM International (ASTM)

1.	ASTM B 843-07	Magnesium Alloy Anodes for Cathodic Protection

B. NACE International (NACE)

1.	NACE **S**P0169-200**7**	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

C. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250-2003	Enclosures for Electrical Equipment (1000 Volts Maximum)

1.03 DEFINITIONS

A. Structure: The pipe, gate, trash rack, tank, or other metalwork being monitored or cathodically protected.

B. Foreign Structure: Any metallic structure that is not intended to be electrically continuous with the structure requiring corrosion monitoring and/or cathodic protection.

C. Bonded Dielectric Coating: A protective barrier coating system with high electrical resistivity bonded directly to the underlying metal and for the most part physically and electrically isolating the metal from the electrolyte.

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. Structure-to-Electrolyte Potential:

1. Also referred to as structure-to-soil, pipe-to-soil, fitting-to-soil, and structure-to-water potentials.

2. The potential, or voltage difference, developed by a structure in an electrolyte when compared with a stable reference electrode.

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 period. Also referred to as native structure-to-electrolyte potential.

4. Polarized structure-to-electrolyte potential: The structure-to-electrolyte potential determined after an external current, as from a cathodic protection system, has been flowing, but immediately after it has been interrupted. Also referred to as "instant off" structure-to-electrolyte potential, it is an IR-free reading.

5. 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 also sometimes called a protective potential and may contain significant IR drop error.

6. Polarization: The change from the static or native potential as a result of current having flowed across the electrode/electrolyte interface for some time. Also considered the difference between polarized and static potentials.

F. 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. Should have a minimum input impedance of 10 megohm.

2. Should be capable of measuring DC voltages between + or – 0.1 millivolts and + or – 100 volts.

3. When measuring structure potentials using a digital instrument, the structure is typically connected to the positive terminal of a voltmeter and the reference electrode to the common (negative) terminal of the voltmeter. Polarity and voltage magnitude are then read 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 are required.

G. Stray Current Interference: Corrosion resulting from current through paths other than the intended circuit - e.g., corrosion occurring on a protected structure caused by the cathodic protection system on a foreign structure, or some other source of current, either AC or DC.

H. Cable: All metallic conductors other than the protected structures and the anodes; sometimes called wires.

I. Shunt: Calibrated resistor placed within a circuit to determine the current flow within the circuit. Calibration is typically expressed in ohms or amperage/voltage.

J. Reference Electrode: An electrode whose open circuit potential is constant under similar conditions of measurement, which is 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 for such a purpose.

K. Test Station: A location for conducting tests on a protected structure, normally having an enclosure containing terminals of cables from one or more structures and from anodes along with accessories such as calibrated shunts.

L. Junction Box: An enclosure containing the terminals from multiple electrodes along with accessories such as calibrated shunts and variable resistors. From the junction box, a single cable is normally fed to a test station.

1.04 QUALIFICATIONS

A. The Contractor shall employ the services of an individual having a NACE International Cathodic Protection Technician certification or higher to ensure cathodic protection systems are properly installed.

B. Testing will be conducted by or under the direction of a Cathodic Protection Specialist. Testing personnel may be assisted by other qualified individuals.

1.05 SYSTEM DESCRIPTION

A. Provide galvanic anode cathodic protection and monitoring system(s) for the submerged metalwork, including:

1. Except for the gates at the pipe inlet structure, each gate, on **upstream and downstream side** including stop-log guides. The gates at the pipe inlet structure shall be cathodically protected only on the upstream side.

2. Immersed support poles for sensors and solar panels, and their ladders.

B. All materials and engineering services shall be provided to **design,** furnish, install, and energize the corrosion monitoring and galvanic anode cathodic protection system(s).

1. Include electrical continuity joint bonds, test stations, galvanic anodes, and accessory equipment and features as directed in this specification or as otherwise indicated.

C. Galvanic anode system(s) shall 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 steel having a high quality bonded dielectric coating.

b. Alternately, -0.100 volts of polarization **if Reclamation determines the criteria in a. cannot be obtained** (e.g. isolated bare or poorly coated steel structures).

c. A polarized potential at any point on a dielectrically coated structure not exceeding -1.100 volts in all instances.

D. Galvanic anodes shall be placed and connected:

1. Such as to provide adequate distribution of cathodic protection current, as indicated by potential readings.

2. Submerged and restrained (e.g. **cut out** PVC pipe**; see drawing 423-D-777**) in such a way as to:

a. Maintain sufficient anode material below the minimum normal operating water level.

b. Not allow the anodes to come in direct contact with the protected structure.

c. Not place stress on the anode cables.

3. Through cables:

a. Suitable for direct immersion.

b. Having all portions insulated that are exposed to electrolyte.

4. Through junction box(es) **where multiple anodes are involved** to protected structure(s):

a. Connecting individual anodes to the structure(s) through individual calibrated shunts for current measurement.

b. Connecting individual anodes to the structure(s) through variable resistors within junction box(es) to allow equalizing current from individual anodes where multiple anodes are used or where adjustment of current may be needed.

c. Locating all junction boxes **near the associated test station and** to make them readily accessible.

5. **Through test stations where single anodes are involved. Junction boxes shall also connect anodes to structures through test stations.**

E. Electrical continuity joint bonds shall be provided:

1. Using metallurgical bonds at mechanical type joints (e.g., non-welded joints) between ferrous parts to be protected to ensure electrical continuity, where isolation is not required by design.

2. Bonding associated metalwork systems, where appropriate, for mutual protection.

F. NACE RP-0169 and NACE TM0497 shall apply to any issues not specifically addressed by this specification.

1.06 SUBMITTALS

A. Submit the following in accordance with Section 01330 – Submittals.

B. RSN 13111-1, Manufacturers Data and Preconstruction Drawings:

1. Manufacturers Data. Include catalog data sheets where available for.
    a. Cable.
    b. Anode.
    c. Junction box.
    d. Test station.
    e. Variable resistor and calibrated shunt resistor.
    f. Exothermic metallurgical bond system (include instructions).
    g. **Dielectric metallurgical bond coating system.**
2. Preconstruction drawings:
    a. Intended locations of anodes, junction boxes, and test stations.
    b. Details of intended placement and restraint of anodes.
    c. Typical details of intended junction box and test station wiring.

C. RSN 13111-2, As-Built Drawings:

1. Actual locations of anodes, junction boxes, and test stations.
2. Details of actual placement and restraint of anodes.
3. Typical details of actual junction box and test station wiring.

PART 2 PRODUCTS

2.01 GENERAL

A. 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.

2. Black, high-molecular-weight polyethylene (HMWPE) with minimum thickness of 0.100 inch.

C. Unspliced lengths to permit installation from terminus to terminus (e.g. anode to junction box or test station) free of splices and without stress.

D. Gauge:

1. No. 6 AWG or larger for carrying current between structures and anodes, and for joint bonds between parts.

2. No. 12 AWG or larger for determining of structure-to-electrolyte potentials and from individual **galvanic** anodes.

2.03 GALVANIC ANODES

A. Galvanic anodes: Bare 2-1/2-inch diameter extruded high potential magnesium rod anodes manufactured by Farwest Corrosion Control Co., 480 Artesia Blvd., Gardena CA, 90248**,** or equal, with the following essential characteristics:

1. Minimum weights of magnesium:

a. 4 pounds per foot

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. Core:

a. Mild or galvanized steel centered within the anode material and extending essentially the entire length of anode

b. Exposed at one end for the anode-to-cable connection.

c. Connection between the anode cable and core: Crimped, silver-solder.

B. Anode-to-cable connection, including the crimped and silver-soldered connection, exposed core, and exposed copper cable shall be potted in epoxy by the supplier.

C. Anode cable **of appropriate length, of one piece from anode connection to terminus, and** in accordance with **all other** cable requirements of this section.

2.04 JUNCTION BOXES

A. Junction boxes specifically constructed for cathodic protection system installations when multiple anodes are used to protect a structure:

1. NEMA 250 type 3-R, hinged, lockable cabinets constructed of No. 16-gauge or thicker galvanized steel that are weatherproof and vented for heat dissipation.

2. Engraved 1/4-inch minimum NEMA grade C phenolic panels.

3. Solderless, pressure-type terminals.

4. Brackets: Suitable for pole or wall mounting.

B. Identify terminals and cables.

C. Equip with 0.01 ohm calibrated shunts of adequate electrical rating for each anode.

D. Equip with variable resistors of adequate electrical rating to adjust the current flow of each anode.

E. Protect as required for permanency.

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, post-mounted type.

2. Orange in color.

3. Specifically constructed for cathodic protection system installations.

4. Protected as required for permanency.

5. 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.

B. Test station cables in accordance with cable requirements of this Section.

2.06 EXOTHERMIC METALLURGICAL BONDS

A. Exothermic metallurgical bond system by ThermOweld, 4102 South 74th East Ave., Tulsa, OK 74145-4700, or equal, having the following essential characteristics:

1. Specifically designed for cathodic protection systems.

2. The exothermic reaction produces molten copper alloy, which produces a permanent, high conductivity connection.

3. Uses a special alloy to provide minimum heat effect on the steel.

4. Current carrying capacity equal to that of the conductor.

2.07 DIELECTRIC METALLURGICAL BOND COATING

A. Repair coating at exothermic metallurgical bonds **using dielectric material such as Bitumastic 50 manufactured by Carboline, 350 Hanley Industrial Court, St. Louis, MO 63144-1599, or equal having the following essential characteristics:**

1. **Approved dielectric material.**
2. **Suitable for intended environment.**

PART 3 EXECUTION

3.01 INSTALLATION

A. Cable:

1. Inspect for insulation defects prior to installation.
    a. Repair defects using approved methods or replace the cable.
    b. COR will inspect and approve all repairs prior to installation.
2. Install without kinks, stresses, and/or splices.
3. Run cable through rigid galvanized conduit, test station pipe, or similar protection once cable emerges from the water.
4. Connect to test station **or junction box** terminals with crimped, ring-tongue connectors.
5. Identify origin of cables terminating in an enclosure:
    a. Factory printed letters on self-adhesive strips attached to the cables clearly visible within the enclosure.
    b. Encase printed labels in clear heat shrink tubing.

B. Electrical continuity joint (jumper) bonds:

1. Provide metallurgical bonds between **immersed** ferrous parts to be included in a particular cathodic protection system as indicated in this specification section or as necessary to ensure electrical continuity.
2. A minimum of two cables per bond joint.
3. Allow **sufficient bond cable** for at least 1/2-inch of movement.
4. Jumper bond locations:
    a. Between gates and associated stop-logs.
    b. Between associated gates.
    c. Between sensor poles and their associated ladders.
    d. Above water level when convenient.

C. Structure connections:

1. Connect cables and jumper bonds to structures by exothermic metallurgical bond.
    a. Make exothermic metallurgical bond in accordance with the bonding supply manufacturer's instructions.

b. Bonds shall not damage the **coating system**; 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.

e. Allow dielectric material to cure before repair of the damaged structure coating or lining.

1) Repair dielectric coatings/linings in accordance with Section 09902 – Coatings

D. Galvanic Anodes:

1. Install **in anode restraints (see drawing 423-D-777)** as follows and as directed by the COR:

a. Two 8 foot long, 2-1/2-inch diameter anodes distributed **one** on each side of the gate **structure** on the upstream side where **the** 2 **pipe inlet** gates are to be protected.

1) Anodes at least 28 feet from the **nearest** structure to be protected **(e.g. stoplog guides)**.

2) Anodes at least 10 feet from one another.

b. **For trashrack gates, two 8 foot long, 2-1/2-inch diameter anodes distributed one on each side of the gate structure on the downstream side; and one such anode between the trashrack and the gates in each bay.**

1) **Anodes at least 28 feet from nearest structure to be protected (e.g. stoplog guides).**

2) **Anodes at least 10 feet from one another.**

c. **Otherwise, two** 8 foot long, 2-1/2-inch diameter anodes distributed **one** on each side of the gate **structure** on the upstream side**;** and **an equal arrangement** on the downstream side where a set of 3 gates are to be protected.

1) Anodes at least 28 feet from the **nearest** structure to be protected **(e.g. stoplog guides)**.

2) Anodes at least 10 feet from one another.

d. One 5 foot long, 2-1/2-inch diameter anode for each of the 3 instrument support poles.

1) Anodes at least 28 feet from the structures to be protected.

2. Do not lower anodes into their restrained locations using the cable (e.g. lower anodes using a separate rope made of non-conductive material).

3. Do not connect anodes to structures at test stations; energizing the systems will be done at time of testing.

4. Connect galvanic anode cables to structures through individual calibrated 0.01 ohm shunts in a junction box or test station.

5. Include in series with the calibrated shunts a variable resistor in the junction box or test station capable of 0 to 20 ohms of resistance.

6. **Restraints to be held in place by 304 or 316 (L or non-L grade) stainless steel hardware.**

7. **Anodes are to be wetted whenever associated structures are wetted.**

E. Electrical isolation:

1. All structures to be cathodically protected shall be electrically isolated from rebar or other extraneous metal not to be protected.

F. Test Stations:

1. Locations:

a. Where test stations are not likely to be damaged or interfere with personnel and/or equipment (e.g., adjacent to above ground structures). Exact location is subject to approval of COR.

b. As close to each current carrying structure and/or junction box 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 originating structure.

4. Contain three cables, at a minimum:

a. Current carrying cable(s) from the protected structure(s).

b. Current carrying cable(s) from the anodes.

c. Cable from the protected structure(s) for determining structure-to-water potentials.

5. At single anode locations, connect individual anodes to the structures through individual calibrated shunts, and variable resistors, of appropriate rating for current measurement.

6. At multiple anode locations, a cable between the test station and an anode junction box may be used to connect anodes to the structure.

a. Connect individual anodes to the structures through individual calibrated shunts of appropriate rating within the junction boxes for current measurement.

b. Install individual variable resistors **of appropriate rating** in series with these calibrated shunts in the junction box.

c. Install junction boxes adjacent to and preferably below test stations, where required.

7. **Upstream sides of gate structures are to have separate test stations from the downstream side. Each individual trashrack bay gate is to have a separate test station (i.e. upstream side).**

3.02 ENERGIZING, ADJUSTING, AND TESTING

A. Energizing, adjusting, and testing will be performed by the Government under the direction of **their** NACE certified Cathodic Protection Specialist.

END OF SECTION

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SECTION 13112 – SUBMERGED GALVANIC ANODE CATHODIC PROTECTION SYSTEM - PIPES

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Submerged Galvanic Anode Cathodic Protection System – Pipes:

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

1.02 REFERENCES

A. ASTM International (ASTM)

1.	**ASTM B 843-07**	**Magnesium Alloy Anodes for Cathodic Protection**
2.	**ASTM F 512-06**	**Smooth-Wall Poly(Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation**

B. **Federal Specifications (FS)**

1.	**FS RR-C-271D(1)**	**Chains and Attachments, Welded and Weldless**

C. 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

1.03 DEFINITIONS

A. Structure: The pipe, gate, trash rack, tank, or other metalwork being monitored or cathodically protected.

B. Foreign Structure: Any metallic structure that is not intended to be electrically continuous with the structure requiring corrosion monitoring and/or cathodic protection.

C. Bonded Dielectric Coating: A protective barrier coating system with high electrical resistivity bonded directly to the underlying metal and for the most part physically and electrically isolating the metal from the electrolyte.

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. Structure-to-Electrolyte Potential:

1. Also referred to as structure-to-soil, pipe-to-soil, fitting-to-soil, and structure-to-water potentials.

2. The potential, or voltage difference, developed by a structure in an electrolyte when compared with a stable reference electrode.

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 period. Also referred to as native structure-to-electrolyte potential.

4. Polarized structure-to-electrolyte potential: The structure-to-electrolyte potential determined after an external current, as from a cathodic protection system, has been flowing, but immediately after it has been interrupted. Also referred to as "instant off" structure-to-electrolyte potential, it is an IR-free reading.

5. 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 also sometimes called a protective potential and may contain significant IR drop error.

6. Polarization: The change from the static or native potential as a result of current having flowed across the electrode/electrolyte interface for some time. Also considered the difference between polarized and static potentials.

F. 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. Should have a minimum input impedance of 10 megohm.

2. Should be capable of measuring DC voltages between + or – 0.1 millivolts and + or – 100 volts.

3. When measuring structure potentials using a digital instrument, the structure is typically connected to the positive terminal of a voltmeter and the reference electrode to the common (negative) terminal of the voltmeter. Polarity and voltage magnitude are then read 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 are required.

G. Stray Current Interference: Corrosion resulting from current through paths other than the intended circuit - e.g., corrosion occurring on a protected structure caused by the cathodic protection system on a foreign structure, or some other source of current, either AC or DC.

H. Cable: All metallic conductors other than the protected structures and the anodes; sometimes called wires.

I. Shunt: Calibrated resistor placed within a circuit to determine the current flow within the circuit. Calibration is typically expressed in ohms or amperage/voltage.

J. Reference Electrode: An electrode whose open circuit potential is constant under similar conditions of measurement, which is 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 for such a purpose.

K. Test Station: A location for conducting tests on a protected structure, normally having an enclosure containing terminals of cables from one or more structures and from anodes along with accessories such as calibrated shunts.

L. Junction Box: An enclosure containing the terminals from multiple electrodes along with accessories such as calibrated shunts and variable resistors. From the junction box, a single cable is normally fed to a test station.

1.04 QUALIFICATIONS

A. The contractor shall employ the services of an individual having a NACE International Cathodic Protection Technician certification or higher to ensure cathodic protection systems are properly installed.

B. Testing will be conducted by or under the direction of a Cathodic Protection Specialist. Testing personnel may be assisted by other qualified individuals.

1.05 SYSTEM DESCRIPTION

A. A directly connected galvanic anode cathodic protection system and monitoring capabilities will be provided for the submerged pipe interiors.

B. All materials and engineering services will be provided to furnish, install, and energize the corrosion monitoring and cathodic protection system(s).

1. Include test stations, galvanic anodes, supports, bonds, and accessory equipment and features as directed in this specification or as otherwise indicated.

C. Galvanic anode cathodic protection system(s) and components will have capacity to:

1. Provide a minimum service life of 20 years (system and all components).

D. Galvanic anodes will be placed and connected:

1. As indicated in this specification.

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.

1) Suitable for direct immersion.

2) Have all portions electrically insulated that are exposed to electrolyte.

E. NACE **S**P-0169 and NACE TM0497 shall apply to any issues not specifically addressed by this specification.

1.06 SUBMITTALS

A. Submit the following in accordance with Section 01330 – Submittals.

B. RSN 13112-1, Manufactures Data and Preconstruction Drawings:

1. Manufacturers Data, including catalog data sheets when available for:

a. Cables.

b. Anodes.

c. Dielectric anode covering at anode **restraint** points

d. Test stations.

e. Isolation kits.

f. Exothermic metallurgical bond systems (including instructions).

g. Coatings for metallurgical bonds

h. Permanent reference electrodes.

i. **Deleted.**

2. Preconstruction Drawings:

a. Intended location of anodes, and test stations.

b. Details of intended placement and restraint of anodes, cables, and conduit.

c. Typical details of intended test station wiring.

d. **Details of intended permanent reference electrode and corrosion test coupon intended terminations.**

C. RSN 13112-2, As-Built Drawings:

1. Actual location of anodes, and test stations.

2. Details of actual placement and restraint of anodes, cables, and conduit.

3. Typical details of actual test station wiring.

4. **Details of permanent reference electrode and corrosion test coupon termination.**

PART 2 PRODUCTS

2.01 GENERAL

A. Materials shall provide a minimum service life of 20 years (system and all components).

2.02 PERMANENT REFERENCE ELECTRODES

A. Copper/copper sulfate permanent reference electrodes electrically isolated from the structure such as the model IR supplied by Electrochemical Devices, Inc. (P.O. Box 355, Belmont, MA 02478-0003) or equal.

1. Supported near the top of the pipes.
2. Having a nearby steel coupon:
    a. Electrically isolated from the pipes and supports and from the reference electrodes.
    b. Restricted from movement due to flowing water.
    c. **Exothermic metallurgical bond connection** to a #12 AWG or larger cable returning to a test station.
    d. With the cable to coupon splice sealed and suitable for immersion.
    e. The steel coupon shall be at least 1/2-inch thick at its thinnest dimension and shall expose at least 1/4 square inch **or more** of steel.

B. Cables from the permanent reference electrodes and steel coupons meeting the cable requirements of this section.

C. Locate as indicated in the installation section.

2.03 PVC CONDUIT

A. **ASTM F 512.**

1. **1-1/2-inch nominal size.**
2. **Couplings as required for installation.**

2.04 U-BOLTS

A. **Federal Specifications RR-C-271D(1), type 304 stainless steel.**

1. **3/8-inch diameter bolt without mounting plate, for 2-1/2-inch diameter pipe.**
2. **3/8-inch diameter bolt without mounting plate, for 1-1/2-inch diameter pipe.**

3. **Other Hardware: Locknuts, washers, and other hardware shall be stainless steel products suitable for the required application.**

   a. **Locknut type:**

      1) **Centerlock distorted-thread.**

2.05 CABLES

A. Single-conductor, stranded, plain, annealed copper cable.

B. Cable insulation:

1. Rated for 600 volts and direct immersion or burial.
2. Black, with a high-molecular-weight polyethylene (HMWPE) insulation at least 0.100 in. thick.

C. Unspliced lengths to permit installation from terminus to terminus (e.g. anode to structure or reference electrode to test station) free of splices and without stress.

D. Gauge:

1. No. 12 AWG or larger for determining of structure-to-electrolyte potentials.
2. No. 6 AWG or larger for current carrying anode cables and test station cable to structure.

2.06 GALVANIC ANODES

A. High potential magnesium rod anodes such as Galvomag anodes supplied by Farwest Corrosion Control (1480 W. Artesia Blvd., Gardena, CA 90248), or equal, with the following essential characteristics:

1. Anode material specifically designed for cathodic protection systems and the intended environment**,** providing an open circuit potential of at least -1.70 V with respects to a copper/copper sulfate reference electrode**, and meeting or exceeding the requirements of ASTM B 843.**
2. 2.5 inch diameter minimum.
3. Approximately 25 feet long with a 3-foot or longer #6 AWG bonding cable **crimped and silver soldered to the core rod** at each end installed by the manufacturer**;** and sealed **at the cable to core connection** using an appropriate compound. **Anodes at the bends in the pipes and at the ends may need to be a special length from the manufacturer.**
4. 4 lb/ft of anode material.
5. A steel or galvanized steel 3/16 inch core wire running the length of the anode rod.

B. Supports shall hold the **closest surface of the** anodes 7 inches from the interior wall of the pipes.

1. Where supports hold the anodes, the anodes shall be wrapped with **at least two thicknesses** of dielectric barrier material, such as STOPAQ Coat Wrap **CZ H manufactured by** AMCORR, 10624 Sentinel Dr., San Antonio, TX 78217 or equal, to a width of about 4 inches **to either side of the support.**

2. **Supports shall hold the anodes securely.**

C. Anode cable in accordance with cable requirements of this section.

2.07 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, post-mounted type.

2. **Orange in color.**

3. Specifically constructed for cathodic protection system installations.

4. Protected as required for permanency.

5. 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.

B. Test station cables in accordance with cable requirements of this Section.

2.08 EXOTHERMIC METALLURGICAL BONDS

A. Exothermic metallurgical bond system by Thermoweld (4102 South 74th East Ave., Tulsa, OK 74145-4700), or equal, having the following essential characteristics:

1. Specifically applicable to cathodic protection systems.

2. The exothermic reaction produces molten copper alloy, which produces a permanent, high conductivity connection.

3. Uses a special alloy to provide minimum heat effect on the steel.

4. Current carrying capacity equal to that of the conductor.

2.09 DIELECTRIC METALLURGICAL BOND COATING

A. Dielectric material, such as Bitumastic 50 **manufactured by** Carboline, 350 Hanley Industrial Court, St. Louis, MO 63144-1599 or equal **with the following essential characteristics:**

1. Approved dielectric coating material.

2. Suitable for the intended environment.

PART 3 EXECUTION

3.01 INSTALLATION

A. Cable:

1. Inspect for insulation defects prior to installation.
    a. Repair defects using approved methods or replace the cable.
    b. COR will inspect and approve all repairs prior to installation.
2. Install without kinks, stresses, and/or splices.
3. Run structure and permanent reference electrode cables through **rigid 1-1/2-inch** PVC conduit, test station pipe, or similar protection.
4. Connect to test station terminals with crimped, ring-tongue connectors.
5. Identify origin of cables terminating in an enclosure:
    a. Factory printed letters on self-adhesive strips attached to the cables clearly visible within the enclosure.
    b. Encase printed labels in clear heat shrink tubing.
6. **Run all cable from inlet end of pipe.**

B. Structure connections:

1. Connect anode cables to structures by exothermic metallurgical bonds, to the anode **supports** welded to the pipes.
    a. **Trim excess anode cable as needed. Nylon wire ties may be used to secure cable to anode or supports.**
    b. Make exothermic metallurgical bond in accordance with the bonding supply manufacturer's instructions. **Install without kinks or stresses.**
    c. Bonds shall not damage the linings inside pipes; otherwise, repairs shall be required.
    d. Test metallurgical bond integrity by striking side of weld nugget with a 16-ounce hammer, in presence of the COR.
    e. Coat bare copper, weld nugget, and ferrous materials at metallurgical bonds with an approved dielectric metallurgical bond coating.
    f. Allow dielectric material to cure before repair of the damaged structure coating or lining.
        1) Repair dielectric coatings/linings in accordance with Section 09902 – Coatings

C. Galvanic Anodes:

1. Install horizontally **as indicated on drawing 423-D-776 and** as follows:

a. Continuously (some minimal spacing allowed between anode ends) at the 3 o'clock and 9 o'clock positions in each pipe.

b. Support brackets restraining the anodes:

1) Shall be covered in the coating system used for the pipe interiors.

2) Hold the anodes at dielectrically wrapped sites on the anodes.

3) U-bolts and nuts or similar hardware restraining the anodes shall be 304 or 316 stainless steel (either L or non-L grade).

D. Electrical isolation:

1. All structures to be cathodically protected shall be electrically isolated from rebar or other extraneous metal.

2. Isolation kits (e.g. dielectric sleeve and washer, either one piece or two)**, such as provided by Pikotek, P.O. Box 260438, 12980 W. Cedar Dr., Lakewood, CO 80226, or equal** shall be installed on the U-bolts or other fastener hardware holding the anodes to isolate them from the support system.

E. Permanent reference electrodes per pipe **(see drawing 423-D-776)**:

1. Provide a minimum of 3 reference electrodes oriented with the direction of flow along with electrically isolated steel test coupons.

2. Run reference electrode and test coupon cables through **rigid 1-1/2-inch** PVC conduit connected to a support system at the top of the pipes. **Conduit may be run above or below supports.**

3. Locate reference electrodes and test coupons:

a. Near the top of the pipes.

b. About 140 feet from each end, and in the middle, of each pipe.

F. Test Stations:

1. Locations:

a. Where test stations are not likely to be damaged or interfere with personnel and/or equipment (e.g., adjacent to above ground structures). Exact location is subject to approval of COR.

b. 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 pipe within the same test station enclosure. Identify all cables as to the originating structure and reference electrode.

4. Contain:

a. Cables from the **3** permanent reference electrodes and **3** steel test coupons.

b. **Cable** from the protected structures for determining structure to water potentials.

3.02 ENERGIZING, ADJUSTING, AND TESTING

A. Energizing, adjusting, and testing will be performed by the Government under the direction of **their** NACE certified Cathodic Protection Specialist.

END OF SECTION

SECTION 13113 – SUBMERGED IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM - TRASHRACKS

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Submerged Impressed Current Cathodic Protection System – Trashracks:

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

1.02 REFERENCES

A. NACE International (NACE)

1.	NACE **S**P0169-200**7**	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

B. National Electrical Manufacturers Association (NEMA)

1.	NEMA 250-2003	Enclosures for Electrical Equipment (1000 Volts Maximum)

1.03 DEFINITIONS

A. Structure: The pipe, gate, trash rack, tank, or other metalwork being monitored or cathodically protected.

B. Foreign Structure: Any metallic structure that is not intended to be electrically continuous with the structure requiring corrosion monitoring and/or cathodic protection.

C. Bonded Dielectric Coating: A protective barrier coating system with high electrical resistivity bonded directly to the underlying metal and for the most part physically and electrically isolating the metal from the electrolyte.

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. Structure-to-Electrolyte Potential:

1. Also referred to as structure-to-soil, pipe-to-soil, fitting-to-soil, and structure-to-water potentials.

2. The potential, or voltage difference, developed by a structure in an electrolyte when compared with a stable reference electrode.

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 period. Also referred to as native structure-to-electrolyte potential.

4. Polarized structure-to-electrolyte potential: The structure-to-electrolyte potential determined after an external current, as from a cathodic protection system, has been flowing, but immediately after it has been interrupted. Also referred to as "instant off" structure-to-electrolyte potential, it is an IR-free reading.

5. 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 also sometimes called a protective potential and may contain significant IR drop error.

6. Polarization: The change from the static or native potential as a result of current having flowed across the electrode/electrolyte interface for some time. Also considered the difference between polarized and static potentials.

F. 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. Should have a minimum input impedance of 10 megohm.

2. Should be capable of measuring DC voltages between + or – 0.1 millivolts and + or – 100 volts.

3. When measuring structure potentials using a digital instrument, the structure is typically connected to the positive terminal of a voltmeter and the reference electrode to the common (negative) terminal of the voltmeter. Polarity and voltage magnitude are then read 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 are required.

G. Stray Current Interference: Corrosion resulting from current through paths other than the intended circuit - e.g., corrosion occurring on a protected structure caused by the cathodic protection system on a foreign structure, or some other source of current, either AC or DC.

H. Cable: All metallic conductors other than the protected structures and the anodes; sometimes called wires.

I. Shunt: Calibrated resistor placed within a circuit to determine the current flow within the circuit. Calibration is typically expressed in ohms or amperage/voltage.

J. Reference Electrode: An electrode whose open circuit potential is constant under similar conditions of measurement, which is 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 for such a purpose.

K. Rectifier: An electrical/electronic device that converts an AC input to a DC output. The rectifier typically includes a step-down transformer section to reduce the incoming AC voltage as well as a rectification section that converts current to DC, along with meters fuses, lightning arresters, and other accessories.

L. Test Station: A location for conducting tests on a protected structure, normally having an enclosure containing terminals of cables from one or more structures and from anodes along with accessories such as calibrated shunts.

M. Junction Box: An enclosure containing the terminals from multiple electrodes along with accessories such as calibrated shunts and variable resistors. From the junction box, a single cable is normally fed to a test station.

1.04 QUALIFICATIONS

A. The Contractor shall employ the services of an individual having a NACE International Cathodic Protection Technician certification or higher to ensure cathodic protection systems are properly installed.

B. Testing will be conducted by or under the direction of a Cathodic Protection Specialist. Testing personnel may be assisted by other qualified individuals.

1.05 SYSTEM DESCRIPTION

A. Provide potential controlled impressed current cathodic protection and monitoring system for the submerged trashrack.

B. Provide all materials and engineering services to **design,** furnish, install, and energize the corrosion monitoring and impressed current cathodic protection system.

1. Include electrical isolation as needed, electrical continuity bonds, impressed current anodes, and accessory equipment and features as directed in this specification or as otherwise indicated.

C. Impressed current cathodic protection system shall 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 steel having a high quality bonded dielectric coating.

b. Alternately, -0.100 volts of polarization **if Reclamation determines that the criteria in a. cannot be obtained** (e.g. isolated bare or poorly coated steel structures).

c. A polarized potential at any point on a dielectrically coated structure not exceeding -1.100 volts in all instances.

D. Impressed current anodes shall be placed and connected:

1. Such as to provide adequate distribution of cathodic protection current, as indicated by potential readings.

2. Submerged and restrained **(e.g. cut out PVC pipe; see drawing 423-D-777)** in such a way as to:

a. Maintain sufficient anode material below the minimum normal operating water level.

b. Not allow the anodes to come in direct contact with the protected structure.

c. Not place stress on the anode cables.

3. Through cables:

a. Suitable for direct immersion.

b. Having all portions electrically insulated that are exposed to electrolyte.

c. Protected by conduit above the water line.

4. Through junction box to protected structure:

a. Connecting individual anodes to the structure through individual calibrated shunts within junction box for current measurement.

b. Connecting individual anodes to the structure(s) through variable resistors within junction box(es) to allow equalizing current from individual anodes.

c. Locating the junction box to make it readily accessible.

E. NACE **S**P-0169 and NACE TM0497 shall apply to any issues not specifically addressed by this specification.

1.06 SUBMITTALS

A. Submit the following in accordance with Section 01330 – Submittals.

B. RSN 13113-1, Manufacturers Data and Preconstruction Drawings:

1. Manufacturers Data. Include catalog data sheets when available for:

a. Rectifier.

b. Cable.

c. Anode.

d. Junction box.

e. Test station.

f. Adjustable resistor and calibrated shunt resistor.

g. Exothermic metallurgical bond system (including instructions).

h. **Coating for metallurgical bonds.**

2. Preconstruction drawings:

a. Intended location of anodes, rectifier, junction box, and test station.

b. Details of intended placement and restraint of anodes.

c. Typical details of intended junction box and test station wiring.

C. RSN 13113-2, As-Built Drawings:

1. Actual location of anodes, rectifier, junction box, and test stations.

2. Details of actual placement and restraint of anodes.

3. Typical details of actual junction box and test station wiring.

PART 2 PRODUCTS

2.01 GENERAL

A. Materials shall provide a minimum service life of 20 years (system and all components).

2.02 RECTIFIER

A. Potential controlled rectifier with a rated output of at least **9** V – **5** A as manufactured by Universal Rectifiers, Inc., 1613 Cottonwood Rd., Rosenberg, TX 77471, or equal, and having the following significant features:

1. Air cooled.

2. Capable of continuous operation at 120 percent of rated output in ambient temperature of 50 degrees Centigrade.

3. Fitted with a heavy duty transformer with at least 15 percent over design capacity.

4. Rectification section of the silicon diode type.

5. Built-in solid state current interrupter circuit housed within the rectifier cabinet and capable of:

a. Opening and closing the rectifier output circuit by fully adjustable, user selectable intervals between 0.1 seconds and 10 hours.

b. Continuously and automatically maintain rectifier output voltage to any preset value between 10 and 100 percent of rated output.

c. User selectable upper current limit control, capable of maintaining a preset current limit between 10 and 100 percent of rectifier rated current output under a short circuited rectifier output condition.

6. Capable of being operated in either the manual constant-voltage output or automatic constant-potential mode. The mode shall be selectable by positioning a single switch mounted on the front panel of the rectifier.

7. Fitted with switchable meter(s) for determining output voltage and current, and which is (are):

a. Accurate within 2 percent of full scale.

b. Marked with a red line designating rated capacities.

8. Such that the output voltage is adjustable in 18 or more equal increments using quick-change knobs, or continuously from 0 to 100 percent rated output.

9. Energized by 120-volts, single phase AC.

10. Equipped with AC and DC lightning arrestors and protective fuses or circuit breakers.

11. Equipped with solderless, pressure-type terminals for anode and cathode cables.

12. Equipped with an accessible shunt on the front panel for determining current output. The shunt shall be stamped with the amperage per millivolt rating.

13. Engraved panel.

B. The rectifier is to be supplied in a NEMA 250 3R lockable cabinet constructed of 11-gauge or greater galvanized steel. The cabinet shall have:

1. Front and side hinged doors and/or a single slide out rack for access.

2. A combination bracket for wall or pole mounting.

C. The rectifier and cabinet are to be properly grounded.

2.03 CABLES

A. Single-conductor, stranded, plain, annealed copper cable.

B. Cable insulation:

1. Rated for 600 volts and direct immersion or burial.

2. Anode cables black, with a high-molecular-weight polyethylene (HMWPE) outer jacket at least 0.060 in. thick and an inner jacket of Kynar or Halar at least 0.020 inch thick.

3. Structure and above water cables alternately black HMWPE insulation with minimum thickness of 0.100-inch.

C. Unspliced lengths to permit installation from terminus to terminus (e.g. anode to junction box or test station) free of splices and without stress.

D. Gauge:

1. No. 6 AWG or larger for current carrying cables between structures or anodes and rectifier.

2. No. 12 AWG or larger for determining of structure-to-electrolyte potentials.

2.04 IMPRESSED CURRENT ANODES

A. Impressed current anodes: high silicon cast iron tubular anodes as the Anotec anode type 2284 provided by Farwest Corrosion Control Co., 480 Artesia Blvd., Gardena CA, 90248, or equal, with the following essential characteristics:

1. Anode material specifically designed for cathodic protection systems and the intended environment.

2. Approximately 7 feet long, 2.2 inches in diameter, and at least 48 pounds per anode.

3. Chill cast.

4. Center connected cable, sealed, and having a connection resistance not exceeding 0.004 ohm.

B. Anode cable in accordance with cable requirements of this section.

2.05 JUNCTION BOXES

A. Junction box specifically constructed for cathodic protection system installations:

1. NEMA 250 type 3-R, hinged, lockable cabinets constructed of No. 16-gauge or thicker galvanized steel that are weatherproof and vented for heat dissipation.

2. Engraved 1/4-inch minimum NEMA grade C phenolic panels.

3. Solderless, pressure-type terminals.

4. Brackets: Suitable for pole or wall mounting.

B. Identify terminals and cables.

C. Equip with 0.01 ohm calibrated shunts of adequate electrical rating for each anode.

D. Equip with variable resistors of adequate electrical rating to adjust and balance the current flow of each anode.

E. Protect as required for permanency.

2.06 EXOTHERMIC METALLURGICAL BONDS

A. Exothermic metallurgical bond system by Thermoweld, 4102 South 74th East Ave., Tulsa, OK 74145-4700, or equal, having the following essential characteristics:

1. Specifically designed for cathodic protection systems.
2. The exothermic reaction produces molten copper alloy, which produces a permanent, high conductivity connection.
3. Uses a special alloy to provide minimum heat effect on the steel.
4. Current carrying capacity equal to that of the conductor.

B. **Dielectric metallurgical bond coating, such as Bitumastic 50 manufactured by Carboline, 350 Hanley Industrial Court, St. Louis, MO 63144-1599, or equal shall be applied to any exposed metal at metallurgical bonds.**

PART 3 EXECUTION

3.01 INSTALLATION

A. Cable:

1. Inspect for insulation defects prior to installing.
   a. Repair defects using approved methods or replace the cable.
   b. COR will inspect and approve all repairs prior to installation.
2. Install without kinks, stresses, and/or splices.
3. Run through galvanized metal conduit once cables are above water.
4. Connect to terminals with crimped, ring-tongue connectors.
5. Identify origin of cables terminating in an enclosure:
   a. Factory printed letters on self-adhesive strips attached to the cables clearly visible within the enclosure.
   b. Encase printed labels in clear heat shrink tubing.

B. Structure connections:

1. Connect rectifier cable to structures and individual segments of the structure by exothermic metallurgical bonds.
   a. Make exothermic metallurgical bond in accordance with the bonding supply manufacturer's instructions.
   b. Bonds shall not damage the coating; 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.

e. Allow dielectric material to cure before repair of the damaged structure coating or lining.

1) Repair dielectric coatings/linings in accordance with Section 09902 – Coatings

2. Ensure metallurgical bonds do not interfere with operation of **a** rake mechanism or of any other feature.

C. Impressed Current Anodes:

1. Install **in restraint structure as shown on drawing 423-D-777** as follows:

a. At least **25** feet from the structure to be protected.

b. **Four anodes** on the upstream side of the structure. **Anodes at least 15 feet from one another.**

c. **In restraint structures to be held by stainless steel (304 or 316; L or non-L grade), supports rigidly attached to base material.**

d. **Electrically isolated** from any metal supports.

2. Connect anode cables to structures through calibrated 0.01 ohm shunts.

3. Include a resistor of appropriate wattage and capable of producing at least 5 ohms in series with the calibrated shunts to allow adjustment of individual anode current.

4. **Anodes are to be wetted whenever associated structures are wetted.**

D. Electrical isolation:

1. All structures to be cathodically protected shall be electrically isolated from rebar or other extraneous metal.

3.02 ENERGIZING, ADJUSTING, AND TESTING

A. Energizing, adjusting, and testing will be performed by the Government under the direction of **their** NACE certified Cathodic Protection Specialist.

END OF SECTION

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SECTION 13455 - CONTROL AND MONITORING SYSTEM

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in lump sum price offered in the schedule for complete electrical system.

1.02 REFERENCES

A. Electronic Industries Alliance (EIA)

1. EIA/ECA 310-2005 Cabinets, Racks, Panels, and Associated Equipment

B. Institute of Electrical and Electronic Engineers (IEEE)

1. IEEE C2-2007 National Electrical Safety Code (NESC)

C. National Electrical Manufacturers Association (NEMA)

1. NEMA 250-2003 Enclosures for Electrical Equipment (1000 Volts Maximum)

D. National Fire Protection Association (NFPA)

1. NFPA 70-2008 National Electrical Code (NEC)

1.03 PERFORMANCE REQUIREMENTS

A. Provide PLC to monitor water level in the reservoir, gate positions, canal level, and canal flow. PLC will control gate positions. PLC will be programmed by others.

B. Provide one solar-powered RTU system to monitor flow on the pipe outlet and transmit data to PLC.

C. Provide three solar-powered RTU systems to monitor water levels in the forebay/afterbay and two reservoirs and transmit data to PLC.

D. Outdoor Temperature Range: -10 degrees C to 60 degrees C.

1.04 SUBMITTALS

A. Submit in accordance with Section 01330 - Submittals and Section 16051 - Electrical Drawings and Data.

B. RSN 13455-1, Approval Drawings and Data:

1. Manufacturer's technical data for all equipment.

2. Equipment layout drawings.

3. Bill of materials.

4. Schematic diagram drawings.

5. Wiring diagram drawings.

C. RSN 13455-2, Test Report.

D. RSN 13455-3, Operation and Maintenance Manual:

1. Submit for all control and monitoring system equipment.

2. General descriptive information covering the basic features of the equipment.

3. Show information for ordering replacement parts, and maintaining and calibrating equipment.

PART 2 PRODUCTS

2.01 RESERVOIR INLET/OUTLET CONTROL AND MONITORING SYSTEM

A. PLC (Programmable Logic Controller):

1. TSX 37 10 PLC System manufactured by Modicon/Schneider Electric, North American Division, 1415 Roselle Road, Palatine, IL 60067; or equal, having following salient characteristics:

a. Input power:

1) 120 VAC. Provide power supply as required.

2) Provide isolation features to prevent damaging electrical transients from entering controller.

b. Memory:

1) 14 KWords, minimum, battery-backed RAM.

2) 12 KWords, minimum, Flash EPROM.

c. Processor: Support addressing of specified I/O points.

d. Rack(s): 4 slot, minimum.

e. Modular components.

f. 19-inch rack mountable.

g. Provide equipment required to monitor temperature inside PLC cabinet.

h. Provide equipment required to monitor incoming voltage at PLC.

i. Modbus RTU protocol.

j. Communications ports:

1) RS-485.

2) RS-422.

B. I/O Modules:

1. Accommodate all I/O points as specified and as indicated on drawings.

2. Same manufacturer as PLC.

3. 28 discrete I/O points.

C. System Software:

1. Operating system software:

a. Same manufacturer as PLC.

b. Store in on-board permanent flash memory.

c. Support communication systems.

D. Radio:

1. Model MDS 9810 manufactured by Microwave Data Systems, Inc., 175 Science Parkway, Rochester, NY, 14620; or equal, having following salient characteristics:

a. Full-duplex operation, spread-spectrum, up to 19.2 kbps data throughput, 1 watt transmit power, and sleep mode.

b. Configure radio at control building as master to communicate with pipe outlet, reservoir level RTUs, forebay/afterbay RTU, and IID radio system. IID radio system is located at the Coachella Turnout Structure.

E. Antenna:

1. Model 97-3194A16 manufactured by Microwave Data Systems, Inc., 175 Science Parkway, Rochester, NY, 14620; or equal, having following salient characteristics:

a. Type: Omni.

b. Frequency: 902-928 MHz.

c. Gain: 5 dB, minimum.

d. Provide with all mounting hardware required to install on mast on top of control building.

F. UPS (Uninterruptible Power Supply):

1. Solid-state design.

2. Rack-mount type.

3. Input: 120-volt single phase 60 hertz.

4. Output: 120-volt single phase 60 hertz.

5. Batteries:

   a. Hot swap and user replaceable.

   b. Leak-proof.

   c. Maintenance-free sealed lead-acid.

6. Fully charge a completely discharged battery in 24 hours.

7. Size to provide 100 percent of full-load current required by PLC for 5 hours.

8. Integral power cord.

G. I/O Signal Transient Protector:

1. Furnish and install as required to protect I/O signals from damage due to lightning and surge voltage.

2. Solid state, no fuses or relays, automatically reset.

3. Provide two-stage protection against overvoltage transients: Gas discharge tube and silicon avalanche device.

4. Maximum Transient Voltage: 10 KV.

5. Clamping Time: 10 nanoseconds, maximum, with no output voltage overshoot.

2.02 PIPE OUTLET MONITORING SYSTEM

A. OutPAK-R900 Solar-Powered RTU System manufactured by Geomation, 25188 Genesee Trail Rd. #100, Golden, CO; or equal, having following salient characteristics:

1. Integrated solar-powered system to monitor pipe outlet flow, transmit flow data to control building via spread-spectrum radio, and provide power to RTU, flowmeters, and cathodic protection system.

2. RTU:

   a. Provide with input module for 4-20 ma signals from two flowmeters. Equip with transient protection.

   b. Program RTU to receive flowmeter signals and send the signals to the radio for transmission to the control building.

3. Solar Panel:

   a. Pole-mount.

   b. Size to charge battery for 7-day per week, 24-hour per day operation of RTU, flowmeters, and cathodic protection system.

   c. Cathodic protection system power requirement: In accordance with Section 13110 - Impressed Current Cathodic Protection System for

Exterior of Steel Pipes. Provide circuit breaker in accordance with Section 16441 - Distribution Panelboards.

d. Flowmeter power requirement: 35 watts, each. Provide circuit breakers in accordance with Section 16441 - Distribution Panelboards.

e. Provide transformers and inverters as required.

4. Antenna:

a. Pole-mount, yagi.

b. Gain: 5 dB, minimum.

c. As required to transmit flow data to control building PLC.

5. Radio:

a. Model MDS 9810 manufactured by Microwave Data Systems, Inc., 175 Science Parkway, Rochester, NY, 14620; or equal, having following salient characteristics:

1) Full-duplex operation, spread-spectrum, up to 19.2 kbps data throughput, 1 watt transmit power, and sleep mode.

2) Spread-spectrum type to transmit flow data to control building PLC.

6. Battery:

a. Rechargeable.

b. Size to provide power to system for one week with little or no sunlight.

7. Provide interconnection cables for all components as required.

8. Provide all mounting hardware as required.

9. **Pole:**

a. **Shaft Type: Straight round aluminum.**

b. **Height, minimum: 15 feet.**

c. **Diameter, minimum: 4 inches.**

d. **Finish: Brushed aluminum.**

e. **Cast aluminum anchor base.**

f. **Design, furnish, and place concrete foundation. Concrete in accordance with Section 03300 – Cast-In-Place Concrete.**

g. **Accessories:**

1) **Stainless steel attachment hardware.**

2) **Grounding lug.**

3) **Anchor bolts.**

2.03 RESERVOIR AND FOREBAY/AFTERBAY MONITORING SYSTEMS

A. OutPAK-R900 Solar-Powered RTU System manufactured by Geomation, 25188 Genesee Trail Rd. #100, Golden, CO; or equal, having following salient characteristics:

1. Integrated solar-powered system to monitor level, transmit flow data to control building PLC via spread-spectrum radio, provide power to RTU, and provide power to water-level measuring device.
2. RTU:
    a. Provide with input module for 4-20 ma signal from water-level measuring device. Equip with transient protection.
    b. Program RTU to receive water level signal and send signal to radio for transmission to control building PLC.
3. Solar Panel:
    a. Pole-mount.
    b. Size to charge battery for 7-day per week, 24-hour per day operation of RTU, and water-level measuring device.
    c. Water-level measuring device power requirement: In accordance with Section 13423 - Water-Level Measuring Devices.
    d. Provide transformers and inverters as required.
4. Antenna:
    a. Pole-mount, yagi.
    b. Gain: 5 dB, minimum.
    c. As required to transmit water level data to control building PLC.
5. Radio:
    a. Model MDS 9810 manufactured by Microwave Data Systems, Inc., 175 Science Parkway, Rochester, NY, 14620; or equal, having following salient characteristics: Full-duplex operation, spread-spectrum, up to 19.2 kbps data throughput, 1 watt transmit power, and sleep mode.
    b. Configure to transmit flow data to control building PLC.
6. Battery:
    a. Rechargeable.
    b. Size to provide power to system for one week with little or no sunlight.
7. Provide interconnection cables for all components as required.
8. Provide all mounting hardware as required.

B. Provide three systems:

1. Forebay/afterbay.
2. Reservoir #1.
3. Reservoir #2.

2.04 CABINETS

A. Manufacturer's standard gauge sheet steel.

B. Floor-mounted.

C. Type:

1. Pipe Outlet: NEMA 250, Type 4.
2. Control Building: NEMA 250, Type 12.

D. Dimensions:

1. Pipe Outlet: 62 inches high by 60 inches wide by 20 inches deep.
2. Control Building: 72 inches high by 24 inches wide by 24 inches deep.

E. Seams:

1. Continuously welded.
2. Ground smooth.

F. Ground lug: For #4 AWG copper cable.

G. Continuous hinge.

H. Stainless steel clamps on 3 sides.

I. Doors:

1. Pipe Outlet: Double-access front doors.
2. Control Building: Single front door.

J. Hasp and staple for padlocking.

K. Drip shield to protect door hardware from dripping water and settling dust.

L. Backpanel for mounting equipment.

M. Wireway.

N. Provide pipe outlet cabinet with sunshield.

O. Finish:

1. Interior: Manufacturer's standard ANSI white.
2. Exterior: Manufacturer's standard ANSI white.

2.05 19-INCH RACKS

A. Rack Mount Angles:

1. Provide each rack with 2 angles, one pair.
2. Drill and tap No. 10-32 thread holes. Space holes in accordance with EIA 310-D (universal spacing).
3. Provide with all mounting hardware in manufacturer's standard color and finish, white.
4. U-style.

2.06 INTERCONNECTION CABLE

A. In accordance with Section 16120 - Conductors and Cables, and manufacturer's recommendations.

2.07 MISCELLANEOUS MATERIALS

A. Furnish all materials required for operation of control and monitoring system.

B. Furnish standard commercial grades of materials suitable for intent of design.

2.08 FABRICATION

A. Design cabinet layouts.

PART 3 EXECUTION

3.01 INSTALLATION

A. In accordance with IEEE C2 and NFPA 70.

B. Wire following I/O to PLC:

1. RS-422: Canal Inlet Water Level.
2. Modbus Protocol:
   a. Gate Actuator Network: Includes gate operation and gate position for 11 inlet/outlet structure gates.
   b. Trashrake: Interface to built-in trashrake PLC.

C. Wire two 4-20 ma flowmeter signals to RTU at pipe outlet.

D. Wire 4-20 ma forebay/afterbay and reservoir signals to RTUs.

E. Furnish and install PLC monitoring system in PLC and Communication Cabinet in Control Building. Install antenna on mast on top of Control Building. Connect all equipment to grounding system.

F. Install pipe outlet monitoring system in Electrical Equipment Cabinet at pipe outlet. Install antenna and solar panel on pole. Install electronic equipment including RTU, radio, battery, and flow metering cabinets in cabinet. Connect all equipment to grounding system.

G. Install forebay/afterbay and reservoir monitoring systems on water level system structures in accordance with drawings. Install electronic equipment including RTU, radio, and battery in NEMA 250, Type 4 enclosures.

3.02 CONTRACTOR FIELD QUALITY TESTING

A. Post-Installation: Verify that all features function in accordance with specifications.

END OF SECTION

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SECTION 16130 - ELECTRICAL CONDUIT

PART 1 GENERAL

1.01 MEASUREMENT AND PAYMENT

A. Cost:

1. Include in lump sum price offered in the schedule for complete electrical system.
2. Includes cost of accessories.

1.02 REFERENCES

A. American National Standards Institute (ANSI)

1.	ANSI C 80.1-1994	Rigid Steel Conduit - Zinc Coated (GRC)
2.	**ANSI/SCTE 77-2002**	**Underground Enclosure Integrity**

B. ASTM International (ASTM)

1.	ASTM D 3485-02	Smooth-Wall Coilable Polyethylene (PE) Conduit (Duct) for Preassembled Wire and Cable

C. National Electrical Manufacturer's Association (NEMA)

1.	NEMA 250-2003	Enclosures for Electrical Equipment (1000 Volts Maximum)
2.	NEMA FB 1-2007	Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
3.	NEMA RN 1-2005	Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
4.	NEMA TC 2-2003	Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
5.	NEMA TC 3-2004	Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
6.	NEMA TC 7-2005	Smooth-Wall Coilable Electrical Polyethylene Conduit

D. National Fire Protection Association, Inc (NFPA)

1.	NFPA 70 - 2008	National Electrical Code (NEC)

E. Underwriters Laboratories (UL)

1.	UL 360-2003	Liquidtight Flexible Steel Conduit

2. UL 651-2005 Schedule 40 and 80 Rigid PVC Conduit

1.03 DESIGN REQUIREMENTS

A. Wiring Trough: Determine dimensions in accordance with requirements of NFPA 70.

B. Cast Junction Box:

1. Determine dimensions in accordance with requirements of NFPA 70 and manufacturer's recommendations for conduit spacing and clearances.

2. Determine size and location of conduit entrances.

C. Precast Underground Pullbox:

1. Determine dimensions in accordance with requirements of NFPA 70 and manufacturer's recommendations for conduit spacing and clearances.

2. Determine size and location of conduit entrances.

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01330 - Submittals and 16051 - Electrical Drawings and Data.

B. RSN 16130-1, Shop Drawings and Manufacturer's Data:

1. Manufacturer's technical data.

a. Wiring trough.

b. Cast junction box including dimensions, and size and location of conduit entrances.

C. RSN 16130-2, As-Built Drawings: Concrete embedded conduit and direct buried conduit.

PART 2 PRODUCTS

2.01 RIGID METAL CONDUIT (RMC)

A. Conform to ANSI C80.1

B. Fittings and Conduit Bodies: Conform to NEMA FB1.

2.02 PLASTIC-COATED RIGID STEEL (PCRS)

A. Rigid Steel Conduit: Conform to ANSI C80.1.

B. External Coating: Conform to NEMA RN 1 with 0.040-inch thickness, minimum.

C. Internal Coating: 0.002-inch of urethane, minimum.

D. Conduit Fittings: Coated with same material as conduit.

2.03 RIGID POLYVINYL CHLORIDE CONDUIT (PVC)

A. Product Description: Schedule 40 and 80 PVC conduit. Conduit and elbows furnished with integral bell end.

B. Length: Manufacturer's standard 10 or 20 foot lengths.

C. PVC Solvent Cement: In accordance with NEMA TC 2 and as recommended by manufacturer.

D. 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.

2.04 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Suitable for indoor and outdoor use.

B. Sunlight resistant.

C. Color: Black.

D. Conform to UL 360 and UL listed.

2.05 HIGH-DENSITY POLYETHYLENE FLEXIBLE CONDUIT (HDPE)

A. Suitable for direct burial.

B. Coiled shape not retained when taken off reel.

C. Adhesive, couplings, and transition fittings in accordance with manufacturer's recommendations and instructions.

D. Nonmetallic, prelubricated, extruded, flexible high-density polyethylene resin type.

E. Minimum bending radius of less than or equal to 14 times the outside diameter of conduit.

F. Furnish with 3/8-inch woven tape pull member.

G. Conform to NEMA TC7 and ASTM D 3485.

2.06 WIRING TROUGH

A. Material: 16 gauge or 14 gauge galvanized steel.

B. Enclosure:

1. NEMA Type 3R in accordance with NEMA 250.
2. Drip shield top and no knockouts.

C. Slip-on removable cover fastened with captivated screws along bottom edge and provided with provision for padlocking.

D. Embossed mounting holes on back of enclosure.

E. Finish: Manufacturer's standard grey coating.

2.07 CAST JUNCTION BOX

A. Type YT sidewalk box manufactured by O-Z/Gedney; or equal with following essential characteristics:

1. Cast iron box, flange and cover suitable for flush mounting in concrete deck.
2. Cover:
   a. Cross-ribbed checkered with pry bar slots.
   b. Neoprene gasket.
   c. Suitable for vehicular traffic (H-20 loading).
   d. Secured with stainless steel screws.
3. Conduit Entrances: Bossed, drilled, and tapped.
4. Finish: Hot dip galvanized.
5. Provide following engraved lettering on covers:
   a. Boxes housing power cable: "ELECTRIC".
   b. Boxes housing instrumentation and telemetry cable: "TELEMETRY".

2.08 PRECAST UNDERGROUND PULLBOX

A. Quazite® PG style manufactured by Hubbell®; or equal with the following essential characteristics:

1. Material: Precast polymer concrete.

2. Open bottom construction.

3. Cover:

a. Logo: "ELECTRIC" embossed on surface.

b. Tier level rating embossed on surface.

4. ANSI/SCTE 77 Application Tier: Tier 15.

5. Conform to ANSI/SCTE 77 and UL listed.

2.09 CAST DEVICE BOX

A. Type FD box manufactured by Cooper Crouse-Hinds; or equal, having the following essential characteristics:

1. Rectangular, deep-wiring device outlet box with threaded hub connections for rigid steel conduit.
2. Material: Iron alloy or copper-free aluminum.
3. Number of gangs: As required.
4. Provide plugs for unused openings.
5. Extension rings: Iron alloy with corrosion-resistant finish.

2.10 WATERTIGHT CONDUIT HUBS

A. Myers® hub manufactured by Cooper Crouse-Hinds, catalog series ST-, STA-, and SSTG-; catalog series HUB- and HUBG- manufactured by Appleton; catalog series CHM- and CHMG- manufactured by O-Z/Gedney; or equal.

2.11 WARNING TAPE

A. Type: Heavy-duty polyethylene, detectable underground warning tape.

B. Width: 6 inches.

C. Color: Black on red.

D. Legend: Continuously imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW"; or equivalent wording.

2.12 UTILITY MARKER

A. Weather resistant, single-piece marker at least 62-inches in length.

B. Constructed from a durable, UV resistant composite material.

C. Flexible and resistant to damage by vehicles, animals, or vandals.

D. Permanently affixed label that identifies buried electrical conduit below.

E. Purpose: Identify ends of buried PVC conduit beneath interstate highway I-8.

2.13 FOAM SEALANT

A. Hydra-Seal™ S-60 WTF manufactured by Arnco Corporation; Polywater® Duct Sealant manufactured by American Polywater Corporation; or equal.

2.14 CONDUIT ACCESSORIES

A. Fittings required to complete electrical conduit systems. Includes, caps, connectors, couplings, nipples, bushed nipples, reducers, elbows, pipe plugs, locknuts, bondnuts, bushings, seals, 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. Thread Lubricant: Lithium, graphite, or zinc based material designed to inhibit corrosion and to lubricate metal-to-metal joints.

D. Electrical duct seal for sealing ends of raceways.

E. Fabricated Sheet Steel Boxes:

1. Large junction and conduit boxes, excluding outlet boxes, to contain wiring devices or to accommodate lighting fixtures.
2. Sheet steel thickness: No. 14 United States Standard gauge, minimum.
3. Sheet steel finish: Galvanized.
4. Attach covers with bronze, brass, or stainless steel screws or bolts.
5. Boxes exposed to weather:
    a. Weather-resistant and watertight type.
    b. Provide covers with gaskets.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with NFPA 70 with proper fittings and supports.

B. Conduit Bends:

1. Make bends with standard conduit bending machines.
2. Ensure conduit bends are free from kinks, indentations, or flattened surfaces.
3. Radius of bends: In accordance with NFPA 70.
4. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduit.
5. Bending of conduit with pipe tee or vise is not acceptable.

C. Install cast junction boxes in concrete structure decks as shown.

D. Install precast underground pullboxes at canal stations as shown. Locate pullboxes along side of O&M road as directed by COR.

E. Determine routing of exposed, buried, and embedded conduit when not shown.

F. Remove burrs and sharp corners at ends of metal conduit.

G. Coat male threads of rigid metal conduit with thread lubricant before making joints.

H. Tighten conduit joints securely to ensure electrical continuity and to prevent entrance of moisture or foreign material.

I. Install bushings or CHASE® nipples on ends of conduit to protect insulation of insulated conductors from abrasion.

J. Use electrical duct seal to seal ends of raceways that terminate at outdoor boxes, panelboards, wiring troughs, or cabinets and to seal ends of raceways that enter a building or structure from underground.

K. Stub conduit that terminates at horizontal surfaces 2 inches above finished floor level and terminate with coupling and plug. Replace plug with bushing or CHASE® nipple before installing insulated conductors.

L. 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.

M. Use liquidtight flexible metal conduit for conduit connections to equipment subject to vibration, where flexibility is required, or where shown. Maximum length to be 24 inches.

N. Furnish and install firestopping around conduit that penetrates the wall between engine-generator room and electrical control room. Furnish and install system in accordance with Section 07840 – Firestopping.

O. Conduit Terminations at Sheet Metal Enclosures:

1. Make terminations at NEMA 250 Type 4 and Type 4X enclosures using a watertight conduit hub.

2. Make terminations at all other sheet metal enclosures using a coupling and CHASE® nipple. Install the conduit and coupling square to the enclosure. Tighten the CHASE® nipple with no exposed threads. Use of two locknuts, one inside and the other outside the enclosure, is not acceptable.

P. Conduit Embedded in Concrete:

1. Use rigid steel type, unless indicated otherwise.

2. Determine locations of embedded conduit stub-ups based on equipment being furnished.
3. Hold conduit, conduit fittings, and conduit boxes securely in position while concrete is being placed.
4. Protect ends of conduit to prevent entrance of concrete, sand, or other foreign material.
5. Terminate ends of conduit that do not terminate at boxes with couplings and pipe plugs or insulating bushings and caps.
6. Clean concrete from inside of conduit boxes immediately after forms are removed.
7. Clean threads for attaching devices and covers to boxes.
8. Swab conduit within 24-hours after removal of forms with clean dry rags until conduit is thoroughly cleaned and dried.
9. Grease threads of removed plugs and reinstall plugs to prevent entrance of water or foreign material.
10. Seal conduit boxes with rubber gasketed blank cover.

Q. Exposed Conduit Runs:

1. Straight and parallel with each other and with centerlines of room or structure.
2. Support conduit rigidly from wall or ceiling within 3 feet of each outlet box, junction box, cabinet, or fitting; and at intervals of not more than 5 feet.
3. Installation includes, where required, drilling holes in bottom, side, or top of enclosures or plates of other electrical equipment.

R. PVC Conduit:

1. Schedule 40: Install for underground, concrete encased, exposed applications in accordance with NFPA 70, and as shown.
2. Schedule 80: Install where conduit is subject to physical damage and as shown.
3. Join conduit and fittings in accordance with NEMA TC 2 and manufacturer's instructions. Use manufacturer's recommended cement.
4. Before applying cement, ensure surfaces to be joined are wiped clean and are free of dirt, oil, grease, or moisture.
5. Apply full even coat of cement to entire area inserted in bell or fitting.

S. Buried Conduit:

1. Depth, minimum: 24 inches.
2. Install 2 inches of sand around each conduit.

3. Install detectable warning tape above conduit in accordance with manufacturer's instructions and at the manufacturer's recommended depth.

4. Cap both ends of buried empty conduit beneath Interstate Highway I-8. Provide utility markers to mark location of each end.

5. Backfill and compact remaining portions of trench in accordance with Section 02318 – Earthwork for Structures.

END OF SECTION

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