REVISED PHASE FOUR FINAL DESIGN REPORT
GENERAL ELECTRIC HUDSON FALLS PLANT SITE
HUDSON FALLS, NEW YORK

PREPARED FOR:

GENERAL ELECTRIC COMPANY
319 GREAT OAKS BLVD.
ALBANY, NEW YORK 12203

PREPARED BY:

TETRA TECH ENGINEERS, ARCHITECTS, & LANDSCAPE ARCHITECTS, P.C.

P.N. 117-2204240

DECEMBER 21, 2012

TETRA TECH

BRIERLEY ASSOCIATES
Creating Space Underground

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TETRA TECH
Revision 1 – December 21, 2012

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1 INTRODUCTION

1.1 PURPOSE

This Revised Phase Four Final Design Report for the Tunnel Drain Collection System (TDCS) at the General Electric (GE) Hudson Falls Plant Site (Site) includes the installation of mechanical infrastructure to support future operation of the TDCS, the installation of the equalization system for the expanded Water Treatment Plant (WTP), and related WTP improvements. These activities, with the approval of the New York State Department of Environmental Conservation (NYSDEC) in March 2006, were deferred until hydraulic equilibrium with the operation of the TDCS was reached. An evaluation of the effectiveness of the TDCS was presented in detail in the TDCS Performance Evaluation and Phase Three Completion Report (Tetra Tech GEO 2011a). The construction of the TDCS has been performed in phases. The first three phases of TDCS construction were completed from 2007 to 2009, and the TDCS became fully operational in May 2009. The design for the final phase of TDCS Construction (Phase Four) was revised as described in the Revised Phase Four Concept Design and Implementation Plan (Tetra Tech GEO 2011b) and is summarized herein.

1.2 SUMMARY OF ORIGINAL DESIGN

The elements of the original Phase Four design were detailed in Bid and Construction Documents for TDCS (Tetra Tech 2006) and included: permanent piping from the shut-off valve at each drain well to the TDCS sump; pumping station in the TDCS sump, consisting of two vertical turbine pumps and ancillary equipment and controls; water line and accessories for flushing drain wells; an air compressor, air distribution piping system and related accessories; heating and ventilation equipment for the shaft and tunnels; elevator and stairway; permanent shaft lining; permanent oxygen and methane gas monitors in each tunnel and the shaft; a building with all necessary mechanical and electrical systems; a new electrical service and extension of the electric line from Allen Street; an emergency generator and fuel tank, and WTP equalization system.

The pumping station and associated control systems and the emergency generator were installed in 2009 to allow for continuous, reliable TDCS operation.

1.3 REVISED PHASE FOUR FINAL DESIGN

This Revised Phase Four Final Design includes the necessary elements for the continued long-term, safe and effective operation, maintenance and monitoring of the TDCS and reflects experience gained from over two years of operation and maintenance. The elements of the Revised Phase Four Final Design include upgrades to the following:

- WTP equalization system;
- TDCS access system;
- TDCS shaft lining;
- TDCS discharge piping;
- TDCS tunnel and shaft utilities;
- TDCS Site electrical power;
- TDCS support building, and;
- TDCS Site plan and layout which includes the work associated with the Compartment 1A Regrading Design Report (Tetra Tech 2012).

2 WATER TREATMENT PLANT EQUALIZATION

The WTP was expanded by the construction of a second treatment train with a capacity of 250 gallons per minute (gpm). The new treatment train was commissioned in December 2007. The design of an equalization system for the expanded WTP was deferred until the groundwater discharge came into equilibrium with the operation of the TDCS. The equalization design is presented in the following sections.

2.1 WATER TREATMENT PLANT EQUALIZATION

The Revised Phase Four Final Design for the WTP equalization is based on separating process water (extracted site groundwater) and storm water and changing the WTP operation from batch mode to continuous (24 hours per day/7 days per week [24/7]) operation. Currently, the process and storm water flows are combined and stored in the North Basin, and in general, the WTP operates 10-12 hours per day for six or seven days per week depending on flows from the recovery system.

Discharge from the TDCS and selected recovery wells and sumps will be routed to a new Dense Non-Aqueous Phase Liquid (DNAPL) separator to be located within the WTP. After passing through the DNAPL separator, the water will be pumped to the existing influent tanks at the WTP.

Several piping changes will be done to connect process water to the DNAPL separator and to separate process water from storm water. Storm water will be routed to the North Basin for storage prior to treatment at the WTP. Existing influent tanks and the railcar pit located at the WTP will be used for process water flow equalization/storage. Once these modifications are made, and as described in the Recovery System Optimization Plan (RSOP; Tetra Tech GEO, 2011c), several recovery systems will be shut down, tanks T-0100, 0200 and 0300 and related pumps, piping and instrumentation will be decommissioned. Figures 1 and 2 show the existing and proposed modifications to the collection and pumping systems.

2.1.1 PROCESS FLOW

Following approval of the RSOP, the following recovery wells and pumps will remain in use and continue to discharge to the WTP:

- TDCS;
- North Sump located in Eastern Raceway;
- RW-100;
- RW-103;
- RW-104;
- RW-105;
- RW-110;
- RW-2A;
- Return Air Duct (RAD) Room sump and;
- Collection Pit.

Based on 17 months of flow data (March 2010 to July 2011), the daily average flow to the WTP was 134,000 gallons per day (gpd), and the peak flow during a storm event was 309,000 gpd. This includes storm flow and flow from several pumping systems that are scheduled to be decommissioned. Daily average flow from the pumping systems to remain in use is anticipated to be approximately the same as the current daily average flow because the pumping rates from the systems remaining on line are anticipated to increase when the other pumping systems are shut down. Since storm water flows will be separated from process water, no significant peak flow in the amount of process water treated at the WTP is expected. Daily flow from the current sources to the WTP is provided in Table 1, while daily total flow to the WTP is depicted in Figure 3.

After passing through the DNAPL separator, process water will be pumped to the two existing influent tanks with any overflow routed to a contingency storage system in an existing concrete sump (railcar pit) located in Building 4A. Each influent tank has a capacity of 10,000 gallons, while the railcar pit provides an additional capacity of 40,400 gallons. The railcar pit will be configured to receive overflow via gravity from the influent tanks and return it to the influent tanks by pumping.

Based on the expected daily flow to the WTP, the 250 gpm treatment train will be operated at a flow rate of about 125 gpm for purposes of treating process water, with the additional capacity available as needed to treat storm water. In addition, the original 125 gpm treatment train will be available to start up and run automatically whenever the 250 gpm train is not available. The 125 gpm train will be operated once a month for about 8 hours in a recirculation mode in which the treated effluent from the 125 treatment train will be returned to the influent tanks while the 250 gpm treatment train is operating.

Since the WTP will be operating on a 24/7 basis, storage of process water will only be needed if a situation arises that requires both treatment trains to be shut down for maintenance. In that event, the influent tanks and railcar pit will provide interim storage of process water until one or both treatment trains are back in operation.

2.1.2 STORM FLOW

Once process water and storm water storage are separated, only the storm water (roof drains from Buildings 1 thru 4A and a Catch Basin CB-1 located north of Building 4B) will enter the North Basin, which has a capacity of 202,000 gallons. As storm water accumulates in the North Basin, it will be pumped to the influent tanks at a rate of 150 to 200 gpm. The estimated volume of storm water that may be routed to the North Basin during a 10-year storm event is 226,000 gallons and 325,000 gallons during a 100-year storm based on a 24-hour period. Figure 4 is a hydrograph which illustrates the operation of the North Basin during a 100-year storm. The figure shows the cumulative volume entering the North Basin, the cumulative flow pumped from the North Basin to the influent tanks, the volume stored in the North Basin and the rate that water is pumped from the North Basin to the influent tanks. Additional contingency storage in the railcar pit will be available to store excess storm water (i.e. overflow from the influent tanks), if needed. Since the 250 gpm treatment train can process 360,000 gallons of water per day, there is adequate treatment capacity for both process flow and storm flow. In addition, 125 gpm treatment train will be available to operate automatically as a backup.

2.2 DNAPL SEPARATOR

Process water will enter the new DNAPL separator to be installed at the WTP in Building 4A. The effluent from the separator will discharge by gravity to a new feed tank (2,000 gallon capacity). There will be two pumps (each rated at 200 gpm) to transfer the process water from the feed tank to the influent tanks.

The DNAPL separator is capable of handling 125 gpm continuous flow and a maximum intermittent flow of 313 gpm. This separator has a volume of 3,770 gallons and provides 1,282 gallons of oil storage capacity. Any DNAPL accumulated in the separator will be collected manually on a periodic basis.

The new feed tank will have a level transmitter, and the pumps will be on variable frequency drive (VFD). The DNAPL separator, feed tank and pumps will be located within the secondary containment area. There will be a manual bypass of the DNAPL separator that will allow water to go directly to the influent tank during separator maintenance. There will be flow meters on the DNAPL separator influent and separator bypass lines. Table 2 provides a list of proposed equipment and instruments.

2.3 RAILCAR PIT

The railcar pit is an existing, unlined concrete sump located in Building 4A that will be retrofitted to provide contingency storage for overflow from the influent tanks. The railcar pit will be cleaned and fitted with a liner. A self-priming pump rated at 200 gpm will be installed to transfer the water via new piping to the influent tanks based on levels in the railcar pit and influent tanks. The railcar pit will have a level transmitter, and the pump will be operated using a VFD.

2.4 EXISTING INFLUENT TANKS

These tanks will receive process water from the DNAPL separator feed tank and storm water from the North Basin. These tanks will also receive water stored in the railcar pit. The existing influent pumps for both the 250 gpm and 125 gpm treatment

trains will continue to operate as before. These tanks will have new overflow piping discharging into the railcar pit.

2.5 NORTH BASIN REHABILITATION

The North Basin will receive storm water only. This basin will be cleaned and the existing liner will be replaced. Two self-priming pumps (each rated at 200 gpm) will pump storm water from the North Basin to the influent tanks via existing piping. The basin will have a level transmitter, and the pumps will be operated using a VFD. A temporary pumping system will be provided to divert stormwater from North Basin to South Basin during rehabilitation of the North Basin.

2.6 RECOVERY WELLS

Five recovery wells (RW-100, RW-103, RW-104, RW-105 and RW-110) will be modified so that each will have a new: level transmitter; flow meter and; VFD, so that each well can be monitored and controlled, remotely, via a programmable logic controller (PLC). The existing DNAPL recovery system will be replaced with a new system at each of these five wells. DNAPL will be collected manually on a periodic basis.

2.7 PROGRAMMING AND CONTROLS

The entire WTP and pumping systems will be operated by PLC. The PLC will be programmed to monitor all new pumps and instruments, and to control the new VFDs. There will be various pumps with interlocks based on respective tanks/basin levels. PLC screens located at WTP Control Room will be modified to add new equipment, pumps and instruments. Programming changes will be made to operate both the 250 gpm and 125 gpm treatment trains on a 24/7 basis. An auto dialer will be programmed to transmit several process-related alarms. These alarms will be sent to the WTP operator and other key personnel via a phone line. PLC screens will be remotely accessible to key personnel via a secured remote connection.

Recovery wells and TDCS pumps will operate on a continuous basis to maintain a pre-determined water level at each location.

Since the normal flow to the WTP in the absence of storm water will be about 90 gpm, the 250 gpm train will be operated at 125 gpm (a minimum flow needed for various equipment) to maintain about five feet of water in the influent tanks. In order to run at 125 gpm, it will be necessary to recycle water back to the influent tanks. For a 90 gpm inflow, 35 gpm of water will be recycled back to the influent tanks after the UV/OX system. As the plant inflow increases (i.e. during a storm event), the influent tanks level will rise and 250 gpm influent pumps (running on VFDs) will match the incoming flow, and the recycled flow will be adjusted automatically. If the plant inflow rate remains higher than 250 gpm for a long period, the influent tank level will continue to rise and water will be allowed to overflow to the railcar pit for additional storage. If the railcar pit water level starts approaching the high level, the North Basin pumps will be controlled (reduced or stopped), and storm water will be stored at the North Basin. The North Basin pump will start automatically as the influent tanks level drops. Once the North Basin level reaches ”low level”, water from the railcar pit will be pumped back into the influent tanks.

If the influent tanks, railcar pit and North Basin start approaching their capacity (an extreme condition), then the 125 gpm treatment train will start automatically to increase treatment capacity.

3 TDCS LONG TERM INFRASTRUCTURE

This Revised Phase Four Final Design is based on a review of the original Phase Four design and the experience of operating the TDCS for more than two years. The revisions to the original design include several elements that will support the continued long-term, safe and effective operation, maintenance and monitoring of the TDCS. The Revised Phase Four Final Design includes the installation of mechanical infrastructure needed for operation of the TDCS. These elements are discussed in the following sections.

3.1 TDCS TUNNEL ACCESS SYSTEM

The current access system for entering the TDCS involves the use of two truck-mounted cranes and two personnel baskets. This dual-crane approach provides a redundant personnel lift capability, should the need arise, and will continue to be used until the permanent system is in place.

The permanent TDCS access system will be a two crane system that provides redundant personnel lift capability. The primary crane will be a 15-ton capacity bridge crane for personnel and heavy lifts including removal of the existing shaft cover. The secondary crane will be a jib crane with 5-ton capacity for personnel lifts. There will be a dedicated laydown area for the shaft cover and personnel baskets.

3.2 TDCS SHAFT LINING AND COLLAR

The final design for the TDCS shaft lining has been developed based on the results of inspections of the existing shaft lining, and evaluation of long-term rock load support requirements. The existing shaft lining includes the initial rock support installed during construction and consists of a 1-inch to 3-inch layer of shotcrete applied to the walls of the shaft following the installation of rock dowels. The permanent lining will consist of a drainage system between the existing shaft wall and the structural lining system. The structural lining will be either 12-inch thick, fiber-reinforced shotcrete or 12-inch thick, cast-in-place unreinforced concrete. The lining method will be determined at the time of

bid evaluation and will be based on evaluation of cost, schedule, and construction considerations. Both shotcrete and cast-in-place methods have been designed to resist full hydrostatic pressure from groundwater and lateral loads from potential rock wedges within the rock mass that were identified from analysis of the geologic mapping data collected during the excavation of the shaft. Structurally, the final lining will behave as a compression ring. The shaft lining was designed in general accordance with American Concrete Institute (ACI) Building Code Requirements, ACI 318, for plain (unreinforced) concrete.

Prior to liner construction, the existing shaft wall will be pressure washed, loose material (shotcrete and rock) removed, and existing utility anchors disconnected. A 4-ft. wide drainage composite will then be installed with a 10-ft on-center spacing that will carry the water to discharge at the drain gutter along the perimeter of the bell-out. The drainage composite will reduce hydrostatic stress on the liner, while allowing collection of groundwater.

If selected, the permanent shotcrete lining would be installed through use of scaffolding, and crane supported baskets, whereas a cast-in-place option would utilize formwork and scaffolding. An alternative cast-in-place method involves slip-form installation, which would involve bottom-up construction by means of a continuously rising formwork.

The top of the shaft is currently secured with a heavy steel frame and cover, 28.5 feet in diameter that sits on the concrete shaft collar. At the center of the cover is a 9-ft. by 12-ft. access hatch and a protective handrail that provides fall protection around the hatch opening. The final design for the shaft collar includes a 48-inch high concrete ring wall around the shaft opening to provide fall protection at the edge of the shaft. The existing shaft cover will fit on top of the ring wall and will provide security against unauthorized access.

3.3 TDCS Discharge Piping and Shaft Utilities

The design for the TDCS discharge piping includes replacing the existing discharge pipe and pipe support brackets in the vertical shaft. The pipe and supports have been designed and materials selected to ensure a long service life in the shaft.

The final design for the shaft utilities includes replacement of uncoated steel piping, utility supports and anchor rods with corrosion resistant materials. New pipe support brackets will be constructed with hot dip galvanized steel and will be anchored to the new shaft lining with stainless steel chemical resistant anchors. Replacement of utilities in the tunnel will be addressed on an as-needed basis as part of the on-going maintenance program. The existing fiberglass ventilation duct in the shaft is functional and will not be replaced; however, the support brackets will be replaced with new brackets and anchor rods made from the same corrosion resistant materials mentioned above, as well as, reworking the duct at the top of the shaft to be below grade adjacent to the shaft opening.

3.4 TDCS Site Electrical

The TDCS site electrical concept design includes a new power service drop at Allen Street, dedicated transformer, emergency backup generator and transfer switch. In addition, the existing TDCS electrical components will be consolidated into the future TDCS service building (discussed in Section 3.5). This design work will be coordinated with future decommissioning plans for the GE high voltage switchyard on the corner of Sumpter Street and John Street and will be submitted separately.

3.5 TDCS Buildings

The TDCS buildings include an Access Building and a Service Building to be constructed in the future. The design report for the Service Building will be submitted separately.

The final design for the TDCS Access Building will include a pre-engineered building with framing to support the bridge crane and a roof. The building has been sized

to accommodate shaft cover removal and laydown, as well as clear work space adjacent to the shaft. A concrete slab will be provided in a portion of the structure footprint that includes a contained and covered equipment decontamination area.

The concept design for the future TDCS Service Building includes a basic building with the primary function of housing and protecting the facilities, equipment, and components necessary for long term TDCS operation, maintenance and monitoring. This design includes electrical equipment, TDCS worker and small equipment decontamination stations, restrooms, control room, entry equipment storage area and possible WTP location.

3.6 TDCS SITE PLAN AND LAYOUT

The final design for the TDCS site layout incorporates appropriate laydown areas for TDCS operations, vehicle parking, fencing with access controlled gate, emergency vehicle space and storm water management. The site plan will include site utilities, and grading, drainage, lighting and landscaping. Site grading and drainage have been designed to accommodate future possible development of the site for the TDCS Service Building and WTP building.

3.7 COMPARTMENT 1A REGRADING

The work associated with the Compartment 1A Regrading Design Report (Tetra Tech 2012) has been incorporated into and will be completed as part of the Phase Four construction.

3.8 TEMPORARY PUMPING SYSTEM FOR TDCS SHAFT WORK

During TDCS shaft lining and installation of permanent utilities, a temporary pumping system will be provided to pump water from the TDCS shaft sump to an at-grade weir tank. The water from the weir tank will be pumped to the WTP through existing piping. The weir tank's overflow will be piped to discharge to the South Basin for temporary contingency storage and another temporary pumping system at the South Basin will return the water from South Basin to the weir tank.

4 SCHEDULE

4.1 PHASE FOUR IMPLEMENTATION

Following NYSDEC approval of the Revised Phase Four Final Design, the following steps toward implementation are planned:

- Prepare Bid Documents;
- Solicit Bids;
- Bid Review and Selection of Contractor;
- Develop Construction Schedule;
- Prepare Construction Drawings and;
- Submit Construction Schedule and Drawings to NYSDEC.

4.2 PHASE FOUR SEQUENCE

The schedule and contingency planning will take into account that the pumping from the TDCS will be continuous and the North Basin rehabilitation work can be subject to a storm event. The construction of the Revised Phase Four Final Design will be sequenced so as to have minimal effect on the operational capability of the TDCS pumping system. The TDCS pumping system outages required for the shaft lining and shaft utility construction will be limited to a maximum of eight hours. The rehabilitation of the North Basin will occur after the improvements to the Water Treatment Plant have been completed and process water is flowing directly to the WTP and storm water is temporarily diverted to the South Basin. The water in the South Basin will be pumped automatically to a temporary weir tank and then into the existing piping system to the WTP.

5 REFERENCES

Tetra Tech, 2006. Bid and Construction Documents for Hudson Falls Tunnel Drain Collection System, Hudson Falls, New York, February 15, 2006.

Tetra Tech GEO, 2011a. Tunnel Drain Collection System Performance Evaluation and Phase Three Completion Report, Hudson Falls, New York, Revision 1: October 13, 2011.

Tetra Tech GEO, 2011b. Revised Phase Four Concept Design and Implementation Plan, Hudson Falls, New York, November 4, 2011.

Tetra Tech GEO, 2011c. Recovery System Optimization Plan, Hudson Falls Plant Site, July 1, 2011.

Tetra Tech GEO, 2012. Compartment 1A Regrading Design Report, GE Hudson Falls Plant Site, July 18, 2012.

TABLES

TABLE 1
Daily Flow Statistics by Location
GE Hudson Falls, NY

Location	Daily, in Gallons [1]		
	Minimum	Maximum	Average
Raceway			
North Sump	0	15,427	2,988
Overburden			
Collection Pit	0	15,578	585
MH-4	0	100	0.2
RAD	0	34,739	1,107
RW-1	0	1,054	617
RW-2A	0	1,712	309
RW-3B	0	3,709	588
RW-4	0	5,681	1,062
RW-5	0	2,283	378
RW-6	0	7,298	231
RW-7	0	16,111	1,046
Bedrock			
HF-54BS	0	2,483	599
HF-63BD	0	3,151	599
HF-65BD	0	1,366	275
OBG-1 [2]	0	2,138	15
RW-100	0	21,246	4,187
RW-101	0	5,879	848
RW-102	0	11,988	633
RW-103	0	23,296	5,887
RW-104	0	10,306	2,380
RW-105	0	38,453	16,253
RW-110	0	31,592	21,078
TDCS	52,568	157,966	73,723
Other Sources [3]	85	10,723	1,194
Total Inflow to WTP	73,000	309,000	134,000

Notes:

1 Flow data from March 2010 to July 2011

2 OBG-1 - Off-line since September 20, 2012

3 Other sources include: John Street Tunnel Sump, Stub Tunnel Sump and Lower Raceway

Table 2
Proposed Equipment/Instrumentation List
GE Hudson Falls, NYSite

Proposed Equipment

Item #	Description	Details	Vendor name	Power Required	Additional Comments
1	DNAPL Separator	125 gpm continuous 313 gpm intermittent	Hydrosep	none	New - with operating platform
2	Feed Tank (T-1020)	84" dia x 84" H, 2000 gallon tank	Highland Tank	none	New - similar to existing steel tanks, flat-bottomed, flat-top
3	Transfer Pumps (P-1020A/B)	250 gpm at 29' TDH	Goulds	3 HP, 460V/3ph/60Hz	Use two existing Goulds 3196 pumps presently at end of utility tunnel - no modifications necessary
4	North Basin Transfer Pump (P-1030A/B)	225 gpm at 60' TDH	Gorman-Rupp	7.5 HP, 460V/3ph/60Hz	Use existing P-3A as-is & use existing P-1 (T-100 pump) from P.T. Building and replace existing 5HP with new 7.5HP motor
5	Railcar Pit Pump (RCP) (P-1040)	150 gpm at 45' TDH	Gorman-Rupp	5 HP, 460V/3ph/60Hz	Use existing P-2 (T-200 pump) from P.T. Building
6	DNAPL recovery system at five RWs (RW-100, 103, 104, 105, 110)	LP1301 pump with inlet screen; C100M pneumatic-electronic controller; in-well exhaust valve	QED	120V + compressed air (plant air or portable)	self-contained system

Proposed instruments - (all instruments to communicate with SCADA)

Item #	Description	Range	Vendor name	Power Required	Additional Comments
1	VFDs for Transfer pumps (P-1020A/B)	0 - 250 gpm	ABB PumpSmart	460V/3ph/60Hz/3HP	Use existing ABB PumpSmart VFDs at end of tunnel - Locate on stands at relocated Goulds 3196 pumps
2	VFDs for North Basin pumps (P-1030A/B)	0 - 250 gpm	ABB PumpSmart	460V/3ph/60Hz/7.5HP	New stand-alone VFDs to be mounted inside new pump shed
3	VFDs for five RWs	0 - 50 gpm	Grundfos CU-300	230V/1ph/60Hz	VFD at RW-103 and RW-110 in building 4A; VFD at RW-100, RW-104, and RW-105 located in pump sheds
4	Flow meter on Transfer pumps (FT-1020)	0 - 250 gpm	Badger-Meter	120V in - 4-20mA out	New 3" magmeter - Locate in Bldg 4A
5	Flow meter on N. Basin pumps (FT-1030)	0 - 250 gpm	Badger-Meter	120V in - 4-20mA out	New 3" magmeter - Locate in new pump shed at North Basin
6	Flow meters at five RWs (FT-100/103/104/105/110)	0 - 50 gpm	Badger-Meter	120V in - 4-20mA out	New 1" magmeter replaces existing 1" battery flowmeters at RW-100/103/104/105/110
7	Flow meter on RW-104 and Tail Race (FT-104A)	0 - 50 gpm	Badger-Meter	120V in - 4-20mA out	New 1" magmeter - Locate in TDCS tunnel
8	Flow meter on TDCS discharge (FT-400)	0 - 400 gpm	Badger-Meter	120V in - 4-20mA out	New 3" magmeter - Locate in new valve vault outside tunnel building. Locate transmitter inside control shed.
9	Flow meter on Separator influent (FT-1010)	0 - 250 gpm	Badger-Meter	120V in - 4-20mA out	New 3" magmeter/integral transmitter - Locate along separator platform
10	Flow meter on Separator bypass (FT-1010A)	0 - 250 gpm	Foxboro	120V in - 4-20mA out	Existing 4" FIT-2241 in Bldg 4A to be re-used and re-named. Flowmeter stays as located on influent tank mezzanine
11	Flow meter on RCP discharge (FT-1040)	0 - 200 gpm	Foxboro	120V in - 4-20mA out	Existing 2" from P-2 (T-200 pump) in pre-treatment bulding to be relocated to RCP discharge and renamed.
12	Level Transmitter at Feed Tank (LT-1020)	0 - 6.0 feet	Siemens 'The Probe'	4-20 mA loop power	New - 'The Probe' ultrasonic transducer (with handheld programmer)
13	Level Transmitter at RCP (LT-1040)	0 - 15.0 feet	Siemens 'The Probe'	4-20 mA loop power	New - 'The Probe' ultrasonic transducer (with handheld programmer)
14	Level Transmitter at North Basin (LT-1030)	0 - 15.0 feet	Siemens 'The Probe'	4-20 mA loop power	Re-Use existing 'The Probe' already in place
15	HI-Level/Low-Level Switch for Feed Tank (LSHH/LSLL-1020)	Field set - level not viewable	Drexelbrook	4-20 mA loop power	New multi-point contact level switch
16	HI-Level/Low-Level Switches for North Basin and RCP (LSHH/LSLL-1030 & 1040)	Field set - level not viewable	GE	4-20 mA loop power	New level float switches - similar to existing feed tanks
17	HI-Level Switch for Separator (LSH-1010)	Field set - level not viewable	Dwyer	4-20 mA loop power	New horizontal level float switch - mount in instrument nozzle on separator sidewall
18	Level Transducers at five RWs (LT-100/103/104/105/110)	LT-100 (0-100psi); LT-103 / 104 / 105 (0-75psi); LT-110 (0-50psi)	GE	4-20 mA loop power	New submersible pressure diaphragm transducer - lightning protection
19	Actuated On/Off valve on TDCS recycle line (MOV-407)		Hayward EPM	120V	Electric Actuated with limit switch & override handle. Mount with Hayward PVC Butterfly Valve - Locate in TDCS
20	Pneumatic On/Off valve on Separator bypass (MOV-1010A)		Asahi-America	Pneumatic	Existing 4" FCV-2240 in Bldg 4A to be re-used and re-named. Valve stays as located on influent tank mezzanine

FIGURES

TUNNEL DRAIN COLLECTION SYSTEM

RW-106
RW-107
RW-108
RW-109
RW-104
RW-6
RW-7

TAILRACE TUNNEL EMERGENCY PUMP

TAILRACE TUNNEL LIFT STATION

TAILRACE FLOOR DRAIN

DISCHARGE PIPE THROUGH BUILDINGS 1 THROUGH 4

RW-100
HF-63BD
CENTRAL SUMP

CENTRAL LIFT STATION

OBG-1
HF-65BD
NORTH SUMP
RW-102
RW-101

MH-4

RW-105
RW-5
RW-110
RW-3B
RW-4
HF-54BS
RW-2A

HF-45BD
STUB TUNNEL SUMP
JOHN STREET SUMP
RW-1
RW-103
RETURN AIR DUCT
COLLECTION PIT

SUMPTER STREET LIFT STATION

N.O.

BUILDING 1 ROOF LEADERS

BUILDING 3 ROOF LEADERS

MH

P4

NORTH BASIN

MH-4A

BUILDING 4A ROOF LEADERS

TRUCK DOCK SUMP

CATCH BASIN CB-1

SOUTH BASIN

OIL/ WATER SEPARATOR

1,500 POLY TANK

PUMPING SYSTEM IN BUILDING 1

CONTAINMENT SUMPS

T-0100
T-0200
T-0300
P1
P2
P3
P3A SPARE

WATER TREATMENT PLANT

T-2100
T-2200

TO 125 GPM TREATMENT TRAIN CLARIFIER

TO 250 GPM TREATMENT TRAIN CLARIFIER

EXISTING COLLECTION SYSTEM TO REMAIN IN USE

EXISTING COLLECTION SYSTEM TO BE DECOMMISSIONED

EXISTING COLLECTION SYSTEM FLOW SCHEMATIC

General Electric Company
TDCS
PHASE FOUR
DESIGN
Hudson Falls, New York

DATE: DECEMBER 21, 2012

RCN: 112IC04086

TETRA TECH, INC.
240 Continental Drive, Suite 200
Newark, Delaware 19713
ph. 302 738-7551
fax 302 454-5980
www.tetratech-de.com

DRAWING TITLE: EXISTING COLLECTION SYSTEM FLOW SCHEMATIC

DRAWING NUMBER: FIGURE 1

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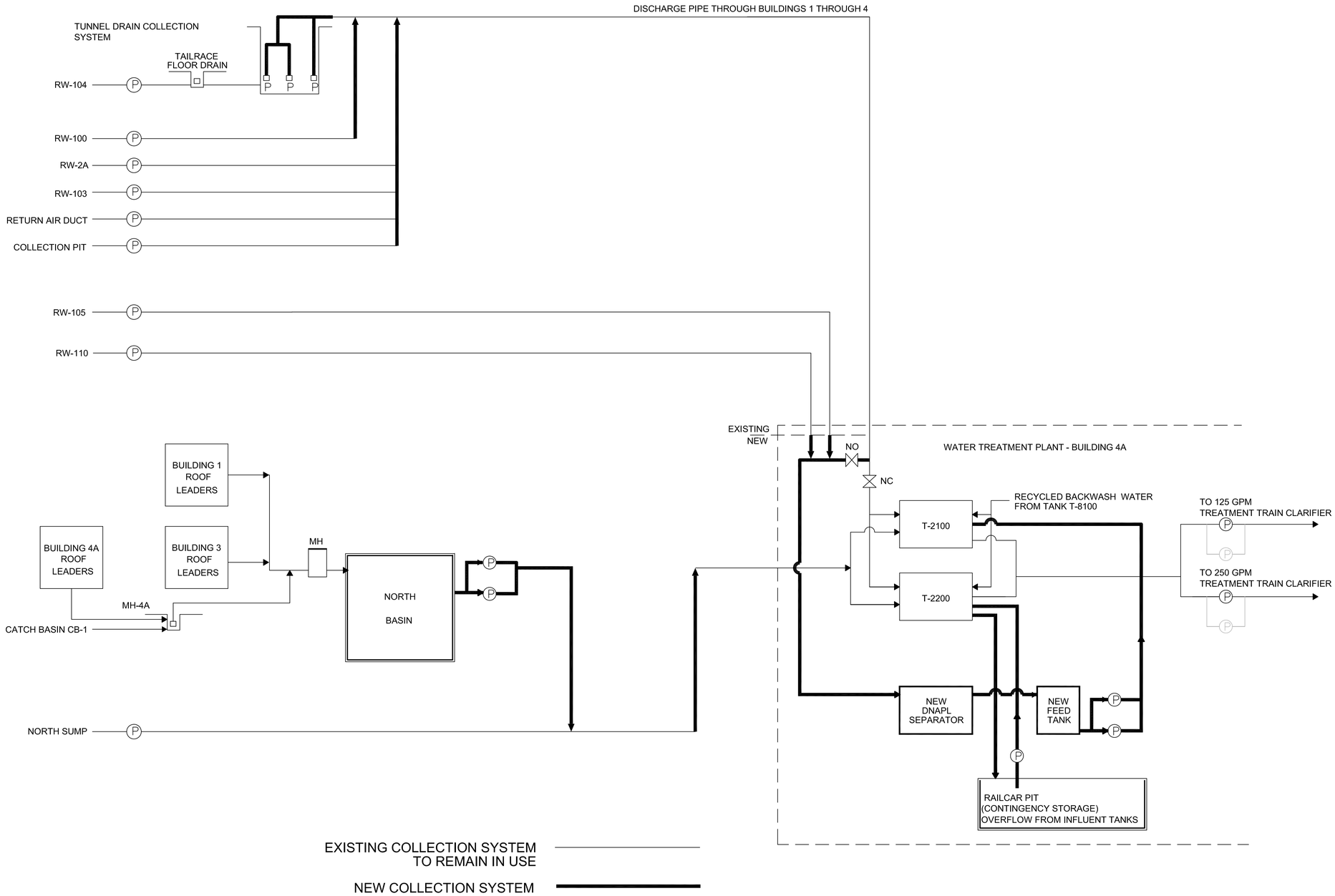

FINAL COLLECTION SYSTEM FLOW SCHEMATIC

General Electric Company
TDCS
PHASE FOUR
DESIGN
Hudson Falls, New York

DATE: DECEMBER 21, 2012

RCN: 112IC04086

TETRA TECH, INC.
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fax 302 454-5980
www.tetratech-de.com

DRAWING TITLE: FINAL COLLECTION SYSTEM FLOW SCHEMATIC

DRAWING NUMBER: FIGURE 2

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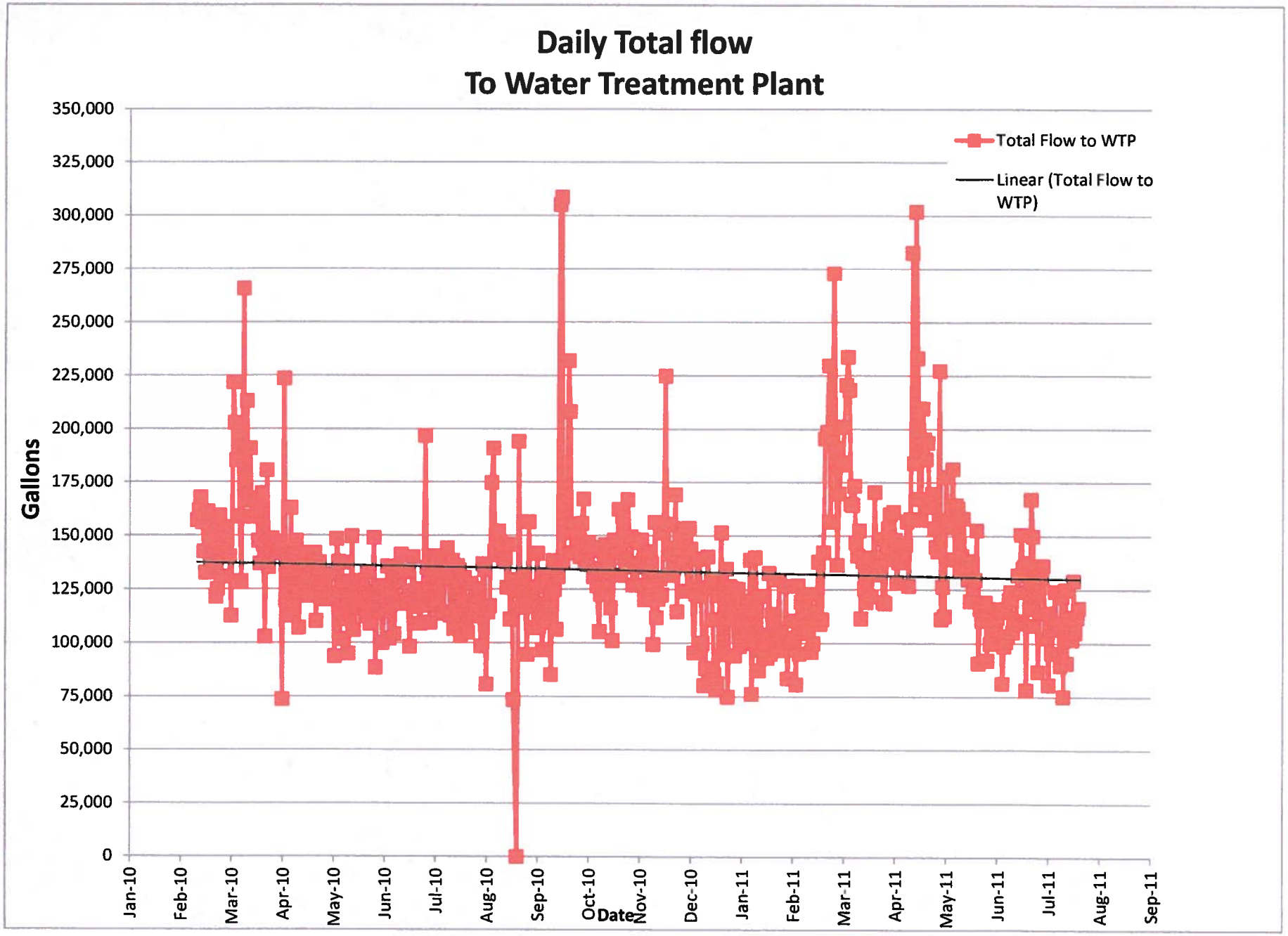
Daily Total flow
To Water Treatment Plant
Total Flow to WTP
Linear (Total Flow to WTP)
Gallons
350,000
325,000
300,000
275,000
250,000
225,000
200,000
175,000
150,000
125,000
100,000
75,000
50,000
25,000
0
Jan-10
Feb-10
Mar-10
Apr-10
May-10
Jun-10
Jul-10
Aug-10
Sep-10
Oct-10
Nov-10
Dec-10
Jan-11
Feb-11
Mar-11
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May-11
Jun-11
Jul-11
Aug-11
Sep-11
Date

FIGURE 3

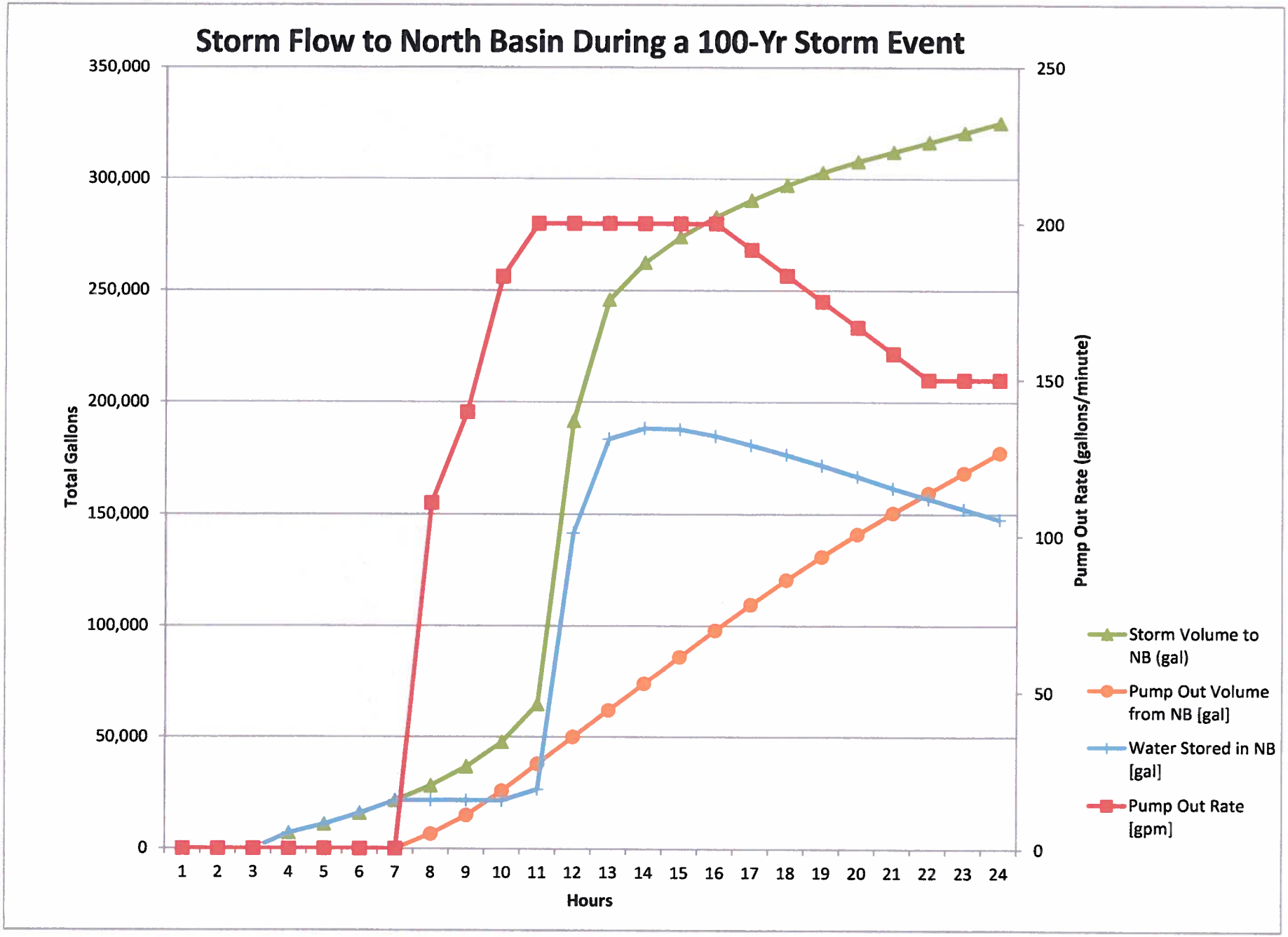
Storm Flow to North Basin During a 100-Yr Storm Event
Total Gallons
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
Pump Out Rate (gallons/minute)
250
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hours
Storm Volume to NB (gal)
Pump Out Volume from NB [gal]
Water Stored in NB [gal]
Pump Out Rate [gpm]

FIGURE 4

ATTACHMENT A

TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATIONS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section

1.2 BACKGROUND AND SUMMARY OF WORK

A. Tunnel Drain Collection System (TDCS) constructed in 2007 has been in operation as the remedy at the Hudson Falls Site. The TDCS consists of a service shaft from ground surface down to about 220' below grade, a series of tunnels extending from the base of this shaft and drain wells (boreholes) from the tunnel upward toward the top of rock surface and laterally beneath the river bottom. The drain wells discharge into a drain system that leads to a pumping station located at the base of the shaft.

B. Groundwater is pumped continuously from the TDCS and is presently discharging into the North Basin via existing piping located in utility tunnel and building 1. From this basin, this water is pumped into an existing tank T-0300.

C. In addition, there are several recovery wells through this site that also pump groundwater to tanks T-100 and T-200 pumping system. These tanks also pump into T-0300. From T-0300, water is pumped to an existing on-site water treatment plant (WTP) located in Building 4A.

D. Presently the WTP operates on a batch mode (10-12 hour/day, 7 days/week) while all recovery systems run on a continuous basis. The North Basin and tanks T-0100 thru T-0300 provide storage capacity while the WTP is not running.

E. The TDCS Phase 4 scope consists of separating process and storm water by rerouting all process water to a new DNAPL separator, adding a feed tank and a duplex pumping system at this separator, rehabilitating the North Basin with a new liner and adding a duplex pumping system, modifying the railcar pit and adding a pumping system, constructing a permanent tunnel access system, and an access building at the TDCS.

F. The TDCS Phase 4 design for the Water Treatment Plant (WTP) equalization is based on changing the WTP operation from batch mode to continuous (24/7) operation. The newer, 250 gpm, treatment train will normally be operated at a flow rate of about 125 gpm, while the older, 125 gpm, treatment train will be available to start up and run automatically whenever the 250 gpm train is not available.

G. Flow equalization for process water will be provided by the existing influent tanks, while the North Basin will be dedicated for storm water storage. An existing concrete sump (railcar pit) located at building 4A will be configured to receive overflow from the influent tanks and thus provide additional storage of process water, while the North Basin will be used to store storm water runoff. Pumps at both the railcar pit and North Basin will direct water into influent tanks.

H. Various existing pumps will be reused for this project. Construction of various tasks will be sequenced properly so that the shutdown of existing recovery wells and TDCS can be minimized.

1.3 DEFINITIONS

A. Owner: General Electric Company

B. Owner's Representative: TBD.

C. Engineer/Architect: Tetra Tech, Engineers, Architects, and Landscape Architects, P.C. and its subconsultant Brierley Associates, LLC.

D. Construction Manager: (To be Determined).

1.4 DETAILED SCOPE OF WORK- PROCESS RELATED

A. Collection System Modification: There are several recovery wells and pumping systems located throughout the site and as shown on drawings. Eight of these recovery well/pumping systems and TDCS pumping system will be modified to stay in operation while remaining recovery wells will be decommissioned.

1. Reroute existing wells RW-100, RW-103 and RW-2A piping (located in building 1) to existing TDCS pipeline located in building 1.

2. Reroute return air duct (RAD) room sump pump and collection pit pump discharge (located in building 1) to existing TDCS pipeline.

3. Reroute existing wells RW-110 and RW-105/RW-5 piping (located in building 4A) to TDCS pipeline also located in building 4A.

4. Reroute existing TDCS piping located in building 4A into a new DNAPL separator. This pipe is also connected to influent tanks thus providing a DNAPL separator bypass.

B. Modification at TDCS pumping system piping system: The existing TDCS pumping system consists of two vertical pumps and a submersible pump. The existing discharge pipe (6-inch) runs up the shaft wall and then buried underground to a utility tunnel and then in the basement of Building 1 thru 4A. The existing pipe will continue to operate until new discharge piping system is complete as described below.

1. A submersible pump (P-405) will be relocated from the process sump into the DNAPL sump and 4" discharge piping will be constructed from this pump up to a manifold at the base of the shaft.

2. New 4" discharge piping system for two vertical pumps (P-403 and P-404) discharge will be constructed from these pumps up to a manifold at the base of the shaft.

3. Then two new 4-inch pipes will be constructed up along the shaft wall from the manifold to a new valve vault at existing ground surface.

4. At this manifold, install a 4" recycle line with a new motor operated ON/OFF valve.

5. From this valve vault, construct new piping system to connect into existing pipe via another valve vault and two more pipes for future connection as per drawings. Install a new flow meter in this valve vault.

C. New DNAPL Separator System:

1. Install a new DNAPL separator in building 4A. This separator will be located near the clarifier area.

2. Construct an operating platform around this separator.

3. Install a feed tank and a duplex pumping system with level control and variable frequency drives (VFD).

4. At separator and feed tank will have a vent pipe connected to existing vent system in building 4A.

5. Install a discharge line from feed tank pumps to influent tanks.

6. Relocate and reinstall existing sludge transfer pump and associated piping from this area so that it is not under the new platform.

D. Railcar Pit (RCP) Modification:

1. Pump out any free water back into treatment plant.

2. Remove the sludge and store in a roll-off for proper disposal.

3. Once the pit is empty, thoroughly wash/clean the pit and pump the water back into treatment plant.

4. Install a new liner inside RCP.

5. Install a pumping system with level control to pump water from this pit to the influent tanks. This pump's discharge line will utilize a portion of existing 125 gpm treatment train by-pass line (located near GAC pumps).

E. Existing Influent Tanks (T2100/T2200) Modification:

1. Install an overflow and return piping from these tanks to railcar pit.

F. North Basin Rehabilitation/Improvement:

1. Completion of North Basin modification is time critical and weather dependent.

2. Prior to start of this task, TDCS and all recovery wells water should be going to WTP via new DNAPL separator. Only storm water will continue to go to the North Basin via the existing pipe and manhole.

3. All existing pipes and manholes connecting from the buildings to the North Basin are to be cleaned to minimize re-contamination of North Basin.

4. During this task, divert the storm water to the South Basin by plugging an outlet pipe at a manhole near the North Basin and using a temporary pumping system and overland piping up to the South Basin.

5. Pump out all free water back into treatment plant.

6. Remove the sludge and store in a roll-off for proper disposal.

7. Once the basin is empty, thoroughly wash/clean the basin and pump the water back into treatment plant.

8. Once the basin is clean, remove existing pumps and related piping.

9. Remove liner and dispose of it properly.

10. Provide safe access and safety support for structural inspection of North Basin concrete to be performed by the Engineer. Coordinate this with Owner.

11. Install a new liner.

G. Pumping/Piping Modifications at North Basin Area: Once North Basin modification is complete, the following work will be completed:

1. Install a duplex pumping system with VFD and discharge piping inside a new shed.

2. Install related instrumentation and controls.

3. Install North Basin pump’s discharge pipe (a double-wall aboveground pipe with insulation and heat tracing) will connect into an existing North sump pump’s discharge pipe located near North Basin.

4. The North sump pump’s discharge is currently discharging into T-100. Modify this pipe to connect to an existing pump P-3A (located inside pre-treatment building) discharge line going to influent tanks at WTP. Pump P-3A will be decommissioned once new system is ready for operation.

5. With this change, pump P-3A will no longer be in service and North Basin pumps and North sump pump will discharge into existing influent tanks.

H. Recovery Wells Modification:

1. At RW 100, RW-103, RW-104, RW-105 and RW-110 wells, install variable frequency drives (VFD), level transmitters and flow meters. These wells will now be monitored and controlled via SCADA.

2. At these five wells, remove existing DNAPL recovery system and install a new system as shown on drawings.

3. At RW-100, RW-104 and RW-105, install a pre-fabricated steel enclosure.

I. Decommissioning of existing systems: Once the above improvements are operational, the following will be decommissioned in place:

1. Tanks T-0100, T0200, T0300, two sump pumps, associated piping, electrical and instrumentation.

2. Three existing pumps located inside pre-treatment building (P-1, P-2 and P-3) will be removed and reused for this project.

3. Pretreatment building along with one pump P-3A, associated piping, electrical and instrumentation located in this building and up to above tanks.

4. A shed located on top of North Basin shed, a pump and associated piping.

5. Recovery wells piping no longer in use.

6. All tanks and piping must be drained and water must be pumped back to the treatment plant.

7. Equipment/piping draining and decon of tanks/piping will be according to waste disposal plan.

8. Decommissioning of various recovery wells will be by others.

J. PLC and SCADA Related Work:

1. At RW-100, RW-103, RW-104, RW-105 and RW-110 wells, a new PLC and control panel will be added to monitor the well level and to control the pump VFD. The new PLC will communicate to the SCADA system over a serial data link (via Modbus RTU) to a protocol converter located in the treatment plant main PLC cabinet. The protocol converter will convert the serial data protocol to Ethernet TCP which can be accessed by either the SCADA system PLCs and HMIs.

2. Antenna for the radio modems at the TDCS will be mounted on the TDCS Crane building Line-of-site with RW-104 and RW-100.

3. At the North Basin, PLC Genius remote I/O with control panel will be added for control of the North Basin pumps. The remote I/O will use the existing Genius I/O Bus (to the pre-treatment building) to communicate with the treatment plane PLCs.

4. At the TDCS, the new tail race flow meter (located in TDCS tunnel), the new recirculation bypass solenoid operated valve (located at the bottom of TDCS shaft) and the TDCS flow meter (located inside a valve vault) will be monitored and controlled using spare PLC I/O in the TDCS remote I/O panel.

5. The new Feed Tank VFDs, the rail car pit VFD will be controlled and the associated levels and flows will be monitored using spare I/O in the 250 gpm treatment plant main PLC cabinet.

6. The existing SCADA alarm call-out system in the 250 gpm treatment train main will be connected to the plant phone lines. Spare relay outputs for the treatment plant main PLC will connected to the SCADA alarm call-out system to trigger alarm call-outs for plant alarm conditions.

7. Installation and wiring of the instrumentation and PLC controls for the TDCS Phase 4 are included in the scope of this of this specification.

8. Modifications to the PLC program(s), changes to the SCADA HMI graphics, and configuration of the SCADA alarm callout system will be performed as part of the TDCS Phase 4 commissioning (by others).

1.5 DETAILED SCOPE OF WORK- LONG TERM INFRASTRUCTURE

A. Long-term TDCS shaft lining: The existing shaft lining consists of a, 1 to 3-inch thick layer of synthetic fiber reinforced shotcrete. The existing lining will be cleaned and scaled, and a permanent shaft lining installed. The permanent lining will consist of one of the following (method to be selected based on Contractor's bid cost and method):

1. A 12-in thick layer of fiber reinforced shotcrete; or

2. A 12-in thick unreinforced, cast-in-place concrete lining.

The long-term shaft lining will be equipped with drainage composite to reduce groundwater loads while allowing collection groundwater.

B. A new Shaft Access building at the TDCS site. This building will also be an approximately 30 foot tall pre-engineered steel building approximately 4,900 sf. in area with a roof only. The Shaft Access Area includes:

1. Domestic water supply – Existing 2-inch domestic water service from municipal water main will remain with the replacement of the existing meter and vault.

2. Electrical supply – The existing electric service will be utilized with the addition of required power for the new cranes, lighting and site amenities. The existing service size has been verified to accommodate the amenities mentioned above.

3. Design will seek to locate building such that existing TDCS system can remain functioning with only minor adjustments to existing utilities, as well as accommodating space for consideration of a future Water Treatment Plant.

4. Top of the existing vertical access shaft, laydown space for the shaft cover, storage space for personnel baskets as well as supplies and equipment, and a decontamination area.

C. Site plan with soil erosion and sediment pollution control design, grading (to incorporate current re-grading design) and storm water management will include:

1. Soil excavation and regrading along the south property line and replacement of concrete curb and gutter along Allen Street

2. Layout that includes aggregate access drives from Allen Street and John Street, maintenance access around the building, and adequate space for parking.

3. Collection piping and inlets necessary to capture and convey localized storm water runoff.

4. Storm water detention areas with drywells sized to accommodate the required volume mitigation requirements of the NYSDEC, and minimize the long-term maintenance aspect for the client.

5. A water quality surface sand filter design to provide required water quality.

6. A final discharge outfall or direct connection that will provide stabilized flow from the site.

D. Shaft wall will be raised to accommodate the proposed finished floor elevation and will incorporate a new ring wall 4 feet above that elevation for safety. Two below-grade vaults will also be added adjacent to the shaft to ease current phase and future utility connections.

E. Tunnel Access System will be a two crane combination with a 15-ton Bridge crane and a 5-ton Jib crane.

F. Utility and pipe support brackets in shaft to accommodate installation of new utilities and re-installation of existing utilities to be reused.

G. Architectural Systems and Finishes:

1. Roof Construction: Continuous standing seam pre-finished metal roof panels (1-mil thick baked-on fluoropolymer enamel) on horizontal “Z” purlins.

H. Structural Systems:

1. Building foundations will consist of concrete piers and spread footings at all column locations, and a continuous concrete wall and footing below the perimeter walls. Bottom of footing will be a minimum of 4 feet below adjacent grade to achieve frost protection.

2. The slab on grade within the shaft access area will consist of an 8-inch thick conventional reinforced slab that is depressed by 6 inches for containment of possible spills. This slab will occur in approximately 2/3 of the building footprint and the remaining 1/3 will be gravel.

I. Mechanical Systems:

1. The existing shaft ventilation fan will be relocated to work with new site design and with a new concrete pad. The existing supply ductwork will be reused, and buried below grade and protected with concrete so the duct will not crush. The below grade ductwork will be coordinated with the building foundation. The existing ductwork in the shaft will be removed for the shaft wall resurfacing and when re-installed it will be relocated to accommodate better below grade duct placement and new fan location .

J. Plumbing Systems:

1. The existing water service will be utilized. A new line for hose bibs at the decon area will be provided. The new water lines will be heat taped and insulated to protect from freezing. The existing water line in the shaft will be removed and relocated thru the below grade vault after the shaft lining is completed.

2. The existing compressed air line will be utilized as well with the addition of extended pipe and new quick connects with valves. The existing compressed air line in the shaft will be removed and relocated thru the below grade vault after the shaft lining is completed.

K. Electrical Systems:

1. The existing power system will be utilized for re-use at the shaft location. Items requiring new power such as the crane, lights and site entrance gate will be connected into existing power panels.

2. Power System - The electrical system is supplied normal power from the local utility. A standby generator supplies power to a manual transfer switch (MTS) so that if the utility power fails, the generator can be started and supply the building load.

3. Lighting System –The tunnel access space consists of metal halide HID lighting controlled via a lighting contactor with low voltage switching located within the space.

4. Exterior lighting is provided by building mounted metal halide light fixtures and one pole mounted light fixture at the fenced entrance. The exterior lighting is controlled via photocells.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

SECTION 01100

ATTACHMENT "A" – SCOPE OF WORK

BID PACK 1 – TDCS AREA RELATED WORK

This section describes the general work required to complete Bid Pack 1 of the project. Tasks described are consistent with the bid items referenced in the Bid Proposal Form. Other details of the work are provided elsewhere in these technical specifications and are shown on the Drawings.

A. BP-1 Task 1.1 – Mobilization, Demobilization, and Support Activities. This item includes all work performed during the Bid Pack 1 construction phase, including but not limited to the following:

1. Attend all project meetings and/or conference calls.
2. Comply with all applicable federal, state, and local regulations and requirements.
3. Identify and acquire construction-related permits, and attend any required inspections.
4. Procure and coordinate subcontractors and equipment as necessary to perform the work.
5. Prepare submittals, work schedule, and other required documentation
6. Provide all other office and administration services necessary to support Contractor activities for the duration of this construction phase.
7. Mobilize and demobilize personnel, equipment, and materials to the work area.
8. Provide field trailers, shops, change houses, and other enclosures as required to complete the work and comply with regulations and requirements. (The Contractor does not need to provide office space or services for Owner's or NYSDEC's representatives).
9. Coordinate for and cover costs associated with the provision of electrical power, phones, water, and sewer hook-ups for field offices and facilities installed at the site, as necessary.
10. Provide, service, and maintain both male and female sanitary facilities for the duration of this construction phase.
11. Install, maintain, and remove temporary access areas, work areas, and equipment and materials staging areas.
12. Implement general erosion and sedimentation control measures and associated monitoring and maintenance.
13. Implement Contractor and Owner-required health and safety monitoring and measures.
14. Implement noise control measures.
15. Provide all other labor, equipment, materials, subsistence, and related activities associated with daily operations.
16. Protect all existing equipment and facilities from damage due to construction activities.

B. BP-1 Task 1.2 – Temporary Facility (pumping/utilities excluding crane system) and Protection of Existing Equipment.

1. Includes all material, labor, equipment and supplies required for temporary pumping system at TDCS, temporary protection for shaft lining and temporary pumping system needed at South Basin as specified under Section 01500.

C. BP-1 Task 1.3 – Temporary Crane Systems.

1. Includes all material, labor, equipment and supplies required for temporary crane systems as specified under Section 01500.

D. BP-1 Task 1.4 – Relocation of Existing Utilities and Installation of Shaft Utilities (piping, electrical, instrumentation, electrical shed) at TDCS.

1. This item includes all work associated with removal, relocation and new permanent installation of site utilities at TDCS area.
2. Includes piping, electrical, instrumentation, control and PLC programming modification related to TDCS pumps (P-403, P-404 and P-405) and around TDCS area.
3. Includes underground piping from valve vault to an existing piping connection.

E. BP-1 Task 1.5 – Shaft Lining.

1. This item includes all work associated with installation of shaft lining inside TDCS shaft.

F. BP-1 Task 1.6 – Concrete Work Including Foundations, Slab, Vaults and Shaft Ring Wall.

1. This item includes all material, labor, equipment and supplies required for concrete construction for the access building foundations and associated components, jib crane foundation, valve vaults, shaft extension (including ring wall) and slab on grade.

G. BP-1 Task 1.7 – Sitework

1. This item includes all material, labor, equipment and supplies required for sitework at the TDCS site.

H. BP-1 Task 1.8 – Access Building Including Connection for Crane Rail.

1. This item includes all coordination, material, labor, equipment and supplies required to construct the access building and associated components.

I. BP-1 Task 1.9 – Permanent Cranes Including Crane Rails.

1. This item includes all coordination, material, labor, equipment and supplies required for 15 ton bridge crane and 5 ton jib crane and associated components.

BID PACK 2 – WTP AND NORTH BASIN AREA RELATED WORK

This section describes the general work required to complete Bid Pack 2 of the project. Tasks described are consistent with the bid items referenced in the Bid Proposal Form. Other details of the work are provided elsewhere in these technical specifications and are shown on the Drawings.

A. BP-2 Task 2.1 – Mobilization, Demobilization and Support Activities. This item includes all work performed before, during, and after the Bid Pack 2 construction phase. The work includes, but is not limited to, the following:

1. Attend all project meetings and/or conference calls.
2. Comply with all applicable federal, state, and local regulations and requirements.
3. Identify and acquire construction-related permits, and attend any required inspections.
4. Procure and coordinate subcontractors and equipment as necessary to perform the work.
5. Prepare submittals, work schedule, and other required documentation.
6. Provide all other office and administration services necessary to support the Contractor's activities for the duration of the project.
7. Mobilize and demobilize personnel, equipment, and materials to the work area.
8. Provide field trailers, shops, change houses, and other enclosures as required to complete the work and comply with regulations and requirements. (The Contractor does not need to provide office space or services for Owner's or NYSDEC's representatives).
9. Coordinate for and cover costs associated with the provision of electrical power, phones, water, and sewer hook-ups for field offices and facilities installed at the site, as necessary.
10. Provide, service, and maintain both male and female sanitary facilities for the duration of this construction phase.
11. Install, maintain, and remove temporary access areas, work areas, and equipment and materials staging areas to support this construction phase.
12. Implement general erosion and sedimentation control measures and associated monitoring and maintenance, not otherwise described and specified elsewhere, as required.
13. Implement Contractor and Owner-required health and safety monitoring and measures.
14. Implement noise control measures.
15. Provide all other labor, equipment, materials, subsistence, and related activities associated with daily operations.
16. Protect all existing equipment and facilities from damage due to construction activities.

B. BP-2 Task 2.2 – Temporary Pumping Facility

1. Includes all material, labor, equipment and supplies required for temporary pumping system at North Basin and temporary pumping system needed at South Basin during temporary North Basin pumping system as specified under Section 01500.

C. BP-2 Task 2.3 – DNAPL Separator and Related Work

1. Includes all material, labor, equipment and supplies required for a DNAPL separator and related platform, a feed tank and all mechanical and piping from separator to existing influent tanks.

D. BP-2 Task 2.4 – Modification at Rail Car Pit

1. Includes all material, labor, equipment and supplies required to modify an existing rail car pit including liner, transfer pump and all mechanical and piping from this pit to existing influent tanks.

E. BP-2 Task 2.5 – North Basin Rehabilitation/Improvement

1. Includes all material, labor, equipment and supplies required to rehabilitate existing North Basin including liner removal and replacement and coordination with Owner regarding structural inspection by the Engineer.

F. BP-2 Task 2.6 – RWS and TDCS Piping Modifications up to DNAPL Separator

1. Includes all material, labor, equipment and supplies required to modify eight existing recovery wells discharge piping and TDCS piping located in Building 1 thru 4A .

G. BP-2 Task 2.7 – North Basin Pumping/Piping and Piping Around Pre-Treatment Plant

1. Includes all material, labor, equipment and supplies required at North Basin including transfer pumps, shed and all mechanical and piping from this basin pit to existing piping around pre-treatment tanks (T-0100 thru T-0300).

H. BP-2 Task 2.8 – Improvement at Recovery Wells

1. Includes all material, labor, equipment and supplies related to various instruments and DNAPL pumping systems at five recovery wells.

2. Includes sheds at four recovery wells and associated concrete slab.

I. BP-2 Task 2.9 – Electrical, Instrumentation, Controls at WTP, RWs and NB.

1. Includes all material, labor, equipment and supplies required for electrical, instrumentation, control and programming modification work at WTP, North Basin and all recovery wells requiring modifications.

J. BP-2 Task 2.10 – Decommissioning of Pre-Treatment System and RW Piping

1. Includes all material, labor, equipment and supplies related to decommissioning of all process piping pre-treatment tanks and recovery wells.

END OF SECTION 01100

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. Coordination Drawings.

2. Administrative and supervisory personnel.

3. Project meetings.

4. Requests for Interpretation (RFIs).

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor. See Section 01750, Work Phase Description for additional information.

C. Related Sections include the following:

1. Section 01100 Summary of Work.

2. Section 01310 Construction Progress Documentation.

3. Section 01700 Execution Requirements.

4. Section 01770 Closeout Procedures.

1.3 DEFINITIONS

A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.4 COORDINATION

A. Coordination of Operations: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different sections, that depend upon each other for proper installation, connection, and operation.

B. Coordination with Other Contractors: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

2. Coordinate installation of different components with other Contractors to ensure maximum accessibility for required maintenance, service, and repair.

3. Make adequate provisions to accommodate items scheduled for later installation.

4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

C. Coordination Memoranda: Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other Contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.

2. Preparation of the Schedule of Values.

3. Installation and removal of temporary facilities and controls.

4. Delivery and processing of submittals.

5. Progress meetings.

6. Preinstallation conferences.

7. Project closeout activities.

8. Startup and adjustment of systems.

9. Project closeout activities.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1.5 SUBMITTALS

A. Coordination Drawings: Upon written request of the Construction Manager, prepare Coordination Drawings to address limited space availability and maximum utilization of space for efficient installation of different components or coordination required for installation of products and materials fabricated by separate entities.

1. Content: Project-specific information, drawn accurately to scale. Do not base Coordination Drawings on reproductions of the Contract Documents or standard printed data. Include the following information, as applicable:

    a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    b. Indicate required installation sequences.
    c. Indicate dimensions shown on the Contract Drawings and make specific note of dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Engineer/Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

2. Sheet Size: At least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 30 by 40 inches (750 by 1000 mm).

3. Number of Copies: Submit six opaque copies of each submittal.

4. Refer to individual Sections for Coordination Drawing requirements for Work in those Sections.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone. Keep list current at all times.

1.6 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

1.7 PROJECT MEETINGS

A. General: Attend and participate in meetings and conferences conducted at the Project site by the Construction Manager.

B. Preconstruction Conference: Attend a preconstruction conference organized by the Construction Manager before starting construction. The meeting will be scheduled at a time convenient to Owner**,** Construction Manager**,** Engineer/Architect, and Contractor but no later than 15 days after execution of the Agreement. Revise first subparagraph below to suit Project.

1. Items to be discussed at the Preconstruction Conference will include the following:

    a. Tentative construction schedule.

b. Phasing.
c. Critical work sequencing and long-lead items.
d. Designation of key personnel and their duties.
e. Procedures for processing field decisions and Change Orders.
f. Procedures for RFIs.
g. Procedures for testing and inspecting.
h. Procedures for processing Applications for Payment.
i. Distribution of the Contract Documents.
j. Submittal procedures.
k. LEED requirements.
l. Preparation of Record Documents.
m. Use of the premises and existing building.
n. Work restrictions.
o. Owner's occupancy requirements.
p. Responsibility for temporary facilities and controls.
q. Construction waste management and recycling.
r. Parking availability.
s. Office, work, and storage areas.
t. Equipment deliveries and priorities.
u. First aid.
v. Security.
w. Progress cleaning.
x. Working hours.

2. Minutes: Construction Manager will record and distribute meeting minutes.

C. Preinstallation Conferences: Attend preinstallation conferences organized by the Construction Manager, as may be required, at Project site before each construction activity that requires coordination with other construction.

1. Items to be addressed during the conferences include the following:

a. The Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility problems.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written recommendations.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.

t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

2. Minutes: Construction Manager will record and distribute conference minutes.

D. Progress Meetings: Attend weekly progress meetings conducted by the Construction Manager. The meetings will be coordinated with dates of payment requests.

1. The purpose of the weekly progress meetings will be to:

a. Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time. Review schedule for next period.
b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site utilization.
8) Temporary facilities and controls.
9) Work hours.
10) Hazards and risks.
11) Progress cleaning.
12) Quality and work standards.
13) Status of correction of deficient items.
14) Field observations.
15) RFIs.
16) Status of proposal requests.
17) Pending changes.
18) Status of Change Orders.
19) Pending claims and disputes.
20) Documentation of information for payment requests.

2. Minutes: Construction Manager will record and distribute to the meeting minutes.

1.8 REQUESTS FOR INTERPRETATION (RFIs)

A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at any project meeting, prepare and submit an RFI in the form specified to the Construction Manager.

1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.

2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:

1. Project name.

2. Date.

3. Name of Contractor.

4. Name of Engineer/Architect and Construction Manager.

5. RFI number, numbered sequentially.

6. Specification Section number and title and related paragraphs, as appropriate.

7. Drawing number and detail references, as appropriate.

8. Field dimensions and conditions, as appropriate.

9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.

10. Contractor's signature.

11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.

a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.

C. Hard-Copy RFIs: Use CSI Form 13.2A.

1. Identify each page of attachments with the RFI number and sequential page number.

D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

E. Engineer/Architect's and Construction Manager's Action: Engineer/Architect and Construction Manager will review each RFI, determine action required, and return it. Allow seven working days for Engineer/Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.

1. The following RFIs will be returned without action:

a. Requests for approval of submittals.
b. Requests for approval of substitutions.
c. Requests for coordination information already indicated in the Contract Documents.
d. Requests for adjustments in the Contract Time or the Contract Sum.
e. Requests for interpretation of Engineer/Architect's actions on submittals.
f. Incomplete RFIs or RFIs with numerous errors.

2. Engineer/Architect's action may include a request for additional information, in which case Engineer/Architect's time for response will start again.

3. Engineer/Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 1 Section "Contract Modification Procedures."

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Construction Manager in writing within seven days of receipt of the RFI response.

F. On receipt of Engineer/Architect's and Construction Manager's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Construction Manager within seven days if Contractor disagrees with response.

G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log on a monthly basis. Use CSI Log Form 13.2B. Include the following**:**

1. Project name.

2. Name and address of Contractor.

3. Name and address of Engineer/Architect and Construction Manager.

4. RFI number including RFIs that were dropped and not submitted.

5. RFI description.

6. Date the RFI was submitted.

7. Date Engineer/Architect's and Construction Manager's response was received.

8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01310

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Preliminary Construction Schedule.
2. Contractor's Construction Schedule.
3. Submittals Schedule.
4. Daily construction reports.
5. Material location reports.
6. Field condition reports.
7. Special reports.

B. Related Sections include the following:

1. Section 01100 Summary of Work.
2. Section 01310 Project Management and Coordination
3. Section 01300 Submittal Procedures.
4. Section 01400 Quality Requirements for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: Not applicable.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.

3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

H. Major Area: A story of construction, a separate building, or a similar significant construction element.

I. Milestone: A key or critical point in time for reference or measurement.

J. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

K. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 SUBMITTALS

A. Qualification Data: For scheduling consultant.

B. Submittals Schedule: Submit six copies of schedule. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.

2. Specification Section number and title.

3. Submittal category (action or informational).

4. Name of subcontractor.

5. Description of the Work covered.

6. Scheduled date for Engineer/Architect's and Construction Manager's final release or approval.

C. Preliminary Construction Schedule: Submit six opaque copies.

D. Preliminary Network Diagram: Submit three opaque copies, large enough to show entire network for entire construction period. Show logic ties for activities.

E. Contractor's Construction Schedule: Submit three opaque copies of initial schedule, large enough to show entire schedule for entire construction period.

1. Submit an electronic copy of schedule, using software indicated, on CD-R, and labeled to comply with requirements for submittals. Include type of schedule (Initial or Updated) and date on label.

F. CPM Reports: Concurrent with CPM schedule, submit three copies of each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.

2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.

3. Total Float Report: List of all activities sorted in ascending order of total float.

G. Daily Construction Reports: Submit three copies at weekly intervals.

H. Material Location Reports: Submit three copies at weekly intervals.

I. Field Condition Reports: Submit three copies at time of discovery of differing conditions.

J. Special Reports: Submit three copies at time of unusual event.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Owner's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to the Preliminary Construction Schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.

2. Verify availability of qualified personnel needed to develop and update schedule.

3. Discuss constraints, including work stages, area separations, interim milestones and partial Owner occupancy as applicable.

4. Review schedule for work of Owner's separate contracts.

5. Review time required for review of submittals and resubmittals.

6. Review requirements for tests and inspections by independent testing and inspecting agencies.

7. Review time required for completion and startup procedures.

8. Review and finalize list of construction activities to be included in schedule.

9. Review submittal requirements and procedures.

10. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.

2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.

2. Initial Submittal: Submit concurrently with preliminary network diagram. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

   a. At Contractor's option, show submittals on the Preliminary Construction Schedule, instead of tabulating them separately.

3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

B. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each work area or structural entity (e.g. Tunnel Segment 1, Room 1-2, etc.) a separate numbered activity. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Engineer/Architect.

2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.

4. Startup and Testing Time: Include not less than 30 days for startup and testing.

5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer/Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.

2. Work under More Than One Contract: Include a separate activity for each contract.

3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner, if any.

4. Products Ordered in Advance: Include a separate activity for each product. Delivery dates indicated stipulate the earliest possible delivery date.

5. Work Restrictions: Show the effect of the following items on the schedule:

   a. Coordination with existing construction.
   b. Limitations of continued occupancies.
   c. Uninterruptible services.
   d. Partial occupancy before Substantial Completion.
   e. Use of premises restrictions.
   f. Provisions for future construction.
   g. Seasonal variations.
   h. Environmental control.

6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

   a. Subcontract awards.
   b. Submittals.
   c. Purchases.
   d. Mockups.
   e. Excavation and support
   f. Fabrication.
   g. Sample testing.
   h. Deliveries.
   i. Installation.
   j. Tests and inspections.
   k. Adjusting.
   l. Curing.
   m. Startup and placement into final use and operation.

7. Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

   a. Structural completion.
   b. Permanent space enclosure.
   c. Completion of mechanical installation.
   d. Completion of electrical installation.
   e. Substantial Completion.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion**.**

F. Cost Correlation: Refer to Contract for cost reporting and payment procedures.

G. Contract Modifications: Refer to Contract.

2.3 PRELIMINARY CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within seven days of date established for commencement of the Work.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for commencement of the Work. Base schedule on the Preliminary Construction Schedule and whatever updating and feedback was received since the start of Project.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.

1. For construction activities that require 3 months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.5 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. Preliminary Network Diagram: Submit diagram within 14 days of date established for commencement of the Work. Outline significant construction activities for the first 60 days of construction.

C. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for commencement of the Work.

a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of approval of the schedule.

2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.

3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.

4. Use "one workday" as the unit of time. Include list of nonworking days and holidays incorporated into the schedule.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

   a. Preparation and processing of submittals.
   b. Mobilization and demobilization.
   c. Purchase of materials.
   d. Delivery.
   e. Fabrication.
   f. Excavation
   g. Utility interruptions.
   h. Installation.
   i. Work by Owner that may affect or be affected by Contractor's activities.
   j. Testing.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.

3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.

4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

   a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

E. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.

2. Description of activity.

3. Principal events of activity.

4. Immediate preceding and succeeding activities.

5. Early and late start dates.

6. Early and late finish dates.

7. Activity duration in workdays.

8. Total float or slack time.

9. Average size of workforce.

10. Dollar value of activity (coordinated with the Schedule of Values).

F. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.

2. Changes in early and late start dates.

3. Changes in early and late finish dates.

4. Changes in activity durations in workdays.

5. Changes in the critical path.

6. Changes in total float or slack time.

7. Changes in the Contract Time.

2.6 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.

2. List of separate contractors at Project site.

3. Approximate count of personnel at Project site.

4. Equipment at Project site.

5. Material deliveries.

6. High and low temperatures and general weather conditions.

7. Accidents.

8. Meetings and significant decisions.

9. Unusual events (refer to special reports).

10. Stoppages, delays, shortages, and losses.

11. Meter readings and similar recordings.

12. Emergency procedures.

13. Orders and requests of authorities having jurisdiction.

14. Change Orders received and implemented.

15. Construction Change Directives received and implemented.

16. Services connected and disconnected.

17. Equipment or system tests and startups.

18. Partial Completions and occupancies.

19. Substantial Completions authorized.

B. Material Location Reports: At weekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.

C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation on CSI Form 13.2A. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.7 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.

1. Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.

2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

B. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one day before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.

2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.

3. As the Work progresses, indicate Actual Completion percentage for each activity.

C. Distribution: Distribute copies of approved schedule to Engineer/Architect, Construction Manager, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.

2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01320

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. The Construction Manager will be responsible for all photographic documentations as listed below.

1. Preconstruction photographs.

2. Periodic construction photographs.

3. Final Completion construction photographs.

4. Preconstruction videotapes.

5. Periodic construction videotapes.

6. Time-lapse sequence construction videotapes

B. The Contractor may take additional photographs as deemed necessary.

END OF SECTION 01322

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Sections include the following:

1. Divisions 2 through 16 Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Engineer/Architect's and Construction Manager's responsive action.

B. Informational Submittals: Written information that does not require Engineer/Architect's and Construction Manager's responsive action.

1.4 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings will be provided by Engineer/Architect for Contractor's use in preparing submittals.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Engineer/Architect and Construction Manager reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
b. Processing Time: Allow a minimum of 2 weeks for submittal review, including time for resubmittals.

C. Identification: Place a permanent label or title block on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.

2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Engineer/Architect and Construction Manager.

3. Include the following information on label for processing and recording action taken:

a. Project name.
b. Date.
c. Name and address of Engineer/Architect and Construction Manager.
d. Name and address of Contractor.
e. Name and address of subcontractor.
f. Name and address of supplier.
g. Name and address of manufacturer.
h. Submittal number or other unique identifier, including revision identifier.

1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06100.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06100.01.A).

i. Number and title of appropriate Specification Section.
j. Drawing number and detail references, as appropriate.
k. Location(s) where product is to be installed, as appropriate.
l. Other necessary identification.

D. Deviations: Highlight or otherwise specifically identify deviations from the Contract Documents on submittals.

E. Additional Copies: Unless additional copies are required for final submittal, and unless Engineer/Architect or Construction Manager observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

1. Additional copies submitted for maintenance manuals will be marked with action taken and will be returned.

F. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form and addressed to Construction Manager. Construction Manager will then distribute them to Owner and/or Engineer/Architect appropriately. Construction Manager will discard submittals received from sources other than Contractor.

1. Transmittal Form: Provide locations on form for the following information:

a. Project name.
b. Date.
c. Destination (To:).
d. Source (From:).
e. Names of subcontractor, manufacturer, and supplier.
f. Category and type of submittal.
g. Submittal purpose and description.

h. Specification Section number and title.
i. Drawing number and detail references, as appropriate.
j. Transmittal number, numbered consecutively.
k. Submittal and transmittal distribution record.
l. Remarks.
m. Signature of transmitter.

2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Engineer/Architect and Construction Manager on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.

G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.

2. Note date and content of revision in label or title block and clearly indicate extent of revision.

3. Resubmit submittals until they are approved.

H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

I. Use for Construction: Use only final submittals that are approved.

1.5 CONTRACTOR'S USE OF ENGINEER/ARCHITECT'S CAD FILES

A. General: At Contractor's written request, copies of Engineer/Architect's CAD files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:

1. The Contractor shall use for this project only and shall not distribute it to any one else.

2. The Contractor shall destroy the file after completion of this project.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.

2. Mark each copy of each submittal to show which products and options are applicable.

3. Include the following information, as applicable:

   a. Manufacturer's written recommendations.
   b. Manufacturer's product specifications.
   c. Manufacturer's installation instructions.
   d. Standard color charts.
   e. Manufacturer's catalog cuts.
   f. Wiring diagrams showing factory-installed wiring.
   g. Printed performance curves.
   h. Operational range diagrams.
   i. Mill reports.
   j. Standard product operation and maintenance manuals.
   k. Compliance with specified referenced standards.
   l. Testing by recognized testing agency.
   m. Application of testing agency labels and seals.
   n. Notation of coordination requirements.

4. Submit Product Data before or concurrent with Samples.

5. Number of Copies: Submit six copies of Product Data, unless otherwise indicated. Two copies will be return. Mark up and retain one returned copy as a Project Record Document.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal of Engineer/Architect's CAD Drawings are otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

   a. Dimensions.
   b. Identification of products.
   c. Fabrication and installation drawings.
   d. Roughing-in and setting diagrams.
   e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
   f. Shopwork manufacturing instructions.
   g. Templates and patterns.
   h. Schedules.
   i. Design calculations.
   j. Compliance with specified standards.
   k. Notation of coordination requirements.
   l. Notation of dimensions established by field measurement.
   m. Relationship to adjoining construction clearly indicated.
   n. Seal and signature of professional engineer if specified.
   o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 40 inches.

3. Number of Copies: Submit six opaque (bond) copies of each submittal. Two copies will be returned. Mark up and retain one returned copy as a Project Record Drawing.

D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

2. Identification: Attach label on unexposed side of Samples that includes the following:

a. Generic description of Sample.
b. Product name and name of manufacturer.
c. Sample source.
d. Number and title of appropriate Specification Section.

3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer/Architect through Construction Manager, will return submittal with options selected.

5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit four sets of Samples. A minimum of two sets will be retained; remainder will be returned.

        1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
        2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least five sets of paired units that show approximate limits of variations.

E. Product Schedule or List: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product.

2. Number and name of room or space.

3. Location within room or space.

4. Number of Copies: Submit five copies of product schedule or list, unless otherwise indicated. Two copies will be returned.

    a. Mark up and retain one returned copy as a Project Record Document.

F. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.

2. Number and title of related Specification Section(s) covered by subcontract.

3. Drawing number and detail references, as appropriate, covered by subcontract.

4. Number of Copies: Submit five copies of subcontractor list, unless otherwise indicated. Two copies will be returned.

    a. Mark up and retain one returned copy as a Project Record Document.

2.2 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.

1. Number of Copies: Submit four copies of each submittal, unless otherwise indicated. No copies will be returned.

2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

B. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of Engineer/Architects and owners, and other information specified.

C. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

D. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

E. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

F. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

G. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

H. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

I. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

J. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

K. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

L. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

M. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1. Preparation of substrates.

2. Required substrate tolerances.

3. Sequence of installation or erection.

4. Required installation tolerances.

5. Required adjustments.

6. Recommendations for cleaning and protection.

N. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.

2. Statement on condition of substrates and their acceptability for installation of product.

3. Statement that products at Project site comply with requirements.

4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.

5. Results of operational and other tests and a statement of whether observed performance complies with requirements.

6. Statement whether conditions, products, and installation will affect warranty.

7. Other required items indicated in individual Specification Sections.

O. Insurance Certificates and Bonds: Refer to General Conditions.

P. Material Safety Data Sheets (MSDSs): Submit information directly to Construction Manager.

2.3 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer/Architect.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer/Architect and Construction Manager.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ENGINEER/ARCHITECT'S AND CONSTRUCTION MANAGER'S ACTION

A. General: Engineer/Architect and Construction Manager will not review submittals that do not bear Contractor's approval stamp and will return them without action.

1. Action Submittals: Engineer/Architect and/or Construction Manager will review each submittal, make marks to indicate corrections or modifications required, and return it. Engineer/Architect and/or Construction Manager will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.

B. Informational Submittals: Engineer/Architect and/or Construction Manager will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer/Architect and/or Construction Manager will forward each submittal to appropriate party.

C. Partial submittals are not acceptable, will be considered non-responsive, and will be returned without review.

D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01330

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.

2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.

3. Requirements for Contractor to provide quality-assurance and -control services required by Engineer/Architect, Owner, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections include the following:

1. Section 01320 Construction Progress Documentation

2. Divisions 2 through 16 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Engineer/Architect or Construction Manager.

C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples.

D. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.

E. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

G. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

J. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.

K. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of three previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Engineer/Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer/Architect for a decision before proceeding.

1.5 SUBMITTALS

A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.

B. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.

2. Description of test and inspection.

3. Identification of applicable standards.

4. Identification of test and inspection methods.

5. Number of tests and inspections required.

6. Time schedule or time span for tests and inspections.

7. Entity responsible for performing tests and inspections.

8. Requirements for obtaining samples.

9. Unique characteristics of each quality-control service.

D. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.

2. Project title and number.

3. Name, address, and telephone number of testing agency.

4. Dates and locations of samples and tests or inspections.

5. Names of individuals making tests and inspections.

6. Description of the Work and test and inspection method.

7. Identification of product and Specification Section.

8. Complete test or inspection data.

9. Test and inspection results and an interpretation of test results.

10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.

11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.

12. Name and signature of laboratory inspector.

13. Recommendations on retesting and reinspecting.

E. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE DEFINITIONS AND REQUIREMENTS

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersede building codes and regulations governing the Work.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented

according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.

2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

   a. Provide test specimens representative of proposed products and construction.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
   d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
   e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
   f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer/Architect, through Construction Manager, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Engineer/Architect or Construction Manager.

2. Notify Engineer/Architect and Construction Manager seven days in advance of dates and times when mockups will be constructed.

3. Demonstrate the proposed range of aesthetic effects and workmanship.

4. Obtain Engineer/Architect's and Construction Manager's approval of mockups before starting work, fabrication, or construction.

   a. Allow seven days for initial review and each re-review of each mockup.

5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

6. Demolish and remove mockups when directed, unless otherwise indicated.

K. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Sections in Divisions 2 through 16.

1.7 QUALITY CONTROL REQUIREMENTS

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.

2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

   a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least 48 hours in advance of time when Work that requires testing or inspecting will be performed.

3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.

4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.

5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation,

including service connections. Report results in writing as specified in Division 1 Section "Submittal Procedures."

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Testing Agency Responsibilities: Cooperate with Engineer/Architect**,** Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Engineer/Architect, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.

2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.

3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.

4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.

5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.

6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.

2. Incidental labor and facilities necessary to facilitate tests and inspections.

3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.

4. Facilities for storage and field curing of test samples.

5. Delivery of samples to testing agencies.

6. Preliminary design mix proposed for use for material mixes that require control by testing agency.

7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for commencement of the Work.

1. Distribution: Distribute schedule to Owner, Engineer/Architect, Construction Manager, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.

2. Description of the Work tested or inspected.

3. Date test or inspection results were transmitted to Engineer/Architect.

4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Engineer/Architect's and Construction Manager's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.

2. Comply with the Contract Document requirements for Division 1 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

Section 01400

Attachment "A" – Statement of Special Inspections

TETRA TECH ARCHITECTS & ENGINEERS	**STATEMENT OF SPECIAL INSPECTIONS**

Project: *GE Hudson Falls - TDCS Building*

Location: *Hudson Falls, NY*

Owner: *General Electric Company*

This *Statement of Special Inspections* is submitted as a condition for permit issuance in accordance with the Special Inspection and Structural Testing requirements of the Building Code of New York State. It includes a schedule of Special Inspection services applicable to this project. *Refer to individual technical specification sections for additional testing requirements*.

This document includes the following parts:

Qualifications of Inspectors and Testing Technicians

Schedule of Special Inspection Services

Statement of Responsibility

Each contractor responsible for the construction or fabrication of a system or component designated above must submit a Statement of Responsibility (Attached to this Section.)

Qualifications of Inspectors and Testing Technicians

The qualifications of all personnel performing Special Inspection and testing activities are subject to the approval of the Building Official. The credentials of all Inspectors and testing technicians shall be provided if requested.

Key for Minimum Qualifications of Inspection Agents:

When the Registered Design Professional in Responsible Charge deems it appropriate that the individual performing a stipulated test or inspection have a specific certification or license as indicated below, such designation shall appear below the *Qualifications* on the Schedule.

PE Structural Engineer – a licensed PE specializing in the design of building structures

PE/GE Geotechnical Engineer – a licensed PE specializing in soil mechanics and foundations

EIT Engineer-In-Training – a graduate engineer who has passed the Fundamentals of Engineering examination

American Concrete Institute (ACI) Certification

ACI-CFTT Concrete Field Testing Technician – Grade 1
ACI-CCI Concrete Construction Inspector
ACI-LTT Laboratory Testing Technician – Grade 1&2
ACI-STT Strength Testing Technician

American Welding Society (AWS) Certification

AWS-CWI Certified Welding Inspector
AWS/AISC-SSI Certified Structural Steel Inspector

American Society of Non-Destructive Testing (ASNT) Certification

ASNT Non-Destructive Testing Technician – Level II or III.

International Code Council (ICC) Certification

ICC-SMSI Structural Masonry Special Inspector
ICC-SWSI Structural Steel and Welding Special Inspector
ICC-SFSI Spray-Applied Fireproofing Special Inspector
ICC-PCSI Prestressed Concrete Special Inspector
ICC-RCSI Reinforced Concrete Special Inspector

National Institute for Certification in Engineering Technologies (NICET)

NICET-CT Concrete Technician – Levels I, II, III & IV
NICET-ST Soils Technician - Levels I, II, III & IV
NICET-GET Geotechnical Engineering Technician - Levels I, II, III & IV

Association of the Wall and Ceilings Industries International (AWCI)

AWCI 12-B Standard Practice for the Testing and Inspection of Field Applied Thin-Film Intumescent Fire-Resistive Materials; an Annotated Guide.

Schedule of Special Inspection Services

INSPECTION AND TESTING *("Continuous" & "Periodic" defined by the Code; refer to applicable Technical Specification Section for specific frequency requirements)*	**REQUIRED** (*Required if checked; Not Applicable if not* checked)	**TECHNICAL SPECIFICATION SECTION (***Refer to for additional information***)**	**Inspector Qualifications**	**CONTINUOUS**	**PERIODIC**
Soils					
1. Verify materials below footings are adequate to achieve the design bearing capacity	☒	02300	PE/GE	☐	☒
2. Verify excavations are extended to proper depth and have reached proper material	☒	02300	PE/GE	☐	☒
3. Perform classification and testing of controlled fill materials	☒	02300	NICET-ST II	☐	☒
4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of controlled fill	☒	02300	NICET-ST II	☒	☐
5. Prior to placement of controlled fill, observe subgrade and verify that site has been prepared properly	☒	02300	PE/GE	☐	☒
Pile Foundations					
1. Verify pile materials, sizes and lengths	☐	NA	PE/GE	☒	☐
2. Determine capacities of test piles and conduct additional load tests, as required	☐	NA	PE/GE	☒	☐
3. Observe driving operations and maintain complete and accurate records for each pile	☐	NA	PE/GE	☒	☐
4. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and document any pile damage	☐	NA	PE/GE	☒	☐
5. For steel piles, perform additional inspections in accordance with 1704.3	☐	NA	PE/GE	☐	☐
6. For concrete piles and concrete-filled piles, perform additional inspections in accordance with Section 1704.4	☐	NA	PE/GE	☐	☐
7. For specialty piles, perform additional inspections	☐	NA	PE/GE	☐	☐
8. For augered uncased piles and caisson piles, perform inspections in accordance with Section 1704.9	☐	NA	PE/GE	☐	☐
Pier Foundations					
1. Observe drilling operations and maintain complete and accurate records for each pier	☐	NA	PE/GE	☒	☐
2. Verify placement locations and plumbness, confirm pier diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable), and adequate end bearing strata capcity	☐	NA	PE/GE	☒	☐
3. For concrete piers, perform additional inspections in accordance with Section 1704.4	☐	NA	PE/GE	☐	☐
4. For masonry piers, perform additional inspections in accordance with Section 1704.5	☐	NA	PE/GE	☐	☐
Cast-in-Place Concrete					
1. Inspection of reinforcing steel	☒	03300	ACI-CCI or ICC-RCSI	☐	☒
2. Inspection of reinforcing steel welding: See Steel schedule, item 5. b.	☐	03300	AWS-CWI	☐	☐
3. Inspection of bolts to be installed in concrete prior to and during placement	☒	03300	ACI-CCI or ICC-RCSI	☒	☐
4. Verify use of required design mix	☒	03300	ACI-CCI or ICC-RCSI	☐	☒
5. Sampling fresh concrete for fabricating specimens for strength	☒	03300	ACI-CFTT	☒	☐

testing, perform slump and air content tests, and measure temperature of concrete			ACI-STT		
6. Inspection of concrete and shotcrete placement for proper application techniques	☒	03300	ACI-CCI or ICC-RCSI	☒	☐
7. Inspection for maintenance of specified curing temperature and techniques	☒	03300	ACI-CCI or ICC-RCSI	☐	☒
8. Verification of in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs	☒	03300	ACI-CCI or ICC-RCSI	☐	☒
9. Inspection of formwork for shape, location and dimensions of the concrete member being formed	☒	03300	ACI-CCI or ICC-RCSI	☐	☒
10. Inspection of post-tensioning operations	☐	NA	ICC-PCSI	☒	☐
Precast Concrete					
1. Inspection of reinforcing steel	☐	NA	ACI-CCI or ICC-RCSI	☐	☒
2. Verify use of required design mix	☐	NA	ACI-CCI or ICC-RCSI	☐	☒
3. Inspection of prestressed operations					
a. Application of prestressing forces	☐	NA	ICC-PCSI	☒	☐
b. Grouting of bonded prestressing tendons in the seismic-force-resisting system	☐	NA	ICC-PCSI	☒	☐
4. Sampling fresh concrete; slump, air content, temperature, strength test specimens	☐	NA	ACI-CFTT ACI-STT	☒	☐
5. Inspection of formwork for shape, location and dimensions of the concrete member being formed	☐	NA	ACI-CCI or ICC-RCSI	☐	☒
6. Inspection of concrete placement for proper application techniques	☐	NA	ACI-CCI or ICC-RCSI	☒	☐
7. Inspection for maintenance of specified curing temperature and techniques	☐	NA	ACI-CCI or ICC-RCSI	☐	☒
8. Erection of precast concrete members	☐	NA	PE	☐	☒

Masonry					
1. Verify to ensure compliance: a. Proportions of site prepared mortar and grout	☐	NA	ICC-SMSI	☐	☒
b. Placement of masonry units and construction of mortar joints	☐	NA	ICC-SMSI	☐	☒
c. Location and placement of reinforcement, connectors, and anchorages	☐	NA	ICC-SMSI	☐	☒
2. Inspection shall verify: a. Size and location of structural elements	☐	NA	ICC-SMSI	☐	☒
b. Type, size and location of anchors including anchorage of masonry to other structural materials	☐	NA	ICC-SMSI	☐	☒
c. Specified size, grade and type of reinforcement	☐	NA	ICC-SMSI	☐	☒
d. Welding of reinforcing bars	☐	NA	AWS-CWI	☒	☐
e. Cold/hot weather protection of masonry construction	☐	NA	ICC-SMSI	☐	☒
3. Inspection prior to grouting: Grout space is clean, placement of reinforcement, grout proportions verified, and proper mortar joint construction.	☐	NA	ICC-SMSI	☐	☒
4. Grout placement	☐	NA	ICC-SMSI	☒	☐
5. Observe preparation of grout specimens, mortar specimens and/or prisms	☐	NA	ICC-SMSI	☒	☐
6. Compliance with documents and submittals	☐	NA	ICC-SMSI	☐	☒

Structural Steel					
1. Material verification of high-strength bolts, nuts, and washers: Identification markings to conform to ASTM standards specified in the approved construction documents	☒	05120	AWS/AISC-SSI or ICC-SWSI	☐	☒
2. Inspection of high-strength bolting:					
a. Bearing-type connections	☒	05120	AWS/AISC-SSI or ICC-SWSI	☐	☒
b. Slip-critical connections	☐	NA	AWS/AISC-SSI or ICC-SWSI	☒	☒
3. Material verification of structural steel: Identification markings to conform to ASTM standards specified in the approved construction documents	☐	NA	AWS/AISC-SSI or ICC-SWSI	☐	☐
4. Material verification of weld filler materials: Identification markings to conform to ASTM standards specified in the approved construction documents	☒	05120	AWS-CWI	☐	☒
5. Inspection of welding: a. Structural steel:					
1) Penetration groove welds	☒	05120	AWS-CWI ASNT	☒	☐
2) Multipass fillet welds	☐	NA	AWS-CWI ASNT	☒	☐
3) Single-pass fillet welds > 5/16”	☐	NA	AWS-CWI ASNT	☒	☐
4) Single-pass fillet welds ≤ 5/16”	☒	05120	AWS-CWI ASNT	☐	☒
5) Floor and roof deck welds	☒	05310	AWS-CWI	☐	☒
b. Reinforcing steel:					
1) Verification of ASTM A 706 material	☐	NA	AWS-CWI	☐	☒
2) Testing of resisting flexural and axial forces in intermediate and special moment frames, and boundary elements of special reinforced concrete shear walls and shear reinforcement	☐	NA	AWS-CWI	☒	☐
3) Shear reinforcement	☐	NA	AWS-CWI	☒	☐
4) Other reinforcing steel	☐	NA	AWS-CWI	☐	☒
6. Inspection of steel frame joint details for compliance with approved construction documents:	☒	05120	AWS/AISC-SSI or ICC-SWSI	☐	☒
a. Details such as bracing and stiffening	☒	05120	AWS/AISC-SSI or ICC-SWSI	☐	☒
b. Member locations	☒	05120	AWS/AISC-SSI or ICC-SWSI	☐	☒
c. Application of joint details at each connection	☒	05120	AWS/AISC-SSI or ICC-SWSI	☐	☒
Structural Wood					
1. Fabrication of prefabricated wood structural elements and assemblies	☐	NA	PE/EIT	☐	☐
2. High-load diaphragms: Sheathing material grade and thickness, size of framing members at panel edges, fastener diameter and length, fastener layout and spacing	☐	NA	PE/EIT	☐	☐

Sprayed Fire-resistant Materials					
1. Structural member surface conditions	☐	NA	ICC-SFSI	☐	☐
2. Application	☐	NA	ICC-SFSI	☐	☐
3. Thickness	☐	NA	ICC-SFSI	☐	☐
4. Density	☐	NA	ICC-SFSI	☐	☐
5. Bond strength	☐	NA	ICC-SFSI	☐	☐
Intumescent Fire-resistant Coatings					
1. Inspection in accordance with AWCI 12-B	☐	NA	Per AWCI 12-B	☐	☐
Seismic Resistance Inspections					
1. Structural steel: Welding inspection in accordance with AISC 341	☒	NA	PE	☒	☐
2. Structural wood, seismic-force-resisting systems:					
a. Inspection of gluing operations.	☐	NA	PE	☒	☐
b. Inspection of fastening	☐	NA	PE	☐	☒
3. Cold-formed steel framing: Inspection of welding operations and fastening of seismic-force-resisting systems	☐	NA	PE	☐	☒
4. Pier foundations:					
a. Inspection during placement of reinforcement	☒	NA	PE	☐	☒
b. Inspection during placement of concrete	☒	NA	PE	☒	☐
5. Architectural components	☐	NA	PE	☒	☐
6. Mechanical and electrical components:					
a. Inspection of anchorage of electrical equipment for emergency power systems	☐	NA	PE	☐	☒
b. Inspection of anchorage installation or other electrical equipment	☐	NA	PE	☐	☒
c. Inspection of installation of piping systems and associated equipment carrying flammable, combustible, or highly toxic materials	☐	NA	PE	☐	☒
d. Inspection of installation of ductwork that will contain hazardous materials	☐	NA	PE	☐	☒
e. Inspection of installation vibration isolation systems	☐	NA	PE	☐	☒
7. Inspection of Designated Seismic Systems requiring Seismic Qualification (see below): Verify label, anchorage or mounting conforms to certificate of compliance	☒	NA	PE	☐	☐
8. Seismic isolation system: Inspection during fabrication and installation or isolator units and energy dissipation devices that are part of the seismic isolation system	☐	NA	PE	☐	☒

Seismic Resistance Structural Testing					
1. Masonry:					
a. Certificates of compliance used in masonry construction	☐	NA		☐	☐
b. Verification of f'_m and f'_{AAC} prior to construction	☐	NA		☐	☐
c. Verification of proportions of materials in mortar and grout as delivered to site	☐	NA		☐	☐
2. Testing for seismic resistance:					
a. Reinforcing and prestressing steel: Certified mill test reports for each shipment used to resist flexural, shear and axial forces in reinforced concrete intermediate frames, special moment frames and boundary elements of special reinforced concrete or reinforced masonry shear walls	☐	NA		☐	☐
b. Structural steel: Testing required by AISC 341 and additional testing required by IBC 1708.4	☐	NA		☐	☐
c. Seismic qualification of mechanical and electrical equipment: Certificate of compliance from manufacturer for Contract Document designated seismic systems for anchorage, mounting per IBC 1708.5	☐	NA		☐	☐
d. Seismically isolated structures: Testing per ASCE 7, Section 17.8	☐	NA		☐	☐

Section 01400

Attachment "B" – Statement of Special Inspections

TETRA TECH ARCHITECTS & ENGINEERS	**CONTRACTOR'S STATEMENT OF RESPONSIBILITY**

Each contractor responsible for the construction or fabrication of a system or component designated in the in the description of systems or components below must submit a Statement of Responsibility.

Project: GE Hudson Falls Plant Site – TDCS Phase 4 Design

Contractor's Name:

Address:

License No.:

Description of designated building systems and components included in the Statement of Responsibility: Metal building system seismic force resisting system. Coordinate with specification section 13340.

Contractor's Acknowledgment of Special Requirements

I hereby acknowledge that I have received, read, and understand the Quality Assurance Plan and Special Inspection program.

I hereby acknowledge that control will be exercised to obtain conformance with the construction documents approved by the Building Official.

_____ _____
Signature Date

Contractor's Provisions for Quality Control

Procedures for exercising control within the contractor's organization, the method and frequency of reporting and the distribution of reports is attached to this Statement.

Identification and qualifications of the person(s) exercising such control and their position(s) in the organization are attached to this Statement.

CASE Form 103 • Contractor's Statement of Responsibility • ©CASE 2004

END OF SECTION 01400

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Sections include the following:

1. Divisions 2 through 16 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.3 DEFINITIONS

A. Not used.

1.4 USE CHARGES

A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to Owner, Engineer/Architect, Construction Manager, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer service use charges for sewer usage by all entities for construction operations.

C. Water Service: Pay water service use charges for water used by all entities for construction operations.

D. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

1.5 SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Submit shop drawings, descriptions, and a work plan narrative of the proposed temporary systems at TDCS and North Basin including, but not limited to, equipment, methods, standby equipment and power supply; and instrumentation layouts. A schedule of installation and details of the system operation shall also be submitted. A contingency plan and options shall also be submitted. Submittal may take into consideration that TDCS pumping system must be operational on a continuous basis and that the North Basin cleanup can be subject to a storm event. Resubmit as appropriate if this plan is modified during installation or operation.

C. Submit site plans showing proposed location of Owner supplied roll-off container(s).

1.6 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.7 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.76-mm-) thick, galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top rails.

B. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 9-gage, galvanized steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide concrete bases for supporting posts.

C. Wood Enclosure Fence: Plywood, 6 feet (1.8 m) high, framed with four 2-by-4-inch (50-by-100-mm) rails, with preservative-treated wood posts spaced not more than 8 feet (2.4 m) apart.

D. Lumber and Plywood: Comply with requirements in Division 6 Section “Miscellaneous Carpentry."

E. Gypsum Board: Minimum 1/2 inch (12.7 mm) thick by 48 inches (1219 mm) wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C 36/C 36M.

F. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

G. Paint: Comply with requirements in Division 9 painting Sections.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.

2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

2.4 TEMPORARY PUMPING SYSTEM AT TDCS

A. Contactor shall provide and maintain a temporary pumping system to pump all construction water and groundwater that enters the TDCS Sump from shafts and tunnels during the shaft lining work and maintain system until the owner's pumping system is returned to service, re-commissioned and accepted by Owner.

B. The pumping system shall be sized to provide the sustained operating capacities plus any extra capacity required to handle Contractor-supplied water and any fire protection. Disposal of this construction water shall only be to existing Owner piping system and water treatment plant.

C. Coordinate with the Owner regarding the status and changes to the existing and temporary pumping systems. Existing pumping system can be shut down for a maximum of 8 hours for tie-ins. This will require advance planning and coordinate with WTP Operator.

D. Coordinate with Owner regarding all chemicals, including decontamination wash materials that may be introduced by Contractor into system. Use only Owner approved chemicals so as to avoid contaminating the Owner’s treatment system with chemicals that are incompatible with the treatment process.

E. The contractor shall use the existing concrete sump (22 ft diameter by 10 ft deep) located at the bottom of the shaft and shall size the temporary system for shaft and tunnel groundwater minimum inflow rate of 40 gpm and maximum inflow rate of 300 gpm. The

pump system shall be capable of handling water at a capacity sufficient to prevent overtopping of the existing shaft sump rim elevation 24' MSL.

F. The temporary pumping system shall transfer the water in at-grade (elevation ~234' MSL) storage/solid separation weir tank via temporary hoses or existing piping. The tank shall have a minimum capacity of 18,000 gallon. This pump shall operate in Auto mode based on TDCS shaft water level and weir tank level. A high water alarm at weir tank shall be provided and transmitted to WTP via existing signals (TBD).

G. Provide another pumping system at weir tank to transfer water from weir tank to North Basin via an existing piping system located in utility tunnel. The connection point is at grade near the corner of John St and Allen St. This pump shall operate in Auto mode based on weir tank level and North Basin water level.

H. Provide emergency overflow capability in weir tank and connect piping to outlet into existing South Basin and include a wye and valves and a pump in the South Basin so that water can be pumped back to weir tank.

I. A temporary pumping system at South basin will be needed as described in paragraph 2.8.

J. All temporary tanks, hoses and pipes shall have secondary containment system.

K. Clean sediment from weir tank as needed and dispose into Owner provided roll-off container. Stabilize wet sediment to an acceptable dry consistency (no free water) by mixing with Portland cement. Owner will dispose of roll-off containing stabilized material.

L. Decontaminate weir tank in Owner decon pad as necessary to attain surface with no more than 10 micro grams per 100 square centimeters as sampled and tested by Owner. Use only chemicals approved by Owner for decontamination.

2.5 TEMPORARY CRANES AND HOISTING SYSTEM

A. The contractor shall provide necessary cranes and personnel hoisting systems including personnel cages and work platforms needed to complete the work inside the TDCS shaft.

B. Provide two cranes and two personnel lifts and labor including two crane operators, one topside signalman and one bottom signalman for all worker entry into the TDCS shaft.

C. This work shall in accordance with GE Crane Safety manual, GE Confined Space Manual and applicable OSHA Standards.

2.6 TEMPORARY PROTECTION DURING TDCS SHAFT LINING

A. The contractor shall protect existing equipment, piping and electrical panels located at the base of TDCS shaft during the shaft lining and utility work in the TDCS shaft. Protective structural covers shall be installed prior to shaft lining work and removed when shaft work is complete.

B. Efforts shall be made to prevent concrete/shotcrete material entering the TDCS trenches/sump. The contractor shall be responsible for cleaning the protective covers, bell-out floor, trenches and TDCS sump should this material enter TDCS pumping system.

2.7 TEMPORARY PUMPING SYSTEM AT NORTH BASIN

A. This system will be needed once new DNAPL separator is online and the North Basin is ready for cleanup. This pumping system shall be operated and maintained until the proposed pumping system at North Basin is ready for operation.

B. Coordinate with the Owner regarding the status and changes to the existing and temporary pumping systems.

C. The contactor shall provide temporary plug at an existing manhole in a pipe discharging to North Basin and a temporary pumping system to pump all stormwater coming in this manhole from buildings 1 thru 4A roofs to South Basin via an overland piping system. This pump shall operate in Auto mode based manhole water level and South Basin water level. South Basin capacity is about 148,000 gallons.

D. A temporary pumping system at South basin will also be needed as described below.

E. Expected instantaneous peak flow at this location can vary greatly (5,000 gpm during a 10-year storm to >8,000 gpm during a 100-year storm). Thus North Basin cleanup activities will require a careful planning.

F. All temporary hoses and pipes shall have secondary containment system.

2.8 TEMPORARY PUMPING SYSTEMS AT SOUTH BASIN

A. As long as the temporary pumping system at TDCS area (as described above) is in operation, a temporary pumping system at South Basin will be provided and maintained. This pump will pump water from South Basin to the temporary weir tank. This pump shall operate in Auto mode based on South Basin level and weir tank level.

B. As long as the temporary pumping system at North Basin is in operation (as described above), a temporary pumping system at South basin will be needed to pump the water back to WTP at a maximum rate of 100 gpm via an existing piping system located in utility tunnel. The connection point is at grade near the corner of John St and Allen St. This pump shall operate in Auto mode based on South Basin level and a feed tank level (located at WTP).

C. Coordinate with the Owner regarding the status and changes to the existing and temporary pumping systems.

D. E. All temporary hoses and pipes shall have secondary containment system.

2.9 TDCS SHAFT VENTILATION SYSTEM

A. Provide temporary ventilation system for TDCS Shaft work to supply adequate air flow for work in the shaft in accordance with OSHA Standards and GE Confined Space Manual.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction or connect to existing service if adequate.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service underground, unless otherwise indicated.

F. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

3.3 REMOVAL & RELOCATION OF AN ELECTRICAL SHED AT TDCS

A. Provide temporary electrical and control wiring connections as required to maintain the operation of the TDCS system and communication with the water treatment plant while the existing electrical shed is removed, relocated and rewired. Temporary system should remain in place until testing and complete functionality is restored thru the electrical shed.

3.4 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines. Comply with NFPA 241.

2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Division 2 Section "Earthwork."

3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.

4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Division 2 Section "Hot-Mix Asphalt Paving."

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.

2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Provide temporary parking areas for construction personnel.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.

2. Remove snow and ice as required to minimize accumulations.

F. Project Identification and Temporary Signs: Provide Project identification and other signs as indicated on Drawings. Install signs where indicated to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.

1. Provide temporary, directional signs for construction personnel and visitors.

2. Maintain and touch up signs so they are legible at all times.

G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 1 Section "Execution Requirements" for progress cleaning requirements and the Materials Management Plan.

H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

I. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

J. Temporary Use of Permanent Stairs: Cover finished, permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of acceptance.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Division 1 Section "Summary."

2. Comply with the project Materials Management Plan.

B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

1. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.

F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

1. Extent of Fence: As indicated on Drawings.

2. Maintain security by limiting number of keys and restricting distribution to authorized personnel.

G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

H. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

I. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.

1. Prohibit smoking in hazardous fire-exposure areas.

2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.

3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor.

2. Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 1 Section "Closeout Procedures" and project Materials Management Plan."

END OF SECTION 01500

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.

B. Related Sections include the following:

1. Section 01300 Submittal Procedure

2. Section 01770 Closeout Procedures.

3. Divisions 2 through 16 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.

2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.

3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.4 SUBMITTALS

A. Product List: Submit a list, in tabular form, showing named or generic products as called out in the Contract Documents. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.

1. Coordinate product list with Construction Schedule and the Submittals Schedule.

2. Form: Tabulate information for each product under the following column headings:

a. Specification Section number and title.
b. Generic name used in the Contract Documents.
c. Proprietary name, model number, and similar designations.
d. Manufacturer's name and address.
e. Supplier's name and address.
f. Installer's name and address.
g. Projected delivery date or time span of delivery period.
h. Identification of items that require early submittal approval for scheduled delivery date.

3. Initial Submittal: Within 30 days after date of commencement of the Work, submit six copies of initial product list. Include a written explanation for omissions of data and for variations from Contract requirements.

a. At Contractor's option, initial submittal may be limited to product selections and designations that must be established early in Contract period.

4. Completed List: Within 60 days after date of commencement of the Work, submit six copies of completed product list. Include a written explanation for omissions of data and for variations from Contract requirements.

5. Engineer/Architect's Action: Engineer/Architect will respond in writing to Contractor within 15 days of receipt of completed product list. Engineer/Architect's response will include a list of unacceptable product selections and a brief explanation of reasons for this action. Engineer/Architect's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.

B. Substitution Requests: Submit six copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use CSI Form 13.1A.

2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

    a. Statement indicating why specified material or product cannot be provided.
    b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
    c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
    d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    e. Samples, where applicable or requested.
    f. List of similar installations for completed projects with project names and addresses and names and addresses of Engineer/Architects and owners.
    g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
    i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
    j. Cost information, including a proposal of change, if any, in the Contract Sum.
    k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
    l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Engineer/Architect's Action: If necessary, Engineer/Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Engineer/Architect will notify Contractor through Construction Manager of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

    a. Form of Acceptance: Change Order.
    b. Use product specified if Engineer/Architect cannot make a decision on use of a proposed substitution within time allocated.

C. Comparable Product Requests: Submit six copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Engineer/Architect's Action: If necessary, Engineer/Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Engineer/Architect will notify Contractor through Construction Manager of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

a. Form of Approval: As specified in Division 1 Section "Submittal Procedures."
b. Use product specified if Engineer/Architect cannot make a decision on use of a comparable product request within time allocated.

D. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products, installation procedures, and construction methods compatible with products and construction methods of other contractors.

2. If a dispute arises between contractors over concurrently selectable but incompatible products, Engineer/Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.

2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.

3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.

4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.

2. Store materials in a manner that will not endanger Project structure.

3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.

4. Store cementitious products and materials on elevated platforms.

5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.

6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.

7. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

A. Product warranties specified in other Sections shall be in addition to, and run concurrent with, general project warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.

2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.

3. Refer to Divisions 2 through 16 Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.

2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

4. Where products are accompanied by the term "as selected," Engineer/Architect will make selection.

5. Where products are accompanied by the term "match sample," sample to be matched is Engineer/Architect's.

6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.

2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.

3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.

4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.

5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.

6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.

7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.

8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.

9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Engineer/Architect's sample. Engineer/Architect's decision will be final on whether a proposed product matches.

    a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 2 "Product Substitutions" Article for proposal of product.

10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product that complies with other specified requirements.

    a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Engineer/Architect will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
    b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Engineer/Architect will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

A. Timing: Engineer/Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Engineer/Architect.

B. Conditions: Engineer/Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer/Architect will return requests without action, except to record noncompliance with these requirements:

1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Engineer/Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.

2. Requested substitution does not require extensive revisions to the Contract Documents.

3. Requested substitution is consistent with the Contract Documents and will produce indicated results.

4. Substitution request is fully documented and properly submitted.

5. Requested substitution will not adversely affect Contractor's Construction Schedule.

6. Requested substitution has received necessary approvals of authorities having jurisdiction.

7. Requested substitution is compatible with other portions of the Work.

8. Requested substitution has been coordinated with other portions of the Work.

9. Requested substitution provides specified warranty.

10. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

2.3 COMPARABLE PRODUCTS

A. Conditions: Engineer/Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer/Architect will return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.

2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

3. Evidence that proposed product provides specified warranty.

4. List of similar installations for completed projects with project names and addresses and names and addresses of Engineer/Architects and owners, if requested.

5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01600

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.

2. Field engineering and surveying.

3. General installation of products.

4. Progress cleaning.

5. Starting and adjusting.

6. Protection of installed construction.

7. Correction of the Work.

B. Related Sections include the following:

1. Section 01310 Project Management and Coordination.

2. Section 01300 Submittal Procedures.

3. Section 01400 Quality Requirements

4. Section 01700 Execution Requirements

5. Section 01770 Closeout Procedures.

1.3 SUBMITTALS

A. Qualification Data: New York State Registrations for registered land surveyor and licensed professional engineer used on this project.

B. Certificates: Submit certificate signed by registered professional certifying that location and elevation of improvements comply with requirements.

1.4 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, mechanical and electrical systems, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence of such features and all other conditions affecting affecting the Work, including construction performed and features installed under previous construction Phases.

1. Before construction, verify the location and points of connection of utility services.

B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.

2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

a. Description of the Work.
b. List of detrimental conditions, including substrates.
c. List of unacceptable installation tolerances.
d. Recommended corrections.

2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.

5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Construction Manager that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer/Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests on CSI Form 13.2A, "Request for Interpretation**."**

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks, and facilities installed under prior construction Phases. If discrepancies are discovered, notify Construction Manager promptly.

B. General: Engage a registered land surveyor to lay out the Work using accepted surveying practices for both conventional building and underground construction.

1. Establish benchmarks and control points to set lines and levels at ground surface and at all other levels at which work will be performed, both above and below existing ground surface as needed to locate each element of Project.

2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.

3. Inform installers of lines and levels to which they must comply.

4. Check the location, level and plumb, of every major element as the Work progresses.

5. Notify Construction Manager when deviations from required lines and levels exceed allowable tolerances.

6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

D. Shafts and Tunnels: Locate and layout control lines and benchmarks for shaft extension.

E. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

F. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer/Architect and Construction Manager.

3.4 FIELD ENGINEERING

A. Identification: Contract drawings identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Engineer/Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer/Architect and Construction Manager before proceeding.

2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.

3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of shaft and tunnel excavations, sump and foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.

2. Ensure lines and grades of shaft and tunes meet the limits and tolerances indicated on the Drawings and in the Specifications.

3. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.

4. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer/Architect.

2. Allow for building movement, including thermal expansion and contraction.

3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.

2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).

3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.

2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01700

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Inspection procedures.

2. Warranties.

3. Final cleaning.

B. Related Sections include the following:

1. Section 01100 for specific closeout and special cleaning requirements for the Work.

2. Section 01322 Photographic Documentation.

3. Section 01700 Execution Requirements.

4. Section 01781 Project Record Documents.

1.3 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.

2. Advise Owner of pending insurance changeover requirements.

3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.

5. Prepare and submit Project Record Documents, operation and maintenance manuals, and similar final record information.

6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.

7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.

8. Complete startup testing of systems.

9. Submit test/adjust/balance records.

10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.

11. Advise Owner of changeover in heat and other utilities.

12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

13. Complete final cleaning requirements, including touchup painting.

14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Engineer/Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer/Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer/Architect, that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."

2. Submit certified copy of Engineer/Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer/Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Engineer/Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer/Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.

2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

3. Include the following information at the top of each page:

a. Project name.
b. Date.
c. Name of Engineer/Architect and Construction Manager.
d. Name of Contractor.
e. Page number.

1.6 WARRANTIES

A. Submittal Time: Submit written warranties on request of Engineer/Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.

2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

h. Sweep concrete floors broom clean in unoccupied spaces.
i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.
l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.

1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

m. Wipe surfaces of mechanical and electrical equipment**,** elevator equipment**,** and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Replace parts subject to unusual operating conditions.
o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
q. Clean ducts, blowers, and coils if units were operated without filters during construction.
r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
s. Leave Project clean and ready for occupancy.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION 01770

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.

B. Related Sections include the following:

1. Divisions 2 through 16 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

A. Record Documents: Comply with the following:

1. Number of Copies: Submit one set of marked-up Record Prints.

2. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal: Submit one set of corrected Record plots and one set of marked-up Record Prints. Engineer/Architect will initial and date each plot and mark whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
b. Final Submittal: Submit one set of marked-up Record Prints, one set of Record CAD Drawing files, one set of Record CAD Drawing plots, and five copies printed from record plots. Plot and print each Drawing, whether or not changes and additional information were recorded.

1) Electronic Media: CD-R.

3. All applicable Submittals required as per Section 01330.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of black-line white prints of the Contract Drawings and Shop Drawings.

1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Accurately record information in an understandable drawing technique.
c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations below first floor.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order or Construction Work Change Directive.
k. Changes made following Engineer/Architect's written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.

4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

5. Mark important additional information that was either shown schematically or omitted from original Drawings.

6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record CAD Drawings: Immediately before inspection for Certificate of Substantial Completion, review marked-up Record Prints with Engineer/Architect and Construction Manager. When authorized, prepare a full set of corrected CAD Drawings of the Contract Drawings, as follows:

1. Format: Same CAD program, version, and operating system as the original Contract Drawings.

2. Format: DWG, Version 15, operating in Microsoft Windows operating system.

3. Incorporate changes and additional information previously marked on Record Prints. Delete, redraw, and add details and notations where applicable.

4. Refer instances of uncertainty to Engineer/Architect through Construction Manager for resolution.

5. Engineer/Architect will furnish Contractor one set of CAD Drawings of the Contract Drawings for use in recording information.

   a. Engineer/Architect makes no representations as to the accuracy or completeness of CAD Drawings as they relate to the Contract Drawings.
   b. CAD Software Program: The Contract Drawings are available in AutoCAD version 15 program and Microsoft Windows operating system.

C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing Record Drawings where Engineer/Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.

1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.

2. Consult Engineer/Architect and Construction Manager for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared Record Drawings into Record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

D. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

2. Record CAD Drawings: Organize CAD information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each CAD file.

3. Identification: As follows:

   a. Project name.
   b. Date.
   c. Designation "PROJECT RECORD DRAWINGS."
   d. Name of Engineer/Architect and Construction Manager.
   e. Name of Contractor.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Engineer/Architect's and Construction Manager's reference during normal working hours.

3.2 SCHEDULE

A. Record Documents must be completed and delivered to Construction Manager with 45 days of substantial completion.

END OF SECTION 01781

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Erosion, sediment and pollution controls as shown on the Drawings and as directed by the Architect to significantly reduce runoff on downstream properties. This includes temporary control measures to mitigate land disruption by other contractors during construction of this project.

2. Erosion, sediment and pollution control includes, but is not limited to, the following:

   a. Standard control measures such as storm structure protection, silt fence, silt fence dikes, and rip rap.
   b. Off site sediment tracking controls.
   c. Sedimentation basin.
   d. Seeding, sodding, and rolled erosion control matting.
   e. Rock check dam, sediment trap and detention basin with weir.
   f. Temporary protection for existing vegetation.
   g. Clean up.

3. Comply with the Stormwater Pollution Prevention Plan (SWPPP) for this Project in consultation with appropriate local agencies and soil conservation service. *Any local or State Agency requirements are considered part of these specifications.*

1.3 CODE COMPLIANCE

A. The New York State Department of Environmental Conservation (NYSDEC) requires a SPDES General Permit for Storm Water Discharges from Construction Activity that disturbs 1 acre of land or more. This Permit GP-0-10-001 is pursuant to the Environmental Conservation Law and has penalties and fines related to violations.

1.4 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this section concurrently.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product listed.

1. Filter fabric and hardware cloth for storm structure protection.
2. Drop-in Inlet protection.
3. Silt fence and silt fence dikes.
4. Soil separation fabric for off site sediment tracking control.
5. Rolled Erosion Control Matting.

B. Material Certificates: Materials certificates showing content/mechanical analysis are required for the following products. Also, provide samples as noted.

1. Granular Backfill: Sample.
2. Granular Base Course Material: Sample.
3. Seeding & Sodding.
4. Rip Rap.
5. No. 4 stone for off site sediment tracking control.
6. 4,000 psi concrete.

1.6 INFORMATIONAL SUBMITTALS

A. Quality Control Submittals

1. Qualifications Certification: Submit written certification or similar documentation signed by applicable subcontractor, Contractor and manufacturer (where applicable) indicating compliance with applicable “Qualifications” requirements specified below in “Quality Assurance” article.

2. Installer Experience Listing: Submit list of completed projects using products proposed for this Project, including owner’s contact and telephone number for each project, demonstrating compliance with applicable “Qualifications” requirements specified below in “Quality Assurance” article.

B. Certification Statement: Submit photocopy of Certification Statement filled out completely and accurately to the Architect. Construction activities shall not begin prior to submitting certification statement. *Certification Statement Form attached to the end of this Section*.

C. Trained Contractor Qualifications: Submit documents identifying the designated Trained Contractor (required by SPDES Permit) and proof of their successful completion of a NYSDEC endorsed 4 hr Training Course within the last 3 years.

1.7 QUALITY ASSURANCE

A. Perform erosion, sediment and pollution control in compliance with the Contract Documents and applicable requirements of the New York Standards and Specifications Erosion and Sediment Control and other governing authorities having jurisdiction.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Handle and store products according to manufacturer's written instructions.

1.9 NOTICES

A. The Owner will file with the NYSDEC a Notice of Intent (NOI) a minimum of 5 days prior to start of construction. Unless notified by the NYSDEC to the contrary within 5 days, a General SPDES Construction Permit is automatically issued which authorizes discharge of storm water on the construction site.

B. Pre-Construction Conference: Within seven days of start of construction, attend Civil/Structural Preconstruction Meeting. Representatives of all Contractors responsible for earthwork operations are required to attend.

C. Each Contractor responsible for soil disturbances shall identify at least one person from their company that will be responsible for implementation of the SWPPP. This person shall be known as the *Trained Contractor*. Each Contractor shall ensure that at least one *Trained Contractor* is on site on a daily basis when soil disturbance activities are being performed.

D. When the site has been finally stabilized, Contractor shall notify the Architect, in writing, that a final inspection be performed. Upon satisfactory completion of this inspection, the Owner will file with the NYSDEC a Notice of Termination (NOT).

E. The Owner is responsible for payment of annual fees related to the SPDES permit. Filing of a NOT shall typically terminate the Owner's fee responsibility.

F. Pay any fines issued by any agency as a result of non-compliance with the SWPPP or SESC Plans.

G. Duty to Comply: The Owner must comply with all conditions of the SPDES General Permit. All contractors and subcontractors associated with the Project must comply with the terms of the SWPPP. Any non-compliance with the permit constitutes a violation of the Clean Water Act (CWA) and the Environmental Conservation Law (ECL) and is grounds for enforcement action against the Owner and/or the contractor/subcontractor; permit revocation, suspension or modification; or denial of a permit renewal application. Upon a finding of significant non-compliance with the permit or the applicable SWPPP, the DEC may order an immediate stop work to all construction activity at the site until the non-compliance is remedied.

1.10 INSPECTIONS AND MAINTENANCE

A. When construction activities are on-going, the Architect or qualified personnel of the Owner shall review disturbed areas of the construction site at least once every seven calendar days. For construction sites where soil disturbance activities have been temporarily suspended (e.g. winter shutdown) and temporary stabilization measures have been applied to all disturbed areas, the qualified inspector shall conduct a site inspection at least once every thirty calendar days. Reviews shall include, but not be limited to discussion of schedule, observation of areas not finally stabilized, effectiveness of control measures, corrective measures and violations. Special attention will be focused on areas not finally stabilized, structural control measures, and locations where vehicles enter or exit the site. Disturbed areas will be inspected for pollutants entering the drainage system. Structural control measures will be reviewed for effectiveness in preventing significant impacts to receiving waters. Locations where vehicles enter or exit the site will be inspected for evidence of off site sediment tracking. A written report of construction reviews shall be produced during construction operations.

B. Provide timely maintenance of vegetation erosion and sediment control measures, and other protective measures, during construction. Keep a written record of maintenance and corrective work in a journal. The journal shall be added to the on site SWPPP.

C. Maintain a field copy of the General Permit, NOI, NOI Acknowledgement Letter, SWPPP, inspection reports, and erosion control maintenance logs at the construction site until all disturbed areas have achieved final stabilization and the NOT has been submitted to the DEC. The documents must be maintained in a secure location, such as a job trailer, on-site construction office, or mailbox with lock. The secure location must be accessible during normal business hours to a representative of the Owner, Architect, and NYSDEC.

D. Perform corrective measures within three calendar days of the Architect's or Owner's report at no cost to the Owner. Failure by the Contractor to perform corrective work within this schedule automatically authorizes the Owner to hire others and deduct from the Contract Sum the costs incurred by the Owner for the performance of this Work.

E. The Owner shall provide long term maintenance of the storm water facilities after Notice of Termination has been issued. The designated maintenance personnel shall keep written records of maintenance and corrective work in a journal. The journal shall be added to the on site SWPPP.

F. *The Owner* shall retain a copy of the NOI, NOI Acknowledgment Letter, SWPPP, MS4 SWPPP Acceptance Form, NOT, and any inspection reports that were prepared in conjunction with this permit for a period of at least five years from the date that the site achieves final stabilization.

PART 2 - PRODUCTS

2.1 STORM SEWER PROTECTION

A. 1/2-inch mesh hardware cloth covered with a polypropylene silt fence fabric.

2.2 DROP-IN INLET PROTECTION:

A. Standard of quality for aftermarket inlet protection for use in existing and proposed catch basin, drop inlets, curb box inlets and storm manholes shall be Flexstorm Inlet Filters, by Inlet and Pipe Protection, Inc., Naperville, Illinois.

1. Description of System:

a. An aftermarket drop-in inlet filter system designed to collect silt and sediment from surface storm water runoff at drainage locations shown on the plans, at existing inlets in pavement where adjacent disturbance will allow sediment runoff to occur, in areas where access to the site dictates their use due to phasing issues, or as directed by the Engineer.

b. An aftermarket drop-in inlet filter system comprised of a corrosion resistant steel frame and a replaceable geotextile sediment bag attached to the frame with a stainless steel locking band. The sediment bag hangs suspended from the rigid frame at a distance below the grate that shall allow full water flow into the drainage structure if the bag is completely filled with sediment.

c. The aftermarket drop-in inlet filter frame includes lifting handles in addition to the standard overflow feature. A proprietary Removal Tool engages the lifting bars or handles to allow manual removal of the assembly without machine assistance. The frame suspension system is adjustable in ½" increments up to 5" per side on rectangular designs should the casting or drainage structure have imperfections.

d. Standard woven polypropylene sediment bags with a typical flow rate of 200 gpm / sq ft.

2. Woven Sediment Bag Material Specifications:

		MARV[2]	
PROPERTY	TEST METHOD	ENGLISH	METRIC
Mechanical			
Tensile Strength (Grab)	ASTM D-4632	255 x 275 lbs	1130 x 1220 N
Elongation	ASTM D-4632	20 x 15 %	20 x 15 %
Puncture	ASTM D-4833	135 lbs	600 N
Mullen Burst	ASTM D-3786	420 psi	2890 kPa
Trapezoidal Tear	ASTM D-4533	40 x 50 lbs	175 x 220 N
Endurance			
UV Resistance	ASTM D-4355	90%	90%
Hydraulic			
Apparent Opening Size (AOS)[3]	ASTM D-4751	20 US Std. Sieve	0.850 mm
Percent Open Area (POA)	CW-02215 Mod.[4]	20%	20%
Permittivity	ASTM D-4491	1.50 sec^{-1}	1.50 sec^{-1}
Water Flow Rate	ASTM D-4491	200 gpm/ft^2	8,145 $l/min/m^2$

3. Tested Filtration Efficiency:

   a. All testing performed in general accordance with the ASTM D 7351, *Standard Test Method For Determination of Sediment Retention Device Effectiveness in Sheet Flow Application*, with flow diverted into an area inlet. Test Soil used as sediment had the following characteristics with a nominal 7% sediment to water concentration mix:

Soil Characteristics	Test Method	Value
% Gravel	ASTM D 422	2
% Sand		60
% Silt		24
% Clay		14
Liquid Limit, %	ASTM D 4318	34
Plasticity Index, %		9
Soil Classification	USDA	Sandy Loam
Soil Classification	USCS	Silty Sand (SM)

Tested Efficiencies:

Property	Woven Sediment Bag
Filtration Efficiency	82%

2.3 STRAWBALES

A. Clean, free of dirt, hay, grass, or weeds.
B. Bound with twine or wire.
C. Bales, when placed, shall be dry and capable of passing water.

2.4 SILT FENCE

A. Meet the following criteria unless specific type is shown on plans or Architect accepts the change in criteria.

   1. Silt Fence: Polypropylene filter fabric supported by non pressure treated hardwood posts meeting the following requirements.

Property	Unit	Test Method	Value
Grab Strength	lbs	ASTMD-4632	120 min
Grab Elongation	%	ASTMD-4632	30 max
Trapezoid Tear	lbs	ASTMD-4533	60 min
Mullen Burst	psi	ASTMD-3786	280 min
Coeff of Permeability	CM/Sec	ASTMD-4491	.005min
Water Flow Rate	gal/min/ft^2	ASTMD-4491	12 min

2. Basis of Design Product: Subject to compliance with requirements, provide TenCate Geosynthetics, Mirafi 100X fabric or comparable product.

3. Reinforced fence: Fabric backed with 14-1/2 gauge by 6 inch square mesh woven wire. See plans for specific locations.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. DGI Industries.
2. Hanes Geo Components.
3. TenCate Geosynthetics (Mirafi).

2.5 STAKES

A. One of the following

1. 2 inch by 2 inch by 4 foot non pressure treated hardwood.
2. #4 rebar.

2.6 STONE FILTERS

A. Size shown on the plans meeting the requirements of ASTM C33 or State specifications where applicable.

2.7 PERMANENT SEEDING AND SODDING

A. Refer to applicable section.

2.8 TEMPORARY SEEDING (unless otherwise shown on Drawings):

A. Minimum requirements:

1. Lime: 1/2 ton per acre.
2. Fertilizer: Commercial 5-10-10 or equivalent (600 lbs per acre).
3. Seed: Ryegrass (annual or perennial)(40 lbs. per acre).
4. Mulch: Straw at 2 ton per acre.

2.9 EROSION CONTROL BLANKET

A. On Slopes 3:1 or greater, or where indicated in the drawings

1. Permanent erosion control/turf reinforcement mat shall be constructed of a matrix of polypropylene monofilament yarns woven into uniform configuration of resilient pyramid-like projections.

a. Material Properties:

Property	Test Method	Units	Property Requirement
Thickness	ASTM D-6525	mm (in)	10.2 (0.40)
Resiliency	ASTM D-6524	percent	80
Mass Per Unit Area	ASTM D-6566	G/sq m (oz/sy)	455 (13.5)
Tensile Strength	ASTM D-6818	kN/m (lbs/ft)	58.4 x 43.8 (4,000 x 3,000)
Tensile Elongation	ASTM D-6818	percent	65 (max)
Light Penetration (% Passing)	ASTM D-6567	percent	10
UV Resistance	ASTM D-4355	percent	90 at 6000 hrs

b. Performance Properties: In a vegetated state, the RECP must demonstrate acceptable performance (as defined by the Engineer) when subjected to at least 0.5 hrs of continuous flow producing the following conditions:

c. Permissible velocity: 7.6 m/sec (25 ft/sec)

d. Permissible tractive force (shear stress): 0.718 kPa (15 psf)

e. Color: Green.

f. Basis of Design Product: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

g. Pyramat Geotextile System by Propex, Inc.

2.10 OFF-SITE SEDIMENT TRACKING CONTROLS

A. No. 4 stone meeting the following requirements:

Standard ASTM Sieve Size	Percent Passing by Weight
4 inch	100
3 inch	90-100
2 inch	0-15
Passing No. 50	5-10
Passing No. 100	2-5

B. Soil Stabilization Fabric:

1. Stabilization Fabric: A commercially manufactured, UV stabilized low clogging, high flow, woven geotextile meeting the following requirements.

Property	Unit	Test Method	Value
Grab Strength	lbs	ASTMD-4632	315 min
Tensile Strength	lbs/in	ASTMD-4595	175 min
Grab Elongation	%	ASTMD-4632	15 max
Trapezoid Tear	lbs	ASTMD-4533	120 min
Mullen Burst	psi	ASTMD-3786	600 min
Permittivity	/Sec	ASTMD-4491	.05min
Water Flow Rate	gal/min/ft^2	ASTMD-4491	4 min

2. Basis of Design Product: Subject to compliance with requirements, provide TenCate Geosynthetics, Mirafi 500X fabric, or comparable product.

3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. DGI Industries.
b. Hanes Geo Components.
c. TenCate Geosynthetics (Mirafi).

C. Granular Base Course Material: Shall be as specified in Earth Moving Section.

2.11 TEMPORARY TREE PROTECTION

A. Stakes: 2 inch by 4 inch x 6 foot (min) non-pressure treated hardwood.

B. Top Rail: 2 inch by 4 inch x 8 foot (max) non-pressure treated hardwood fastened to stakes by nails or screws.

C. Fabric:

1. Heavy duty orange construction barrier fencing.
2. Basis of Design Product: Subject to compliance with requirements, provide Tenax Corporation “Sentry HD” fencing or comparable product.
3. Fabric shall be attached to the stakes and top rails with staples or other fasteners.

2.12 ROCK CHECK DAMS AND SEDIMENT TRAPS

A. Provide stone rip rap as specified. Vegetation shall be as described on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine conditions under which soil erosion and sediment control is to be installed notify Architect in writing of any conditions detrimental to proper and timely installation. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

B. Beginning installation constitutes Contractor's acceptance of conditions.

3.2 SIGNATURE REQUIREMENTS

A. Between the Pre-Construction Meeting and starting site work:

1. Sign the certification statements. Prominently display the statements at the job site.

2. Review inspection and maintenance procedures. Decide where SWPPP will be temporarily stored for review by NYSDEC, Owner and Architect.

3. Designate specific Owner and Contractor personnel responsible for inspection and maintenance.

4. Prior to the start of construction, submit schedule for completion of installation of measures identified in SESC Plan and SWPPP. DO NOT BEGIN EARTHWORK OPERATIONS AT SITE UNTIL MEASURES IDENTIFIED IN SESC PLAN AND SWPPP HAVE BEEN ACCEPTED BY ARCHITECT AND INSTALLED AT SITE.

5. When conditions change during construction, submit revisions to the SWPPP to Owner, the Architect and other agencies identified in the SPDES permit and the SWPPP.

3.3 GENERAL EROSION CONTROL

A. Provide initial construction erosion control features, shown in the SWPPP and as indicated on Drawings and Specifications or as directed by the Architect, prior to disturbing the site with such construction operations as clearing and grubbing, topsoil stripping, earthwork, trenching excavation and removal of existing vegetation. Keep the disturbance to a minimum. Install other features as described in the sequence of erosion, sediment and pollution control on the drawings.

B. Minimize amount of bare soil exposed at one time. Do not disturb 5 or more acres at one time. Disturbance of five acres or more at one time requires the Contractor to obtain prior written permission from the NYSDEC to vary from the requirement of SPDES Permit GP-0-10-001. Provide written copy of approval from NYSDEC to the Owner and the Architect. Start permanent seeding within seven calendar days of rough grading. When this is not possible, provide temporary seeding of perennial rye grass at the rate of three pounds seed per one thousand square feet. Provide temporary seeding within seven days on non-roof, non-paved areas. When adverse weather conditions prevent good germination, repeat seeding as directed by the Architect until the area is stabilized. Till under temporary grass and fine grade when preparing for final seeding.

C. Until a disturbed area is stabilized, trap runoff sediment by the use of debris basins, sediment basins, silt traps, or other methods acceptable to the Architect and governing authorities. Construct sediment basins to dimensions shown on plans.

D. Place stone filters in accordance with dimensions shown on Drawings. If filters become plugged or partially plugged, remove and replace the stone. Cleaning of stone will only be allowed when method is reviewed by Architect or Owner Representative and found acceptable.

E. Provide erosion controls on slopes and swales traversing, bordering, or leaving the site. Limit the water flow to a non-erosive velocity.

F. Do not store fill materials within fifty feet of the banks of any streams or water bodies, intermittent or perennial.

G. Provide temporary protection for trees and shrubs as outlined and shown on drawings and described in this Section.

H. Inspect erosion and sediment control measures immediately after each rainfall and at least daily during prolonged rainfall. Make required repairs immediately.

I. Remove sediment deposits before they reach one-half of the height of the barrier. Dispose sediment in a manner that does not result in additional erosion or pollution.

J. Provide prompt removal and disposal of rubbish and debris in accordance with the governing authorities.

K. Provide temporary grading of drainage channels, slopes, or fills in accordance with Section 02300 Earth Moving.

L. Coordinate temporary erosion and sediment control measures with permanent erosion control features specified elsewhere in the Contract Documents to the maximum extent possible to assure economical, effective, and continuous erosion, sediment and pollution control.

M. Provide temporary and permanent dust controls on driving areas such as roads, bus loops, parking lots, haul roads and access points, as well as non-driving areas such as lawns and athletic fields and any other disturbed areas where damage, health hazards or traffic safety problems may occur if dust is not controlled.

N. Remove temporary measures at completion of construction, prior to the issuance of the Notice of Termination.

3.4 MUNICIPAL SEWER AND WETLAND EROSION CONTROL

A. Control erosion, siltation and pollution to municipal sewers, water bodies and wetlands by taking appropriate measures such as, but not limited to, the following:

1. Prevent petroleum products and excessive amounts of silt, clay, and muck from entering municipal sewers, waters or wetlands of New York State during construction.

2. Prevent fresh concrete, concrete leachate and washings from equipment and trucks, from entering municipal sewers, waters or wetlands of New York State during construction.

3. Place silt fence to control erosion at the down slope edge of disturbed areas. Place this barrier to sediments before disturbance of the ground occurs and maintain in good condition until disturbed land is heavily vegetated or otherwise permanently stabilized.

4. Seed areas of soil disturbance resulting from this Project with appropriate perennial grass seed and mulched with straw within seven calendar days as described in general erosion control. Maintain mulch until a suitable vegetative ground cover is established.

3.5 STORM STRUCTURE PROTECTION

A. As shown on the Stormwater Pollution Prevention Plan (SWPPP) and the Soil Erosion and Sediment Control Plans (SESC), provide storm structure protection at each inlet as shown on the detail plan. Clean storm structure protection material after each storm event to permit the fabric and/or drainage stone to work effectively. Remove the drainage material when the site is stabilized and certified by the Architect and/or qualified personnel of the Owner.

3.6 SILT FENCE/STRAW BALE DIKES

A. Locate in accordance with plans and details and as directed by the Architect. Excavate trench along the lower perimeter(s) of site, along the contract limit line, and as indicated on the Drawings. The placement of silt fence and/or bales shall consider drainage paths and intercept drainage prior to leaving site or entering storm system. Place excavated material on uphill side of trench for backfilling.

B. Drive stakes securely into the downhill side of the trench. When prefabricated silt fence with fabric attached to stakes is used, drive stakes so that fabric is buried in the ground as detailed.

C. Backfill trench with excavated material, so that fabric is securely buried in the ground to prevent undermining. Tamp soil.

D. Join sections by overlapping fabric between two stakes. Set stakes simultaneously. Overlap by minimum six inches, fold, and staple to prevent sediment bypass.

E. Attach silt fence securely to stakes spaced no more than eight feet on center. Secure fence fabric to stake with minimum three one inch staples.

F. Provide silt fence dikes perpendicular to swale center lines in swales one and one half percent and steeper. Locate dikes at a maximum interval of fifty feet on center unless otherwise shown on drawings.

G. Removal of silt and replacement of silt fence and/or bales shall be on going throughout the duration of the project to maintain an effective silt removing barrier.

3.7 TEMPORARY SEEDING

A. When necessary, provide temporary seeding as described in this Section.

B. Seedbed Preparation:

1. Scarify soil if compacted.
2. Remove debris and obstacles such as rocks and stumps.
3. Apply lime and fertilizer.
4. Apply seed uniformly by mechanical seeder or hydroseeder.
5. Apply straw mulch.

C. Provide permanent seeding as described elsewhere in the Contract Documents.

3.8 EROSION CONTROL MAT

A. Install where indicated on Drawings. Install in accordance with manufacturers' recommendations.

3.9 OFFSITE SEDIMENT TRACKING CONTROLS

A. Install as detailed and shown on Drawings to eliminate tracking sediment off site. Inspect after each rain storm and at least one time per week. When sediment begins tracking off site, immediately replace stone with clean No. 4 stone to retain sediment on site. Remove fabric and stone at project completion. Complete construction of proposed final surface(s).

B. Provide wash down areas stabilized with stone that drain into Architect approved sediment trapping device. Do not flush into water bodies, wetlands, on site or municipal systems.

3.10 ROCK CHECK DAMS AND SEDIMENT TRAPS

A. Install rip rap and vegetation as detailed on the Drawings and described elsewhere in the Contract Documents.

3.11 TREE PROTECTION

A. Temporary Protection for Trees and Shrubs:

1. Provide temporary fencing, barricades or guards as required to protect trees and other plants, which are to remain, from above ground damage.

2. Protect root system from smothering. Do not store construction materials, debris, or excavated material within drip line (outer perimeter of branches). Do not permit vehicular traffic or parking within drip line. Restrict foot traffic to prevent excessive compaction of soil over root systems.

3. Should any trees or shrubs be damaged which are to be saved, arrange to have such damage treated by a licensed arborist or tree surgeon.

4. Trees or shrubs which die because of the Contractor's failure to conform to the Drawings and specifications shall be evaluated by a qualified organization selected by the Owner's Representative. The removal and replacement of the tree, and the evaluation expenses shall be paid for by the Contractor. Contractor shall be required to replace the damaged tree with plant material of comparable size and quality (i.e. damaged 12 inch caliper Red Maple shall be replaced by three 4 inch cal. or four 3 inch cal. Red Maples). Substitutions for variety shall be approved by the Architect

3.12 CLEANING

A. During the Contract and at intervals as directed by the Architect and as erosion, sediment and pollution control procedures are completed, clear the site of extraneous materials, rubbish, and debris. Leave the site in a clean, safe, well draining, and neat condition.

B. Clean storm ponding areas, catch basins, detention basins, and other buried structures. Clean out contaminants, sediment, rubbish, construction debris, foreign objects and accumulated floatables from chambers and ponding areas thoroughly, immediately prior to final acceptance.

END OF SECTION 02150

Attachment: Certification Statement

CERTIFICATION STATEMENT

Authorized, legally responsible signatures for the General Contractor, Site Earthwork, and Landscaping Subcontractor(s) shall sign and prominently display the following certification statement at the job trailer or office during the life of the project:

"I hereby certify under penalty of law that I understand and agree to comply with the terms and conditions of the Storm Water Pollution Prevention Plan (SWPPP) and agree to implement any corrective actions identified by the qualified inspector during a site inspection. I also understand that the operator (person, persons, or legal entity which owns or leases the property on which the construction activity occurs) must comply with the terms and conditions of the most current version of the New York State Pollutant Discharge Elimination System ("SPDES") General Permit for storm water discharges from construction activities and that it is unlawful for any person to cause or contribute to a violation of water quality standards. Furthermore, I understand that certifying false, incorrect, or inaccurate information is a violation of the referenced permit and the laws of the State of New York and could subject me to criminal, civil, and/or administrative proceedings. "

1. **General Contractor**
   Signature: _____
   Name: _____
   Company: _____
   Title: _____
   Address: _____
   _____
   Phone No.: _____
   Fax No.: _____
   E-Mail: _____

2. **Site Earthwork Contractor**
   Signature: _____
   Name: _____
   Company: _____
   Title: _____
   Address: _____
   _____
   Phone No.: _____
   Fax No.: _____
   E-Mail: _____

3. **Site Landscape Contractor**
   Signature: _____
   Name: _____
   Company: _____
   Title: _____
   Address: _____
   _____
   Phone No.: _____
   Fax No.: _____
   E-Mail: _____

4. **Other Prime Contractor(s)** *(as determined by the Architect – Make* additional *copies as necessary)*
   Signature: _____
   Name: _____
   Company: _____
   Title: _____
   Address: _____
   _____
   Phone No.: _____
   Fax No.: _____
   E-Mail: _____

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, removing site utilities, and abandoning site utilities in place.
7. Temporary erosion- and sedimentation-control measures.
8. Disposal of waste material.

1.3 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil (insitu): Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other nonsoil materials.

D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated on Drawings.

E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Cleared materials shall remain the Owner's property and shall be disposed of per Specification Section 02240.

1.5 SUBMITTALS, GENERAL

A. General: Submit all informational submittals required by this Section concurrently.

1.6 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.7 CLOSEOUT SUBMITTALS

A. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.8 PROJECT CONDITIONS

A. Verification of Conditions: Examine conditions under which site clearing is to be accomplished and notify Architect in writing of any conditions detrimental to proper and timely accomplishment. Do not proceed with site clearing until unsatisfactory conditions have been corrected.

B. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises in location to be determined by Owner.

D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

F. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.

4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

I. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 02300 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

2. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with MPI #79, Alkyd Anticorrosive Metal Primer or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain. Flag each tree trunk at 54 inches above the ground.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

D. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction. Refer to Section 02150, “Erosion and Sedimentation Controls”.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree or plant protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. General: Protect trees and plants remaining on-site according to requirements in Section 02150 "Erosion and Sedimentation Controls."

B. Should any trees or shrubs be damaged which are to be saved, arrange to have such damage treated by a licensed arborist or tree surgeon.

C. Protect tree and shrub root systems from smothering. Do not store construction materials, debris, or excavated material within plant protection zone. Do not permit vehicular traffic or parking within plant protection zone. Restrict foot traffic to prevent excessive compaction of soil over tree, shrub and turf root systems.

D. Trees or shrubs which die because of the Contractor's failure to conform to the Drawings and specifications shall be evaluated by a qualified organization selected by the Owner's Representative. The removal and replacement of the tree, and the evaluation expenses shall be paid for by the Contractor. Contractor shall be required to replace the damaged tree with plant material of comparable size and quality (i.e. damaged 12"caliper Red Maple shall be replaced by three 4" cal. or four 3" cal. Red Maples). Substitutions for variety shall be approved by the Architect.

3.4 EXISTING UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Owner will arrange to shut off indicated utilities when requested by Contractor.

C. Locate, identify, and disconnect utilities indicated to be abandoned in place.

D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Owner not less than ten working days in advance of proposed utility interruptions.

E. Excavate for and remove underground utilities indicated to be removed.

F. Coordinate removal of underground utilities with applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security and utilities sections.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Grind down stumps and remove roots, obstructions, and debris to a minimum depth of 18 inches below exposed subgrade.
3. Use only hand methods for grubbing within protection zones.
4. Chip removed tree branches and dispose of legally off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer in accordance with Section 02300 "Earth Moving”.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Do not remove surplus topsoil from site.

D. Refer to Section 02900 Turfs and Grasses for topsoil screening requirements.

E. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

F. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches.
2. Do not stockpile topsoil within protection zones.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction including foundations, slabs, paving, curbs, gutters, retaining walls, aggregate base and other improvements.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically. Leave cut edge neat and square where existing material is cut to adjoin new work.

2. Remove asphalt concrete paving material to full depth and remove from site. Do not use asphalt materials for on-site fill.

3. Gravel and stone fill under removed sidewalks may be reused if suitable for the particular new use and if approved by the Architect.

4. Break up and completely remove miscellaneous concrete, such as small foundations. Remove concrete, retaining walls or foundations below grade to a minimum depth of 2’.

5. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.]

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them per specification section 02240.

END OF SECTION 02200

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preparing subgrades for foundations, slabs-on-grade, walks, pavements, turf and grasses and plants.
2. Structural Fill: For backfill under structures, pavements, concrete pads, etc.
3. Granular Fill: Sub base for interior concrete slabs-on-grade, asphalt paving, concrete paving, etc.
4. Subsurface drainage fill for foundation drains, underdrains, etc.
5. Excavating and backfilling for buildings and structures.
6. Excavating and backfilling trenches for utilities and pits for buried utility structures.

1.3 UNIT PRICES

A. Work of this Section is affected by unit prices for earth moving specified in Division 01 Section "Unit Prices."

B. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.

1. 24 inches outside of concrete forms other than at footings.
2. 12 inches outside of concrete forms at footings.
3. 6 inches outside of minimum required dimensions of concrete cast against grade.
4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
5. 6 inches beneath bottom of concrete slabs-on-grade.
6. 6 inches beneath invert of pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

1.4 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Subbase: Granular aggregate layer supporting the slab-on-grade and pavement that also minimizes upward capillary flow of pore water.

G. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Geotechnical Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices, if specified, or changes in the Work.

2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.

3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Geotechnical Engineer or Architect. Unauthorized excavation, as well as remedial work directed by Geotechnical Engineer or Architect shall be without additional compensation.

H. Fill: Soil materials used to raise existing grades.

I. Hazardous Soil Materials: Soils that are contaminated with petroleum product and/or hazardous chemicals, waste or industrial waste.

J. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Rock Excavation: Track-mounted excavator rated at not less than 222-hp flywheel power with weight of 70,000 lbs or greater and a 30” wide short-tip radius rock bucket. (Ratings are based on Caterpillar's "Model No. 330B”.)

K. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below aggregate base, structural fill, drainage fill, or topsoil materials.

M. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

N. Non-Granular Fill: Soil fill material used to raise existing grades in areas that do not require granular or structural fill.

1.5 SUBMITTALS

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

B. Action Submittals:

1. Product Data: For each type of the following manufactured products required:

   a. Geotextiles.
   b. Warning tapes.

2. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

   a. Classification according to ASTM D 2487.
   b. Laboratory compaction curve according to ASTM D 1557**.**

3. Samples for Verification: For the following products, in sizes or quantities indicated below:

   a. Fill: One-half gallon by volume of material in sturdy container of each type of fill, naming source for each material.
   b. Geotextile: 12 by 12 inches.
   c. Warning Tape: 12 inches long; of each color.

C. Informational Submittals:

1. Qualification Data: For qualified testing agency.

2. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, which might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Qualified Installers as defined below:

1. Earthwork Contractor Experience Requirements: Provide a list of at least four Earthwork projects of comparable size, scope, and quality completed successfully by the proposed Sub Contractor within the past two years that includes the date completed, project Owner’s name and current contact information, including telephone numbers and e-mail addresses.

B. Civil/Structural Preconstruction Conference: Attend Civil/Structural Preconstruction Conference.

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: If work includes improvements on adjoining property, written authorization for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.

D. Do not commence earth moving operations until temporary and permanent erosion- and sedimentation-control measures, specified in Division 02 – Section 02150 “Erosion and Sedimentation Control” are in place.

E. Do not commence earth moving operations until plant-protection measures specified in Division 02 Sections 02150 “Erosion and Sedimentation Control” and 02200 “Site Clearing” are in place.

F. The following practices are prohibited within tree- or plant-protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
8. Directing vehicle or equipment exhaust towards protection zones.
9. Heat sources, flames, ignition sources, and smoking within or near protection zones.

G. Existing Hazardous Materials:

1. If during the performance of the work suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. If present, hazardous materials will be removed by Owner under a separate contract.

2. If during the performance of the work suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide imported soil materials when sufficient satisfactory soil materials are not available from onsite excavations.

B. Topsoil: Refer to Turf and Grasses Specification, Division 32.

C. Hazardous Materials:

1. Provide fill materials that are not contaminated with petroleum product, hazardous waste or industrial waste.
2. Contamination above federal, state or local requirements is not acceptable. Materials with a visible sheen or petroleum odor shall be rejected.

D. Unsuitable Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsuitable soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

E. Non-Granular Fill: Material is to comply with NYSDOT requirements for Select Borrow and Select Fill with modifications shown below. This material is not allowed in areas where granular soils are required, including within the building footprint, below pavement areas or below a synthetic turf athletic field.

1. On-Site Non-Granular Fill

a. Submittal must be provided demonstrating that on-site soil material meets the criteria outlined in this Section for use as fill material.

b. Obtain approval of Architect before proceeding with use of on-site material.

c. Material is to have no particles greater than 4” in maximum dimension, no more than 70% by weight passing the #40 sieve and no more than 20% passing the #200 sieve.

d. Testing submitted is to demonstrate that proper compaction can be achieved as required in Part 3, Execution.

2. Imported Non-Granular Fill

a. Where quantity of approved non-granular fill materials required exceeds that available from on-site stock-piles, provide suitable material from off-site sources.

b. Obtain approval of Architect before proceeding with use of imported fill material.

c. Material is to have no particles greater than 4” in maximum dimension, no more than 70% passing by weight the #40 sieve and no more than 15% passing the #200 sieve.

d. Testing submitted is to demonstrate that proper compaction can be achieved as required in Part 3, Execution.

F. Structural Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand.

1. Type 1 Fill (NYSDOT Standard Specification, Section 304, Type 1 / Granular Fill) gradation requirements:

Sieve Designation	**Percent by Weight Passing Square Mesh Sieves**
3 inch	100
2 inch	90 to 100
1/4-inch	30 to 65
#40	5 to 40
#200	0 to 10

G. Granular Fill: Import all granular fill types from off-site sources. Granular fill consists of stone, sand, and gravel, or blends of these materials, free of slag, complying with New York State Department of Transportation (NYSDOT) Standard Specification, Section 304, as modified below:

1. Type 2 Fill (NYSDOT Type 2 / Crushed Ledge Rock Stone) Gradation Requirements.

Sieve Designation	**Percent by Weight Passing Square Mesh Sieves**
2 inch	100
1/4-inch	25 to 60
#40	5 to 40
#200	0 to 10

2. Type 4 Fill (NYSDOT Type 4 / Select Granular Fill) Gradation Requirements.

Sieve Designation	**Percent by Weight Passing Square Mesh Sieves**
2 inch	100
1/4-inch	30 to 65
#40	5 to 40
#200	0 to 10

3. RCA Fill: Recycled Portland cement concrete aggregate which is the product of mechanical crushing, complying with the following gradation requirements. May be used in lieu of Granular fill, upon permission from the Architect.

Sieve Designation	Percent by Weight Passing Square Mesh Sieves
2 inch	100
1 inch	80 to 100
1/4-inch	50 to 85
#40	15 to 40
#200	0 to 10

H. Crushed Stone: Where indicated, provide the following fill materials, consisting of stone, free of slag, complying with New York State Department of Transportation (NYSDOT) Standard Specifications, Section 703-02 which is product of mechanical crushing, complying with following requirements:

1. NYSDOT No. 1 Crushed Stone Gradation Requirements:

Sieve Designation	Percent by Weight Passing Square Mesh Sieves
1 inch	100
1/2-inch	90 to 100
1/4-inch	0 to 15
#200	0 to 1

2. NYSDOT No. 2 Crushed Stone Gradation Requirements:

Sieve Designation	Percent by Weight Passing Square Mesh Sieves
1-1/2 inch	100
1 inch	90 to 100
1/2-inch	0 to 15
#200	0 to 1

I. Drainage Fill: Mixture of 50 percent NYSDOT No. 1 crushed stone and 50 percent NYSDOT No. 2 crushed stone, complying with New York State Department of Transportation Standard Specifications, Section 703-02.

J. Pea Gravel (For Fuel Oil Tank Backfill) Gradation Requirements:

Sieve Designation	Percent by Weight Passing Square Mesh Sieves
1 inch	100
3/4-inch	90 to 100
1/2-inch	20 to 55
3/8-inch	0 to 15
#4	0 to 5

K. Pea Gravel Surfacing: 1/4 min to 3/8 maximum size graded in accordance with ASTM C33.

L. Sand: ASTM C 33; fine aggregate.

M. Fine Stone Topping Course: 50/50 blend of NYSDOT Type 1A and Type 1B stone with 0 – 1 percent passing the #200 sieve, complying with New York State Department of Transportation Standard Specifications, Section 703-02.

2.2 GEOTEXTILES

A. Separation/Filter Fabric - Nonwoven needle-punched polypropylene geotextile filter/separation fabric complying with the following:

Fabric Property	**Value**	**Test Method**
Grab Tensile Strength	120 lb	ASTM D 4632
Grab Tensile Elongation	50 percent	ASTM D 4632
Trapezoid Tear Strength	50 lbf	ASTM D 4533
Mullen Burst Strength	225 psi min	ASTM D 3786
Puncture Strength	65 lb min	ASTM D 4833
Apparent Opening Size	No. 70 sieve max	ASTM D 4751
Permittivity	1.5 per second min	ASTM D 4491
Flow Rate	120 gal min/ft	ASTM D 4491
UV Stability	70 percent after 500 hours	ASTM D 4355

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. TenCate Mirafi - 140N
   b. Amoco - 4547
   c. Geotex - 451

B. Soil Stabilization Fabric: Heavy duty, commercially manufactured woven polypropylene geotextile meeting the following properties:

Fabric Property	**Test Method**	**Unit**	**Typical Value**
Tensile Strength	ASTM D 1682	lb	300
Grab Tensile Elongation	ASTM D 1682	percent	35 (max)
Modulus (at 10 percent elongation)	ASTM D 1682	lb	140
Trapezoidal Tear Strength	ASTM D 1117	lb	120
Mullen Burst Strength	ASTM D 3786	psi	600+
Puncture Strength	ASTM D 3787	lb	130
Abrasion Resistance	ASTM D 3884	lb	100
Coefficient of Permeability	CFMC GET 2	cm/sec	0.01
Water Flow Rate	CFMC GET 2	gal/min/sf	50
EOS	COE CW 02215	US Std Sve	20 to 45

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. TenCate Mirafi – 500X.

C. Subsurface Drainage Geotextiles: Refer to Specification Section 02630 "Storm Utility Drainage Piping".

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine conditions under which earthwork is to be accomplished in coordination with Installer of materials and components specified in this Section and notify affected Prime Contractors and Architect in writing of any conditions detrimental to proper and timely accomplishment. Do not proceed with earthwork until unsatisfactory conditions have been corrected in manner acceptable to Installer.

1. When Installer confirms conditions as acceptable to ensure proper and timely installation and to ensure requirements for applicable warranty or guarantee can be satisfied, submit to Architect written confirmation from applicable Installer. Failure to submit written confirmation and subsequent installation will be assumed to indicate conditions are acceptable to Installer.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

1. Contractor is entirely responsible for strength and adequacy of bracing and shoring, and for safety and support of construction from damage or injury caused by lack of adequate protection or by movement or settlement.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.3 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.4 EXPLOSIVES

A. Explosives: Do not use explosives.

3.5 SITE CLEARING

A. Refer to Division 02 Section "Site Clearing".

3.6 EXCAVATION, GENERAL

A. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Geotechnical Engineer. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.

a. Intermittent drilling; ram hammering; or ripping of material not classified as rock excavation is earth excavation.

2. Rock excavation includes removal and disposal of rock (refer to Definitions section: “Rock” paragraph above). Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:

a. 24 inches outside of concrete forms other than at footings.
b. 12 inches outside of concrete forms at footings.
c. 6 inches outside of minimum required dimensions of concrete cast against grade.
d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
e. 6 inches beneath bottom of concrete slabs-on-grade.
f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

3.7 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

a. See Structural Drawings for specific removal and replacement instructions if required.

2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Protect trees and other plants in accordance with requirements in Division 1 Section "Temporary Facilities and Controls" and Division 02 Section “Erosion and Sedimentation Control”.

3.8 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.9 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.

2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.

3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.

4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3. Cut and protect roots in accordance with standard nursery practice and Division 02 Section “Erosion and Sedimentation Control”.

3.10 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.
B. If Geotechnical Engineer determines that unsuitable soil is present, continue excavation and replace with compacted backfill or fill material as directed.

3.11 PROOF-ROLLING

A. Proof-roll subgrade below building slabs, concrete pads and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction and repeating proof-rolling in direction perpendicular to first direction with a minimum of six overlapping passes. Limit vehicle speed to 3 mph.

2. Excavate soft spots, unsuitable soils, and areas of excessive pumping or rutting, as directed by Architect, and replace with compacted backfill or fill as directed.

3. Foundations: Proof-roll prior to excavation for foundations but after top soil is stripped.

B. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices (if applicable) or changes in the Work.

C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities without additional compensation.

3.12 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. CLSM (flowable fill), per this specification section, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit in accordance with this Section unless otherwise directed by Geotechnical Engineer.

3.13 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.14 SOIL STABILIZATION FABRIC

A. Install soil stabilization fabric: After subgrade has been compacted and proof-rolled, install soil stabilization fabric as specified by the manufacturer, including the following:

1. Lay fabric in the direction of traffic.
2. Overlap fabric side to side and end to end a minimum of two feet.

3.15 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.16 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Specification Section 03310 "Cast-in-Place Concrete".

D. Trenches under Roadways: Provide 4-inch- thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Specification Section 03310 "Cast-in-Place Concrete".

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Place and compact initial backfill of subbase material or satisfactory soil, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

G. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.

H. Place and compact final backfill of satisfactory soil to final subgrade elevation.

I. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

J. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.17 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows. Refer to Part 2 for material requirements and specific conditions for the use of each type of soil material. All fill materials to be approved by Architect per requirements noted in Part 2.

1. Under grass and planted areas, use satisfactory non-granular fill material.
2. Under walks, pavements and exterior slabs, use Structural Fill below subbase layer and Type 2 granular fill for subbase layer.

3. Under steps and ramps, use structural fill below subbase layer and Type 2 granular fill for subbase layer.
4. Under building slabs, use structural fill below subbase layer. For subbase, use No. 2 Crushed Stone. See Drawings for depth.
5. Under footings and foundations, use structural fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.18 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry density.

3.19 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Maximum layer depth before compaction:

1. Under Pavement: Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

2. Place backfill and fill soil materials in layers not more than 12 inches in loose depth for material compacted by heavy compaction equipment, and not more than 8 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry weight density according to ASTM D 1557:

1. Under structures, building slabs, steps, synthetic turf and pavements: Scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.

2. Under walkways: Scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.

3. Under natural turf or unpaved areas: Compact each layer of subgrade backfill or fill soil material at 85 percent. Compact all layers beneath the upper 2'-0" to at least 95%.

4. Utility trenches: Compact each layer of initial and final backfill soil material at 85 percent.

5. Landscape Planting areas: Compact each layer of subgrade backfill or fill soil material at 75 percent.

3.20 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge and within +0” / -1” tolerance of bottom of slab.

3.21 SUBSURFACE DRAINAGE

A. Drainage Tubing / Subdrainage Pipe: Specified in Division 33 Section "Storm Utility Drainage Piping”.

B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench as shown in Drawings.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698.

C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches.

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.

3.22 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place granular fill base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place granular fill base course under pavements and walks as follows:

1. Place base course material over subgrade under hot-mix asphalt pavement.

    a. If separation geotextile is shown in details, install on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.

2. Shape base course to required crown elevations and cross-slope grades.

3. Place base course 6 inches or less in compacted thickness in a single layer.

4. Place base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

5. Compact base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.23 SUB BASE FOR CONCRETE SLABS-ON-GRADE

A. Place sub base on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact sub base under cast-in-place concrete slabs-on-grade as follows:

1. Place sub base 8 inches or less in compacted thickness in a single layer.
2. Place sub base that exceeds 8 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 8 inches thick or less than 3 inches thick.
3. Compact each layer of sub base to required cross sections and thicknesses to not less than 95 percent of maximum dry density according to ASTM D 4254.

3.24 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections unless otherwise noted.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Inspections and tests:

1. Geotechnical observations: Proof rolling procedures, site preparation, unsuitable soils removal, excavations, footing bearing, and fill placement.

2. Field Density Testing:

   a. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Geotechnical Engineer.

   b. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

      1) Fill under Footings: In each compacted fill layer, 1 compaction test for every 30 linear feet of wall may be taken. 1 compaction test may be made under each individual footing.

      2) Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 50 feet or less of wall length, but no fewer than two tests.

      3) Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.

      4) Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two tests.

   c. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3. Laboratory testing for on-site fills:

   a. ASTM D 1557 Modified Proctor compaction curve including sieve analysis.

3.25 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

   1. Scarify or remove and replace soil material to depth as directed by Geotechnical Engineer or Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.26 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 02300

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes storm utility drainage piping and related components outside the building.

B. Section Includes:

1. Pipe and fittings.
2. Nonpressure transition couplings.
3. Pressure pipe couplings.
4. Cleanouts.
5. Drains.
6. Manholes.
7. Channel drainage systems.
8. Catch basins.
9. Stormwater inlets.
10. Stormwater Outlet structures.
11. Pipe outlets.
12. Dry wells.
13. Stormwater disposal systems.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins stormwater inlets and dry wells. Include plans, elevations, sections, details, frames, covers, and grates.
3. Outlet Structures: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design-mix reports.

C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

D. Quality Control Submittals

1. Qualifications Certification: Submit written certification or similar documentation signed by applicable subcontractor, Prime Contractor and manufacturer (where applicable) indicating compliance with applicable “Qualifications” requirements specified below in “Quality Assurance” article.

2. Installer Experience Listing: Submit list of completed projects using products proposed for this Project, including owner’s contact and telephone number for each project, demonstrating compliance with applicable “Qualifications” requirements specified below in “Quality Assurance” article.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Perform work, including shoring, in compliance with the applicable requirements of governing authorities having jurisdiction.

B. Comply with applicable Utility Company Regulations. Municipal Sewer Connection: Coordinate connection to existing municipal sewer with local sewer authority. Pay for all fees associated with connection to municipal sewer.

1. Local sewer authority contact :

Village of Hudson Falls Department of Public Works
Michael Fiorillo, Superintendent of Public Works
220 Main Street
Hudson Falls, NY 12839
DPW Telephone: 518-747-4544
Village Hall Telephone: 518-747-5426
Fax: 518-747-5597

2. Install connections to municipal sewer in accordance with local sewer authority standards and OSHA regulations. Provide materials complying with local sewer authority standards.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
B. Protect pipe, pipe fittings, and seals from dirt and damage.
C. Handle manholes according to manufacturer's written rigging instructions.
D. Handle catch basins, drywells and stormwater inlets according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy classes.

B. Gaskets: ASTM C 564, rubber.

C. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Charlotte Pipe and Foundry.

2.2 CORRUGATED STEEL PIPE AND FITTINGS

A. Corrugated Metal Pipe: Galvanized, fully bituminous-coated round corrugated steel pipe complying with New York State Department of Transportation Standard Specification Section 707-02 and AASHTO M190, Type I.

1. Unless otherwise noted, provide the following gauge of pipe:

a. 24” or less diameter: 16 gauge.
b. 30" to 36” diameter: 14 gauge.

2. Construct joints with corrugated bands lapping equal portions of each pipe section to be connected and fabricated to allow firm and secure field connection.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Contech

2.3 PE PIPE AND FITTINGS

A. Interior Diameter, 4" to 36": Corrugated polyethylene circular pipe with an integrally formed smooth interior complying with the following specifications:

1. Applicable Standards

a. 4 inch to 10 inch pipe: AASHTO M 252-Type S or SP
b. 12 inch to 36 inch pipe: AASHTO M294-Type S or SP

2. Mannings “n” Value: 0.012.

3. ASTM D3034 for maximum allowable deflection.

4. Fittings to meet performance requirements of ASTM D 3034 and ASTM F 1336. Gaskets to comply with ASTM F477.

B. Interior Diameter, 42" to 60": Corrugated polyethylene circular pipe with an integrally formed smooth interior complying with the following specifications:

1. Applicable Standards

a. 42 inch to 48 inch pipe: AASHTO MP6
b. 60 inch pipe: AASHTO MP7

2. Mannings “n” Value: 0.012.

3. ASTM D3034 for maximum allowable deflection.

4. Fittings to meet performance requirements of ASTM D 3034 and ASTM F 1336. Gaskets to comply with ASTM F477.

C. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Advanced Drainage Systems
2. Lane

2.4 PVC PIPE AND FITTINGS

A. PVC Gravity Sewer Piping:

1. Pipe: ASTM D 3034, SDR 26, PVC Type PSM sewer pipe, green in color, with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

B. PVC Pressure Piping:

1. Pipe: AWWA C900, Class 150 PVC pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: AWWA C900, Class 150 PVC pipe with bell ends
3. Gaskets: ASTM F 477, elastomeric seals.

C. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Charlotte Pipe and Foundry ?
2. J-M Manufacturing
3. IPEX Inc.

2.5 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:

1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Dallas Specialty & Mfg. Co.
   b. Fernco Inc.
   c. Mission Rubber Company; a division of MCP Industries, Inc.
   d. NDS Inc.
   e. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.

2. Description: Elastomeric sleeve with corrosion-resistant-metal tension band and tightening mechanism on each end.

2.6 PRESSURE PIPE COUPLINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cascade Waterworks Mfg.
2. Dresser, Inc.
3. Ford Meter Box Company, Inc. (The); Pipe Products Div.

B. Description: AWWA C219, tubular-sleeve coupling, with center sleeve, gaskets, end rings, and bolt fasteners.

C. Metal, bolted, sleeve-type, reducing or transition coupling, for joining underground pressure piping. Include 200-psig minimum pressure rating and ends sized to fit adjoining pipes.

D. Center-Sleeve Material: Manufacturer's standard.

E. Gasket Material: Natural or synthetic rubber.

F. Metal Component Finish: Corrosion-resistant coating or material.

2.7 CLEANOUTS

A. Cast-Iron Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Josam Company.
   b. Smith, Jay R. Mfg. Co.
   c. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

2. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover with vandal proof screws. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

3. Top-Loading Classification(s): Heavy Duty.

4. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. Plastic Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. NDS Inc.
   b. Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
   c. Zurn Light Commercial Products Operation; Zurn Plumbing Products Group.

2. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.8 DRAINS

A. Inline Drains:

1. Manufacturer(s): Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Nyloplast by Advance Drainage Systems, Inc.

2. Description: Precast PVC Inlet with cast or ductile iron body with anchor flange and round grate in diameter shown on Drawings. Include watertight pipe adapters of sizes indicated.

a. Joint tightness shall conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals

b. Metal used in the manufacture of the castings shall conform to ASTM A536 grade 70-50-05 for ductile iron and ASTM A-48-83 class 30B for 12” and 15” cast iron frames. Grates shall be provided painted black

3. Backfill Material

a. The backfill material shall be crushed stone or other granular material meeting the requirements of Structure Bedding as defined in Specification Section 02300 “Earth Moving”.
b. The drainage inlets shall be bedded and back-filled uniformly in accordance with ASTM D2321.

4. Top-Loading Classification(s): Heavy Duty H20 Traffic Loading.

2.9 MANHOLES

A. Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

2. Diameter: 48 inches minimum unless otherwise indicated.

3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.

4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.

5. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.

6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.

7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.

8. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.

9. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:

1. Description: Castings of uniform quality, free from blow holes, porosity, hard spots, shrinkage defects, cracks, or other injurious defects. Manufactured true to pattern and free from surface imperfections. Provide machined horizontal bearing surfaces on heavy duty round frames and covers or grates and fabricate round frames and covers or grates in pavement of non-rocking design or with machined bearing surfaces. Grinds finish other units to proper fit. Apply shop coat of asphaltum to all units.

2. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

3. Material: Heavy Duty Round Frame and Covers, weight at least 350 lbs, meeting ASTM A 48/A 48M, Class 35 gray iron unless otherwise indicated.

4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Neenah Foundry Co.
b. Syracuse Castings
c. Campbell Foundry

2.10 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

2.11 CHANNEL DRAINAGE SYSTEMS

A. General Requirements Channel Drainage Systems: Modular system of precast, polymer-concrete channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling. Include quantity of units required to form total lengths indicated.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ABT, Inc.
2. ACO USA.
3. Poly-Cast.

C. Sloped-Invert, Polymer-Concrete Systems:

1. Channel Sections:

a. Interlocking-joint, precast, modular units with end caps.
b. 4-inch inside width and deep, rounded bottom, with built-in invert slope of 0.6 percent and with outlets in quantities, sizes, and locations indicated.
c. Extension sections necessary for required depth.
d. Frame: Include gray-iron or steel frame for grate.

2. Grates:

a. Manufacturer's designation "Heavy Duty," with slots or perforations that fit recesses in channels.
b. Material: Gray iron.
c. Grating must meet ADA requirements in Pedestrian areas.

3. Covers: Solid gray iron if indicated.

4. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

D. Drainage Specialties: Precast, polymer-concrete units.

1. Catch Basins:

a. 19- to 24-inch by approximately 6-inch polymer-concrete body, with outlets in quantities and sizes indicated.
b. Gray-iron slotted grate.
c. Frame: Include gray-iron or steel frame for grate.

E. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.

F. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.12 CATCH BASINS

A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.

2. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.

3. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.

4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.

5. Joint Sealant: ASTM C 990, bitumen or butyl rubber.

6. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.

7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and grate.

8. Steps: Individual FRP steps or FRP ladder Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 48 inches.

9. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

B. Designed Precast Concrete Catch Basins: ASTM C 913, precast, reinforced concrete; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for joint sealants.

1. Joint Sealants: ASTM C 990, bitumen or butyl rubber.

2. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.

3. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and grate.

4. Steps: Individual FRP steps or FRP ladder Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 48 inches.

5. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

C. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 by 24 inches minimum unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

D. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch- diameter flat grate with small square or short-slotted drainage openings.

1. Grate Free Area: Approximately 50 percent unless otherwise indicated.

2.13 STORMWATER INLETS

A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to local utility standards.
B. Gutter Inlets: Made with horizontal gutter opening, of materials and dimensions according to local utility standards. Include heavy-duty frames and grates.
C. Combination Inlets: Made with vertical curb and horizontal gutter openings, of materials and dimensions according to local utility standards. Include heavy-duty frames and grates.
D. Frames and Grates: Heavy duty, according to local utility standards.

2.14 STORMWATER OUTLET STRUCTURES

A. Cast-in-Place Concrete, Stormwater Detention Structures: Constructed of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.

1. Ballast: Increase thickness of concrete as required to prevent flotation.

2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch- diameter frame and cover.

3. Steps: Individual FRP steps or FRP ladder Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP ASTM A 615/A 615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D 4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of structure to finished grade is less than 48 inches.

B. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

2.15 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. Riprap Basins: Broken, irregularly sized and shaped, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

1. Average Size: NSSGA No. R-3, screen opening 2 inches.
2. Average Size: NSSGA No. R-4, screen opening 3 inches.
3. Average Size: NSSGA No. R-5, screen opening 5 inches.

C. Filter Stone: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. FS-2, No. 4 screen opening, average-size graded stone.

D. Energy Dissipaters: According to NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 3-ton average weight armor stone, unless otherwise indicated.

2.16 DRY WELLS

A. Description: ASTM C 913, precast, reinforced, perforated concrete rings. Include the following:

1. Floor: Cast-in-place concrete.

2. Cover: Liftoff-type concrete cover with cast-in lift rings.

3. Wall Thickness: 4 inches minimum with 1-inch diameter or 1-by-3-inch- maximum slotted perforations arranged in rows parallel to axis of ring.

a. Total Free Area of Perforations: Approximately 15 percent of ring interior surface.
b. Ring Construction: Designed to be self-aligning.

4. Filtering Material: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch washed, crushed stone or gravel.

B. Frames and Grates: Heavy duty, according to local utility standards.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow.

2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.

3. Install piping with 24-inch minimum cover, or as indicated in Storm Structure Drainage Schedule.

4. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."

5. Install corrugated steel piping according to ASTM A 798/A 798M.

6. Install PE corrugated sewer piping according to ASTM D 2321.

7. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.

G. Install force-main pressure piping according to the following:

1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.

2. Install piping with 48-inch minimum cover.

3. Install PVC pressure piping according to AWWA M23, or ASTM D 2774 and ASTM F 1668.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join hub-and-spigot, cast-iron soil piping with gasketed joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
2. Join corrugated steel sewer piping according to ASTM A 798/A 798M.
3. Join corrugated PE piping according to ASTM D 3212 for push-on joints.
4. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.
5. Join dissimilar pipe materials with nonpressure-type flexible couplings.

B. Join force-main pressure piping according to the following:

1. Join PVC pressure piping according to AWWA M23 for gasketed joints.
2. Join dissimilar pipe materials with pressure-type couplings.

3.4 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Medium-Duty, top-loading classification cleanouts in earth or paved and unpaved foot-traffic foot-traffic areas.
2. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
3. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1-inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 DRAIN INSTALLATION

A. Install type of drains in locations indicated.

1. Use Light-Duty, top-loading classification drains in earth or unpaved foot-traffic areas.
2. Use Medium-Duty, top-loading classification drains in paved foot-traffic areas.
3. Use Heavy-Duty, top-loading classification drains in vehicle-traffic service areas.
4. Use Extra-Heavy-Duty, top-loading classification drains in roads.

B. Embed drains in 4-inch minimum concrete around bottom and sides.

C. Fasten grates to drains if indicated.

D. Set drain frames and covers with tops flush with pavement surface.

E. Assemble trench sections with flanged joints.

3.6 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.
B. Install precast concrete manhole sections with sealants according to ASTM C 891.
C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.
D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 1-inch above finished surface elsewhere unless otherwise indicated.

3.7 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.
B. Set frames and grates to elevations indicated.

3.8 STORMWATER INLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.
B. Construct riprap of broken stone, as indicated.
C. Install outlets that spill onto grade, anchored with concrete, where indicated.
D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
E. Construct energy dissipaters at outlets, as indicated.

3.9 DRY WELL INSTALLATION

A. Excavate hole to diameter of at least 6 inches greater than outside of dry well. Do not extend excavation into ground-water table.

B. Install precast, concrete-ring dry wells according to the following:

1. Assemble rings to depth indicated.
2. Extend rings to height where top of cover will be approximately 8 inches below finished grade.
3. Backfill bottom of inside of rings with filtering material to level at least 12 inches above bottom.
4. Extend effluent inlet pipe 12 inches into rings and terminate into side of tee fitting.
5. Backfill around outside of rings with filtering material to top level of rings.
6. Install cover over top of rings.

3.10 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.11 CHANNEL DRAINAGE SYSTEM INSTALLATION

A. Install with top surfaces of components, except piping, flush with finished surface.
B. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.
C. Embed channel sections and drainage specialties in minimum concrete around bottom and sides.
D. Fasten grates to channel sections if indicated.
E. Assemble channel sections with flanged or interlocking joints.
F. Embed channel sections in 4-inch minimum concrete around bottom and sides.

3.12 STORMWATER DISPOSAL SYSTEM INSTALLATION

A. Chamber Systems: Excavate trenches of width and depth, and install system and backfill according to chamber manufacturer's written instructions. Include storage and leaching chambers, filtering material, and filter mat.

B. Piping Systems: Excavate trenches of width and depth, and install piping system, filter fabric, and backfill, according to piping manufacturer's written instructions.

3.13 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 15 Section "Facility Storm Drainage Piping."

B. Connect force-main piping to building's storm drainage force mains specified in Division 15 Section "Facility Storm Drainage Piping." Terminate piping where indicated.

C. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

D. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

    a. Unshielded flexible couplings for same or minor difference OD pipes.
    b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
    c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure-type pipe couplings for force-main joints.

3.14 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least 8-inch brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

1. Remove manhole or structure and close open ends of remaining piping.
2. Remove top of manhole or structure down to at least 36-inches below final grade. Fill to within 12-inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade according to Division 31 Section "Earth Moving."

3.15 IDENTIFICATION

A. Materials and their installation are specified in Specification Section 02300 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.16 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.

2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.
b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
d. Infiltration: Water leakage into piping.
e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.

4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.

2. Test completed piping systems according to requirements of authorities having jurisdiction.

3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.

4. Submit separate report for each test.

5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
b. Option: Test plastic piping according to ASTM F 1417.
c. Option: Test concrete piping according to ASTM C 924.

6. Force-Main Storm Drainage Piping: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig.

a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.17 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION 02630

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sidewalks.
2. Driveways.
3. Curbs and gutters.
4. Concrete pavement marking paint.

B. Related Sections:

1. Section 03310 "Cast-in-Place Concrete” for general concrete mix, materials, installation and building-related concrete requirements.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

B. Refer to Specification Section 03310 "Cast-in-Place Concrete” for concrete submittal requirements, material certificates, installer qualification data and other required action and informational submittals.

1.4 ACTION SUBMITTALS

A. Jointing Plan: Provide shop drawing showing concrete joint layout, specifically indicating the locations of expansion, tooled and control joints.
B. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer. (Refer to Specification Section 03310 "Cast-in-Place Concrete" for requirements.)

1.6 QUALITY ASSURANCE

A. For Installer and Manufacturer requirements, refer to Specification Section 03310 "Cast-in-Place Concrete”

B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship in the location and of the size indicated where directed by Architect and not less than 96 inches by 96 inches.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 Refer to Specification Section 03310 "Cast-in-Place Concrete” for products, unless noted below.

2.2 FORMS

A. Form Materials: Metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 CONCRETE MATERIALS

A. Refer to Specification Section 03310 "Cast-in-Place Concrete” for cementitious material, aggregates, admixtures, and other concrete materials.

2.4 FIBER REINFORCEMENT

A. Refer to Specification Section 03310 "Cast-in-Place Concrete" for fiber reinforcement materials.

2.5 INTEGRAL COLOR

A. Color Pigment: Refer to Specification Section 03310 "Cast-in-Place Concrete" for integral concrete coloring product requirements.

1. Color: As selected by Architect from manufacturer's full range.

2.6 CURING MATERIALS

A. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1-D, Class B, dissipating, with fugitive dye.

2.7 SEALER

A. Penetrating, Silane Sealer: Single component, 40% silane, waterbased slab sealer that forms chemical bond to the concrete. VOC compliant.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals; Enviroseal 40.
b. Chem Masters; Aquanil Plus 40.
c. Dayton Superior Corporation; Weather Worker 40% J29WB.

2.8 JOINT SEALANT

A. Joint Sealant: Two-part, elastomeric polyurethane or polysulfide-based pourable self-leveling joint sealant complying with ASTM C 920, Type M, Grade P, Class 25, NT and CRD-C-506, Type 1, Classes A & B.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Building Systems; Sonolastic SL 2.

1) Color: Limestone (for uncolored concrete only).

b. W.R. Meadows, Inc.; Deck-O-Seal Sealant. Color: Stone Gray (For uncolored concrete only.)

2.9 RELATED MATERIALS

A. Expansion/Isolation-Joint-Filler Strips: ½-inch rigid, extruded polystyrene insulation (at exterior walls) ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

B. Plastic Expansion Joint Forming System ("Zip-Strip"): Plastic joint form plus cap.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following: (inserted space)

a. W.R. Meadows, Inc.; Snap-Cap.

2.10 DETECTABLE WARNING MATERIALS

A. Detectable Warning Surface - for Handicap Accessible Concrete Curb Ramps: 12-inch square, 12-inch x 24-inch or 24-inch x 24-inch units with raised truncated domes complying with ADA and the NYS Building Code, having a skid resistance of 0.90 coefficient of friction and depth of 2" to 2 ¾".

1. Color: Red

2. Precast Concrete:

3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Hengestone Holdings, Inc.; Unilock ADA Pavers.
b. Wausau Tile ADA Pavers.
c. Hanover Architectural Products; Detectable Warning Pavers.

2.11 PAVEMENT MARKINGS

A. Pavement-Marking Paint: MPI #32 Alkyd Traffic Marking Paint.
B. Colors: White, Yellow, Blue**.**

2.12 CONCRETE MIXTURES

A. Refer to Specification Section 03310 "Cast-in-Place Concrete" for concrete mixtures unless modified below.

1. Compressive Strength (28 Days): 4000 psi.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving in accordance with Section 312000 “Earthwork”. Identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction.

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

D. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

3.4 STEEL REINFORCEMENT

A. Refer to Specification Section 03310 "Cast-in-Place Concrete” for steel reinforcement.

3.5 JOINTS

A. General: Form construction, expansion/isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.

2. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Expansion/Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 30 feet unless otherwise indicated.

2. Extend joint fillers full width and depth of joint.

3. Plastic Expansion Joint Forming System ("Zip Strip"). Install so that cap of channel is flush with surrounding concrete pavement. Install per manufacturer's installation instructions. Remove plastic cap after concrete is cured.

4. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.

5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

D. Control/Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows, to match jointing of existing adjacent concrete paving unless otherwise noted:

1. Tooled/Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.

2. Tooled/Grooved and Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks. Sawed joints without tooling are not allowed.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Refer to Specification Section 03310 "Cast-in-Place Concrete" for concrete placement information.

B. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

C. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

D. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

E. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

F. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, (4.3.2.1 Slump Adjustment).

1. With each concrete mixture submittal, indicate amounts of mixing water to be withheld for later addition at Project site.

2. Water added must not increase the water-cement ratio past the approved mix design ratio.

3. Add additional water reducer or plasticizer to mix instead of adding water to achieve flowable, workable concrete. Do not add water to concrete after adding these admixtures to mixture.

4. Do not add water after truck is more than half empty.

G. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

H. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement dowels and joint devices.

I. Screed paving surface with a straightedge and strike off.

J. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

K. Machine-Placed Curbs and Gutters: Allowed only upon Architect approval. Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

L. Slip-Form Paving: Allowed only upon Architect approval. Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

M. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

N. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.8 DETECTABLE WARNINGS

A. Blockouts: Form blockouts in concrete for installation of detectable paving units specified.

1. Tolerance for Opening Size: Plus 1/4 inch, no minus.

3.9 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 and 305R for hot-weather protection during curing.

B. Slabs: Protect slabs within building from precipitation accumulation. Immediately remove water, snow or ice from surface of slabs within building regardless if source is from precipitation, construction activities, etc.

C. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Formed Surfaces: Cure formed concrete surfaces, including supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

E. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

F. Cure concrete according to ACI 308.1:

1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

G. Apply penetrating, silane sealer per manufacturer’s instructions.

3.10 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow concrete paving to cure for a minimum of 28 days and be dry before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.11 FIELD QUALITY CONTROL

A. Refer to Specification Section 03310 "Cast-in-Place Concrete" for field quality control information.

1. Contractor Requirements:

a. Provide access to concrete construction for representatives of testing agency employed by Owner to perform concrete testing.
b. Notify Architect at least four days in advance of each concrete placement to allow notification of Owner's testing agency.

3.12 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 02775

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Chain-link fences.
2. Gates: Swing.

1.3 PERFORMANCE REQUIREMENTS

A. Design Wind Load: Comply with applicable requirements of building code in effect for Project including applicable portions of ASCE 7 for Wind Load Pressure and CLFMI WLG 2445 Wind Load Guide for the Selection of Line Post Spacings.

1.4 SUBMITTALS

A. General: Submit all action submittals (except Samples for Verification) and informational submittals required by this Section concurrently.

B. Action Submittals:

1. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for chain-link fences and gates.

    a. Fence and gate posts, rails, and fittings.
    b. Chain-link fabric, reinforcements, and attachments.
    c. Accessories: Privacy slats.
    d. Gates and hardware.

2. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show accessories, hardware, gate operation, and operational clearances.

3. Delegated-Design Submittal: For fencing systems noted below, submittals are to be signed and sealed by the qualified professional engineer responsible for submittal preparation. Include analysis data complying with performance design criteria.

4. Samples for Verification:

    a. Polymer-Coated Components: In 6-inch lengths for components and on full-sized units for accessories.

5. Warranty: Sample of special warranty.

C. Informational Submittals:

1. Qualification Data: Submit list of completed projects using products proposed for this Project, including owner's contact and telephone number for each project, demonstrating compliance with "Quality Assurance" article.

2. Product Test Reports: For framing strength according to ASTM F 1043.

D. Closeout Submittals:

1. Operation and Maintenance Data: For the following to include in operation and maintenance manuals:

a. Polymer finishes.
b. Gate hardware.

2. Warranty: Executed special warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Minimum two years experience in installing chain link fences and gates similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance.

B. Mockups: If required by Architect, build mockups to set quality standards for fabrication and installation.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which Contractor agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of any component of fence to perform as designed.
b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
c. Faulty operation of gate(s).

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle. Comply with CLFMI Product Manual and with requirements indicated below:

1. Fabric Height: As indicated on Drawings.

2. Steel Wire Fabric:

a. General Use: Wire with a diameter of 0.148 inch (9 gauge) minimum. For polymer coated fabric, wire with a diameter of 0.148 inch core (9 gauge core) minimum.

3. Mesh Size: 2 inches, unless noted otherwise.

4. Coatings:

a. Zinc-Coated Fabric: ASTM A 392, Type II, Class 1, 1.2 oz./sq. ft. with zinc coating applied before weaving.

b. Polymer-Coated Fabric: ASTM F 668, Class 2b, fused and adhered over zinc-coated steel wire.

1) Color: Black, complying with ASTM F 934.

c. Aluminum-Coated Fabric: ASTM A 491, Type I, 0.40 oz./sq. ft.

5. Selvage: Knuckled at both selvages.

2.2 FENCE FRAMING

A. Posts and Rails: Comply with ASTM F 1043 for framing, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 based on the following:

1. Fence Height: As indicated on Drawings.

2. Heavy Industrial Strength: Group IC, SS40, round steel electric-resistance-welded pipe.

3. Line Post Size (determined by height):

a.	4 feet up to and including 6 feet high:	2 inches o.d.
b.	7 feet up to and including 9 feet high:	2-1/2 inches o.d.
c.	10 feet up to and including 12 feet high:	3 inches o.d.
d.	Over 12 feet high:	4 inches o.d.

4. End, Corner and Pull Post:

a.	4 feet up to and including 6 feet high:	2-1/2 inches o.d.
b.	7 feet up to and including 9 feet high:	3 inches o.d.
c.	10 feet up to and including 12 feet high:	4 inches o.d.
d.	Over 12 feet high:	4 inches o.d.

5. Horizontal Framework Members: Intermediate, top and bottom rails complying with ASTM F 1043. Size in accordance with the following guidelines unless otherwise indicated on drawings

   a. Top, Intermediate and Bottom Rail: 1.66 inches in diameter.

   b. Bottom Rail: Provide bottom rail for:

      1) Fence 9 feet high and over

   c. Intermediate Rail: Provide intermediate rail for:

      1) Fencing 12 feet high and over,
      2) Tennis/basketball court fencing

   d. Softball and Baseball Backstop horizontal framework sizes: Refer to Drawings and Details.

6. Brace Rails: Comply with ASTM F 1043.

7. Metallic Coating for Type I Steel Framing:

   a. Type B, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film.

   b. Polymer coating over metallic coating: ASTM F1043 Section 7, Paragraph 7.3 and Section 8, Paragraph 8.1, and ASTM F 668 Class 2b, 10 to 15 mils (0.254 - 0.38 mm) fused and adhered over zinc-coated framework.

      1) Color: Match chain-link fabric, complying with ASTM F 934.

2.3 TENSION WIRE

A. Metallic-Coated Steel Wire: For use on fencing with zinc coated fence fabric. 0.177-inch-diameter (7 gauge), marcelled tension wire complying with ASTM A 817 and ASTM A 824, with the following metallic coating:

1. Type II, zinc coated (galvanized) with the following minimum coating weight:

   a. Matching chain-link fabric coating weight.

2. Type I, aluminum coated (aluminized)

B. Polymer-Coated Steel Wire: For use on fencing with polymer coated fence fabric. 0.177-inch-diameter, tension wire complying with ASTM F 1664, Class 2b over zinc-coated steel wire.

1. Color: Match chain-link fabric, complying with ASTM F 934.

2.4 SWING GATES

A. General: Comply with ASTM F 900 for gate posts and single and double swing gate types.

1. Gate Leaf Width: 36 inches unless otherwise noted on drawings..
2. Gate Fabric Height: As indicated on drawings.

B. Pipe and Tubing:

1. Coating and finish to match fence framing.

2. Gate Post Size:

a. Gate Leaf up to 6 feet Wide: 2.875 inches o.d.; 4.64 lbs./l.f.

b. Gate Leaf over 6 feet and under 12 feet wide: 4 inches o.d.; 6.56 lbs./lin. ft. (weight applicable to Group IC SS40 framework only)

c. Gate Leaf over 12 feet Wide: 6.625 inches o.d.; 19 lbs./lin. ft.; or 4.5 inches o.d. (applicable to Group IC SS40 material complying with ASTM F 1043 only and upon approval of framework material by Architect.)

C. Frame Corner Construction: Welded.

D. Hardware:

1. Hinges: 180-degree inward swing unless otherwise noted on Drawings.

2. Latches permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.

3. Padlock and Chain: Owner furnished.

4. Keeper: Provide keeper for all vehicular gates, which automatically engages gate leaf and holds it in open position until manually released. Provide sleeve to insert keeper. For concrete paving, set sleeve directly into concrete. For asphalt paving set sleeve into concrete collar.

5. Double Gates: Provide gate stops for all double gates, consisting of mushroom type or flush plate with anchors. Set in concrete to engage the center drop rod or plunger bar. Provide locking device and padlock eyes as an integral part of the latch, requiring one padlock for locking both gate leaves.

6. Closer: Manufacturer's standard.

2.5 FITTINGS

A. General: Comply with ASTM F 626.

B. Post Caps: Provide for each post. Post caps to be weather-tight, securely fastened and vandal-resistant.

1. Provide line post caps with loop to receive tension wire or top rail.

C. Rail and Brace Ends: For each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:

1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches long.
2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails in the fence line-to-line posts.

E. Tension and Brace Bands: Pressed steel.

F. Tension Bars: Steel. Length not less than 2 inches shorter than full height of chain-link fabric with minimum cross-section of 3/16 inch x 3/4 inch. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading. Provide rod and turnbuckle or other means of adjustment.

H. Tie Wires, Clips, and Fasteners: According to ASTM F 626.

1. Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:

a. General Use Fencing including Foul Line, Outfield and Tennis Court Fencing:

1) Aluminum: ASTM B 211; Alloy 1350-H19; 0.148-inch-diameter, mill-finished wire. Coating to match chain-link fence fabric. (Provide polymer coating on fencing with polymer coated fabric.)

b. Baseball and Softball Backstops and Dugouts:

1) Hot-Dip Galvanized Steel: 0.148-inch (9 gauge core) diameter wire. Coating to match chain-link fence fabric. (Provide polymer coating on fencing with polymer coated fabric.)

2. Hog Rings: For attaching chain link fabric to bottom tension wire.

a. Aluminum: ASTM B 211; Alloy 1350-H19; 0.192 inch (6 gauge), mill-finished wire.

I. Fitting Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. zinc.

a. Polymer coating over metallic coating to match coating of chain link fence fabric.

2. Aluminum: Mill finish with coating to match chain-link fence fabric. (Provide polymer coating on fencing with polymer coated fabric.)

2.6 CHAIN LINK CANTILEVER SLIDE GATE

A. Gate Frame: Fabricated in accordance with ASTM F1184, Class 2, using 2" square aluminum members, ASTM B221, alloy and temper 6063-T6, weighing 0.94 lb./ft. Members welded together forming rigid on-piece frame integral with top track. 2 truck assemblies provided for each gate leaf unless otherwise specified. Gates over 27 ft. in single opening shipped in 2 parts and field spliced with manufacturer's special attachments.

1. Internal Uprights: 2" x 2" aluminum members welded in gate frames, at approximately 8 ft. o.c., subdividing frame into panels.

2. Single Gate Leaf (up to 22 ft. wide):

	Gate Leaf Sizes	Cantilever Support (overhang)
a.	6 ft - 10 ft	6'-6"
b.	11ft - 14 ft	7'-6"
c.	15 ft. - 22 ft.	10'-0"

3. Single Gate Leaf (23 ft. to 30 ft. wide) and Bi-Parting Double Gate (46 ft. to 60 ft. wide): Additional 2" square lateral support rail welded adjacent to top horizontal rail, and 2" x 4" aluminum bottom rail provided weighing 1.71 lbs./ft.

	Gate Leaf Sizes	Cantilever Support (overhang)
a.	23 ft - 30 ft	12'-0"

4. Single Gate Leaf (31 ft. to 40 ft. wide) and Bi-Parting Double Gate (62 ft. to 80 ft. wide): 2 top track/rails welded together forming dual enclosed track, and 2 ea. truck assemblies provided for each track for each gate leaf for total of 4 truck assemblies. 2" x 4" aluminum bottom rail provided weighing 1.71 lbs./ft.

	Gate Leaf Sizes	Cantilever Support (overhang)
a.	31 ft - 35 ft	13'-6"
b.	36ft - 40 ft	16'-0"

5. Single Gate Leaf (41 ft. to 50 ft. wide) and Bi-Parting Double Gate (82 ft. to 100 ft. wide): 24" wide rigid box frame truss fabricated consisting of dual side frames similar to standard single leaf gates, separated by square cross members and diagonal truss rod bridging. Dual side frames contain top track/rail providing support for truss from both sides. 4 trucks provided for each track for total of 8 trucks for each gate leaf. Steel plate welded between top of support posts to maintain truck assemblies in alignment with tracks.

	Gate Leaf Sizes	Cantilever Support (overhang)
a.	41 ft - 50 ft	Custom engineered by manufacturer

6. Chain Link Fence Fabric: Unless otherwise indicated, provide No. 9 gauge core (0.148") steel wires, 2" mesh, with top and bottom selvages knuckled, complying with ASTM A-491. Provide one-piece fabric widths for fencing up to 12 ft. high.

   a. Fabric Finish: Aluminum coated, with not less than 0.40 oz. aluminum coating per sq. ft. of wire surface per ASTM A-428.

   b. Fabric Finish: Plasticized PVC coating per ASTM F-668 extrusion bonded to galvanized wire in accordance with FS RR-F-191 H/IB, Plasticized PVC coating per ASTM F-668 extrusion bonded to galvanized wire in accordance with FS RR-F-191 H/IB

7. Bracing: Diagonal adjustable length 3/8" galvanized steel truss rods in each panel of gate frames.

8. Top Track/Rail: Enclosed, combination one-piece track and rail, aluminum extrusion weighing 3.72 lbs/ft. and designed to withstand reaction load of 2,000 lbs. Track not coated with PVC.

9. Truck Assembly: Swivel type, zinc die cast, with 4 sealed lubricant ball bearing rollers, 2" diam. x 9/16" wide and 2 side rolling wheels ensuring truck alignment in track. Trucks mounted on post brackets using 7/8" diam. ball bolts with 1/2" shank. Trucks designed to withstand same reaction load as track.

10. Gate Hangers, Latches, Brackets, Guide Assemblies, and Stops: Malleable iron or steel, galvanized after fabrication and including positive latch with provision for padlocking. Fittings not coated with PVC.

11. Bottom Guide Wheel Assemblies: Consists of 2 ea. 4" diam. rubber wheels, straddling bottom horizontal gate rail, allowing adjustment to maintain gate frame plumb and in proper alignment. One assembly attached to each guide post. Fitting not coated with PVC.

12. Gate Posts: Galvanized steel, 4" O.D. Schedule 40 pipe, weighing 9.1 lbs/ft., with 1 latch post and 2 support posts for single slide gates and 4 support posts for double slide gates.

13. Gate Posts: Galvanized steel, 3" square tube, weighing 7.04 lbs/ft., with 1 latch post and 2 support posts for single slide gates and 4 support posts for double slide gates.

14. Finish: Match fence.

15. Concrete: Minimum 28 day compressive strength of 3,000 psi.

16. Post Bracket: Flange type base plates with 4 holes for surface mounting of posts where indicated.

2.7 PRIVACY SLATS

A. Material: Polyethylene tubular slats, not less than 0.023 inch thick, manufactured for chain-link fences from virgin polyethylene containing UV inhibitor, sized to fit mesh specified for direction indicated; with vandal-resistant fasteners and lock strips. Slats to provide 90%-95% visual screening.

B. Color: As selected by Architect from manufacturer's full range.

2.8 CONCRETE

A. Concrete Footings: Refer to Specification Section 03310 "Cast-in-Place Concrete" for cast-in-place concrete, ASTM F 567 Section 5 and Drawings and Details for footing size. Bottom of footing must not be smaller than the top to prevent frost heaving.

2.9 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107 and compatible with galvanized and clear coatings. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer, for exterior applications. To be compatible with galvanized and clear coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

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

C. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 INSTALLATION, GENERAL

A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements indicated.

1. Install fencing on established boundary lines inside property line.

3.4 CHAIN-LINK FENCE INSTALLATION

A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil. Mechanically driven posts only allowed if shown on Drawings or specifically approved by Architect.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.

a. Concrete Fill: Minimum 28 day compressive strength 3000 psi (20 MPa). Refer to Division 03 Section "Cast-in-Place Concrete".
b. Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

C. Types of Post Footings: As indicated on Drawing or as approved by Architect.

1. Exposed Concrete: Extend 2 inches above grade; shape and smooth to shed water.

2. Concealed Concrete: As indicated on Drawings to allow covering with surface material.

3. Posts Set into Concrete in Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.

4. Mechanically Driven Posts: Drive into soil to depth of 36 inches. Protect post top to prevent distortion. Mechanically driven posts only allowed as indicated on Drawings or upon approval by Architect.

D. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.

E. Line Posts: Space line posts uniformly at 10 feet o.c. unless otherwise indicated on Drawings.

F. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.

1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

G. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with hog rings spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:

1. Extended along bottom of fence fabric. Install bottom within 6 inches of bottom of fabric and tie to each post with tie wires.

H. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

I. Intermediate and Bottom Rails: Install and secure to posts with fittings.

J. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2 inches between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

K. Tension or Stretcher Bars: Thread bar through first row of diamonds of fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches o.c.

L. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Aluminum ties: Both ends of the tie are to make two complete wraps around wire pickets. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.

M. Privacy Slats: Install slats in direction indicated, securely locked in place.

1. Vertically.

3.5 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain chain-link fences and gates.

3.8 COMPLETION AND CLEAN UP

A. Leave the area of installation free of debris and excess soil, concrete, and gravel resulting from installation of the fence. Clean fencing of concrete slurry, hydroseeding overspray and any other excess material. Seed and mulch all areas around the fencing where bare earth is left exposed.

END OF SECTION 02820

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fabricated metal bollards.
2. Pre-fabricated bollards.
3. Decorative Bollard covers.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals (except Samples for Verification) and informational submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Fabricated metal bollards.
2. Pre-fabricated bollards.
3. Decorative Bollard covers.

B. Shop Drawings: Show fabrication and installation details for bollards.

1. Include plans, elevations, sections, and details of bollards and their connections. Show anchorage and accessory items.

1.5 INFORMATIONAL SUBMITTALS

A. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats. Refer to Section 09960, “High Performance Coatings” for painting fabricated bollards requirements.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of construction contiguous with bollards by field measurements.

1.8 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
C. Steel Tubing: ASTM A 500, cold-formed steel tubing.

2.3 NONFERROUS METALS

A. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners. Select fasteners for type, grade, and class required.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Acrylic Primer: Thermoplastic acrylic primer compatible with topcoat.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Rust-Oleum Corporation; 3200 System Clear Blue Undercoat.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Concrete: Comply with requirements in Specification Section 03310 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.6 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.7 FABRICATED METAL BOLLARDS

A. Fabricated Metal Bollard: Fabricate metal bollards from 1/4-inch wall-thickness round galvanized steel tubing.

1. Cap bollards with 1/4-inch-thick dome-shaped steel plate welded to post.
2. Paint metal bollards with high performance coating primer and high performance paint finish coats. Refer to Section 09960, “High Performance Coatings”.

2.8 BOLLARD COVERS

A. Plastic Bollard Cover: Heavy duty plastic bollard cover that fits over standard site-fabricated steel bollard.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Shield, Plastic Bollard Cover, ¼” thick polyethylene or comparable product.
2. Materials: 1/4” thick UV resistant and anti-static LDPE plastic sleeve, domed at top.
3. Sleeve for pipe diameter: 6 inch.
4. Color**:** Yellow. Color warrantied for five years.

2.9 PRE-FABRICATED METAL BOLLARDS

A. Pre-Fabricated Powdercoated Steel Bollard: Pre-fabricated 5 inch O.D., bollard, high with ground mounting and cals.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Victor Stanley Secure Site Street Sentry Series Model L-227.

2. Materials: 6” O.D. tubular steel.

3. Height: 4 feet.

4. Finish: Polyester powdercoating. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

   a. Color: Yellow

5. Mounting: Ground mounting.

2.10 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
B. Finish metal fabrications after assembly.
C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.11 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Primer: Provide high performance shop primer in conformance with Section 09960, “High Performance Coatings”.

C. Painting: Apply high performance coatings in conformance with Section 09960, “High Performance Coatings”.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Coordinate location to avoid utilities.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

G. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 PRIMING AND PAINTING

A. Preparation for Shop Priming: Prepare surfaces in conformance with Section 09960, “High Performance Coatings”.
B. Shop Priming: Apply high performance shop primer in conformance with Section 09960, “High Performance Coatings”.
C. Painting: Apply high performance coatings in conformance with Section 09960, “High Performance Coatings”. Provide the number of coatings (minimum) as specified.

3.3 INSTALLING FABRICATED METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

B. Anchor bollards in place with concrete footings. Center and align bollards in holes 12 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured. Set bollard plumb.

3.4 INSTALLING PRE-FABRICATED BOLLARDS

A. Install bollards according to manufacturer's written instructions. Set bollards plumb.

3.5 INSTALLING PLASTIC BOLLARD COVERS

A. Install with manufacturer’s neoprene adhesive tape per manufacturer’s installation guidelines.

3.6 ADJUSTING AND CLEANING

A. Touchup Painting: Provide touchup painting in conformance with Section 09960, “High Performance Coatings”.
B. Clean all surfaces thoroughly and protect until acceptance.

END OF SECTION 02821

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Seeding.
2. Turf planting soil.
3. Turf planting soil amendments and fertilizers.
4. Turf renovation.
5. Turf maintenance.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Seed.
2. Fertilizer.
3. Compost.

B. Warranty: Sample of special warranty.

1.5 INFORMATIONAL SUBMITTALS

A. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

B. Qualification Data: For qualified landscape Installer.

C. Product Certificates: For soil amendments and fertilizers, from manufacturer.

D. Material Test Reports: For imported topsoil.

1. Before delivery of imported topsoil, submit written statement giving location of properties from which topsoil is to be obtained, names and addresses of property owners, topsoil nutritional analysis report per requirements below, depth to be stripped, and any crops grown during the previous 5 years.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.

2. Turf Installer: Engage an experienced turf installation firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance.

B. Soil Nutritional Analysis Report for Imported Topsoil: Furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; available nutrients; deleterious material; pH and recommendations to obtain optimal pH factor; mineral and nutrient content of the soil.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

1.8 PROJECT CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.

1. Spring Planting: March 15 to May 15.
2. Fall Planting: August 15 to September 15.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.9 SEQUENCING AND REVIEW

A. Notify Architect no fewer than 48 hours in advance of proposed planting to allow review of topsoil finish grading.

B. Do not proceed with planting without Architect's written permission.

1. Architect’s written permission does not alleviate Contractor from conforming to the required grades indicated on Drawings.

1.10 MAINTENANCE

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, as determined by the Architect, but for not less than the following periods:

1. Seeded Turf: Three documented mowings.

a. Document mowings in writing via fax or email to Owner and Architect on the day each mowing is performed. Failure of notification may subject Contractor to further mowings at no additional cost to Owner.

2. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

B. Water: Provide all water required to properly irrigate temporary, permanent, and renovated turf areas. Include all facilities including, but not limited to, hoses, sprinklers, water cannons and reels, as long as it takes to establish and maintain turf. When adequate water supply or pressure is not available, supply water from offsite, including trucking.

1.11 WARRANTY

A. Special Warranty: Installer agrees to repair or replace turf that fails in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.

2. Warranty Period:

a. Turf: 12 months, after acceptable turf is established, as determined by the Architect.

3. Include the following remedial actions as a minimum:

a. Immediately remove dead turf and replace unless required to plant in the succeeding planting season.
b. Replace with seed or sod as originally specified.

B. Provide extended warranty for period equal to original warranty period, for replaced turf material.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Varieties: Premier varieties of Kentucky bluegrass, perennial ryegrass, tall fescue and fine fescue with a mean ranking of 6.0 or higher on the National Turfgrass Evaluation Program (NTEP) current list of tested varieties for the Northeast United States.

C. Seed Blends: Seed of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

1. General Lawn Mixture: Proportioned by weight as follows:

a. 70 percent 1/3 equal mixture of three Kentucky bluegrass (Poa pratensis) varieties.
b. 20 percent perennial ryegrass (Lolium perenne).
c. 10 percent fine fescue (Fescue rubra).

2. General Lawn Sun/Shade Mixture: Proportioned by weight as follows:

a. 60 percent 1/3 equal mixture of three Kentucky bluegrass (Poa pratensis) varieties.
b. 15 percent perennial ryegrass (Lolium perenne).
c. 25 percent fine fescue (Fescue rubra).

3. Athletic Field Blend (Kentucky bluegrass): Proportioned by weight as follows:

a. 75 percent 1/3 equal mixture of three Kentucky bluegrass (Poa pratensis) varieties.
b. 20 percent perennial ryegrass (Lolium perenne).
c. 5 percent fine fescue (Fescue rubra).

4. Athletic Field Blend (Tall fescue): Proportioned by weight as follows:

   a. 95 percent tall fescue.
   b. 5 percent Kentucky bluegrass (Poa pratensis).
   c. 20 percent perennial ryegrass (Lolium perenne).

5. General Lawn Mixture: Proportioned by weight as follows:

   a. 70 percent 1/3 equal mixture of three Kentucky bluegrass (Poa pratensis) varieties.
   b. 30 percent perennial ryegrass (Lolium perenne).

6. General Lawn Sun/Shade Mixture: Proportioned by weight as follows:

   a. 60 percent 1/3 equal mixture of three Kentucky bluegrass (Poa pratensis) varieties.
   b. 15 percent perennial ryegrass (Lolium perenne).
   c. 25 percent fine fescue (Fescue rubra).

2.2 TURFGRASS SOD

A. Turfgrass Sod: Gold Tag certified premium quality seed, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Varieties: Premier varieties of Kentucky bluegrass and fescue with a mean ranking of 6.0 or higher on the National Turfgrass Evaluation Program (NTEP) current list of tested varieties for the Northeast United States.

C. Turfgrass Species: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:

   1. Full Sun: Kentucky bluegrass (Poa pratensis), a minimum of three varieties.
   2. Sun and Partial Shade: Kentucky bluegrass (Poa pratensis) and fescue blend.

D. Moisture Content: Do not harvest or transplant sod when moisture content (excessively dry or wet) may adversely affect its survival.

E. Height: Mow sod before stripping to a height of one inch to 2-1/2 inches.

F. Thickness of Cut: Machine cut sod at a uniform soil thickness of 5/8-inch, plus or minus 1/4-inch, at time of cutting. Exclude top growth and thatch from measurement for thickness.

G. Pad Size: Cut to supplier’s standard width and length. Maximum allowable deviation from standard widths of 1/2-inch. Maximum allowable deviation from standard length of 5 percent. Broken pads and torn or uneven ends not acceptable.

H. “Big Roll” Form: Sod cut a minimum 42 inches wide and 100 feet long, machine cut at uniform soil thickness of 0.75-inch, measured to exclude top growth and thatch.

I. Strength of Sod Sections: Standard size sections of strong strong enough to support own weight and retain size and shape when suspended vertically from a firm grasp on the upper 10 percent of the section.

J. Thatch: Up to 1/2 inch height (uncompressed) allowable.

K. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CY Farms/Batavia Turf.
2. Lakeside Sod Supply Co., Inc.

2.3 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
2. Provide lime in form of ground dolomitic limestone.

B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.

2.4 ORGANIC SOIL AMENDMENTS

A. Compost: Well-decomposed, stable, and weed-free organic matter derived from agricultural, food, or industrial residuals; biosolids; animal manures; yard trimmings; or source-separated or compostable mixed solid waste, meeting the following requirements:

Parameters	Units of Measure	Range	Analysis Method
pH	pH units	5.8-8.0	TMECC 04.11-A
Soluble Salts Concentration (electrical conductivity)	dS/m (mmhos/cm)	Maximum 7	TMECC 04.10-A
Moisture Content	%, wet weight basis	20-45	TMECC 03.09-A
Organic Matter Content	%, dry weight basis	40-90	TMECC 05.07-A
Particle Size	% passing a selected mesh size, dry weight basis	97-100% Passing 3/8”	TMECC 02.02-B or ASTM D 2977

C:N Ratio	Ratio, dry weight basis	12:1 – 30:1	TMECC 05.02-A
Physical Contaminants (man-made inerts)	%, dry weight basis	<1	TMECC 03.08

B. Mix with existing and imported topsoils in ratio designated in "Turf Planting Soil" Article below. Compost must be provided for both existing and imported topsoil, with the exception of topsoil with 10% of organic content and above.

C. Mixing: Mix with existing and imported topsoils in ratio designated in "Turf Planting Soil" Article.

D. Basis-of-Design Product: Subject to compliance with requirements, provide Agresource, Inc.; Agresoil Compost, or comparable product by the following:

1. WeCare Organics, LLC.

2.5 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition, unless otherwise indicated:

1. Spring Fertilization: 10 percent nitrogen, 6 percent available phosphorous, and 2 percent water-soluble potash (10-6-4).

2. Fall Fertilization: 5 percent nitrogen, 10 percent available phosphorous, and 5 percent water-soluble potash (5-10-5).

3. Final Fertilization:

   a. Spring: Granular slow release fertilizer with high nitrogen (38 percent), Uramite or other Architect-approved material.
   b. Fall: "Fall Fertilization" composition above.

4. Follow requirements regarding fertilization recommended in soil reports from a qualified soil-testing laboratory.

2.6 TURF PLANTING SOILS

A. General: Provide turf planting soil consisting of existing and/or imported topsoil with amendments and fertilizers noted in this Section.

1. Where quantities of existing topsoil are insufficient to provide 6 inch depth turf planting soil, supplement with imported topsoil, at no additional cost to Owner.

B. Topsoil Requirements: Free of subsoil, stones 1 inch or larger in any dimension, dense material, hardpan, slag, clay, cinders, sod, roots, sticks, poison ivy, crabgrass, cough grass, noxious weeds, and foreign matter, including but not limited to glass, screws, asbestos, toxins, hazardous wastes, petroleum product contamination, lead and chemicals (such as atrizene and muriatic acid) that may be injurious to humans, animals and plant materials.

1. Topsoil to comply with the following:

a. Organic Matter Content: Not more than 10 percent.
b. Corrected to pH Value: 6.5 to 7.5 on that portion passing 1/4-inch sieve.
c. Soluble Salt Content: Not to exceed 500 parts per million.
d. No more than 60 percent of material passing #100 mesh shall consist of clay as determined by Bouyoucous hydrometer or by decantation method.

C. Existing Topsoil: Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil.

D. Imported Topsoil: Imported topsoil obtained from local sources or from areas having similar soil characteristics as Project site. Obtain topsoil displaced from naturally well-drained sites where topsoil occurs at least 6 inches deep; do not obtain from agricultural land, bogs or marshes.

1. Soil Analysis Report: Provide soil analysis and report to demonstrate that the above requirements are being met and to identify if nutritional amendments are needed.
2. Soil Analysis Recommendations: Provide amendments recommended in the soil analysis report, as approved by Architect.

E. Required Amendments: Mix existing and imported topsoil with the following soil amendments in the following quantities to produce planting soil:

1. Organic Compost:

a. Ratio of Loose Compost to Surface Soil per 1000 Sq. Ft.: 5 parts soil to 1 part compost.

b. Regardless of topsoil organic content, add organic compost to all turf planting soils, including topsoils placed on slopes and in stormwater basins, swales and biofiltration areas.

2. pH Adjustment: Apply approved calcium or sulfur compounds to correct pH level to be between 6.5 and 7.5.

3. Provide fertilizer per “Fertilizer” Article above.

2.7 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

2.8 EROSION-CONTROL MATERIALS

A. Refer to Section 02150 “Erosion and Sedimentation Controls.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.

2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.

3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.

4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

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

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

D. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

3.3 TURF AREA PREPARATION

A. Limit turf subgrade preparation to areas to be planted.

B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Thoroughly blend topsoil with soil amendments and fertilizer.

a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
b. If liming is required, mix lime with dry soil before mixing fertilizer.

2. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

    a. Spread approximately 1/3 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.

C. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:

1. Cut neat line between existing turf to remain and new turf.

2. Remove existing grass, vegetation, and turf. Do not mix into surface soil.

3. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.

4. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.

5. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

F. Before planting, obtain Architect's written permission; restore planting areas if topsoil finish grading is eroded or otherwise disturbed after finish grading.

3.4 SEEDING

A. Timing: Provide seeding within planting times indicated.

1. Seed at earliest possible date to achieve mature turf prior to Owner occupancy.

B. Sow seed with Brillion spreader or similar seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in three passes: second pass at 90 degrees to the first, third pass at 45 degrees to second.

1. Do not use wet seed or seed that is moldy or otherwise damaged.
2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

C. Sow seed at a total rate of 6 lb/1000 sq. ft.

D. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

E. Protect seeded areas with slopes not exceeding 1:4 as follows:

1. In small areas adjacent to buildings, at parking islands and narrow strips of seeding along paving, spread straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment. Avoid areas of thick mulch that will prevent seed determination.

F. Water newly planted areas and keep moist until new turf is established.

3.5 TURF RENOVATION

A. Renovate existing turf indicated on Drawings, turf areas anticipated to be disturbed as part of Project, and areas damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
2. Install new planting soil as required.

B. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.

C. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

D. Mow, dethatch, core aerate to a minimum depth of 4 inches, and rake existing turf.

E. Remove weeds before seeding.

F. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

G. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

H. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.

I. Apply seed and protect with straw mulch as required for new turf.

J. Water newly planted areas and keep moist until new turf is established.

3.6 TURF MAINTENANCE

A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Use hand weeding to control weeds. Schedule weedings throughout the year to maintain turf as free of weeds as possible.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow turf to a height of 2-1/2 to 3 inches.
2. Neatly trim edges and hand clip where necessary.
3. Immediately after each mowing (same day), carefully remove excess clippings to prevent damage to turf.

D. Turf Postfertilization: Apply fertilizer after initial mowing and when grass is dry.

3.7 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

C. Warranty period does not begin until satisfactory turf is established, as determined by the Architect.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

3.8 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

C. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 02900

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, accessories, placement procedures, and finishes, for the following:

1. Footings.
2. Foundation walls.
3. Slabs-on-grade.
4. Suspended slabs.
5. Concrete repair.
6. Permanent Shaft Liner

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product indicated.

2. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments. Pumping of concrete requires a mix design specifically prepared and previously used for pumping.

   a. Indicate amounts of mixing water to be withheld for later addition at Project site.
   b. Include compressive strength test reports.
   c. Include all ingredient certifications, including fibers, if used.

3. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement. Show all concrete wall and footing reinforcement on elevation drawings at a scale not less than 1/4-inch = 1 ft. Do not submit placement plans showing only piece marks referencing a cut list.

4. Slab-on-Grade Control Joint Layout Drawings: Indicate joints as shown on Drawings and proposed locations following required spacing requirements.

5. Pour sequence and formwork shop drawings for cast-in-place shaft lining

B. Informational Submittals:

1. Qualification Data: For Installer and manufacturer.

2. Material Certificates: For each type of the following, signed by manufacturers:
   a. Cementitious materials.
   b. Aggregate gradation and certification.
   c. Admixture certification including chloride ion content
   d. Fibers, if used

3. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

   a. Aggregates.
   b. Vapor Barrier.Fibers, if used
   c. Proposed curing method for all concrete elements.

4. Proposed cold and/or hot weather concrete protection procedures.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 to perform material evaluation tests and to design concrete mixtures.

1. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1.	ACI 301	"Specifications for Structural Concrete," Sections 1 through 5.
2.	ACI 301	Specifications for Structural Concrete for Building
3.	ACI 304	Guide for Measuring, Mixing, Transporting, and Placing Concrete
4.	ACI 305	Hot Weather Concreting
5.	ACI 306	Cold Weather Concreting
6.	ACI 309	Consolidation of Concrete
7.	ACI 315	Details and Detailing of Concrete Reinforcement
8.	ACI 318	Building Code Requirements for Reinforced Concrete
9.	ACI 117	"Specifications for Tolerances for Concrete Construction and Materials."
10.	ASTM C136	Test Method for Sieve Analysis of Fine and Coarse Aggregates
11.	ASTM C138	Test Method for Unit Weight, Yield, and Air Content of Concrete
12.	ASTM C143	Test Method for Slump of Hydraulic Cement Concrete
13.	ASTM C150	Specification for Portland Cement
14.	ASTM C156	Test Method for Water Retention by Concrete Curing Materials
15.	ASTM C157	Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete
16.	ASTM C192	Practice for Making and Curing Concrete Test Specimens in the Laboratory
17.	ASTM C231	Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
18.	ASTM C260	Specification for Air-Entraining Admixtures for Concrete
19.	ASTM C309	Specifications for Liquid Membrane-Forming Compounds for Curing Concrete
20.	ASTM C494	Specification for Chemical Admixtures for Concrete
21.	ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
22.	ASTM C1077	Practice for Laboratories Testing Concrete and Concrete Aggregates for use in Construction & Criteria for Laboratory Evaluation

23. ASTM C1260 Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

24. ASTM D1751 Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

25. ASTM D2419 Test Method for Sand Equivalent Value of Soils and Fine Aggregate

F. Structural Preconstruction Conference: Attend conference at Project site.

G. Permanent Liner Preconstruction Conference: Attend conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

B. Chamfer Strips: Wood, metal, PVC, or rubber strips 3/4 by 3/4 inch, minimum.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces. VOC compliant.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

D. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
B. Plain-Steel Welded Wire Fabric: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For exterior concrete, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.4 CONCRETE MATERIALS

A. All materials furnished for the Work shall comply with the requirements of ACI 318, as applicable. Storage of materials shall conform to the requirements of ACI 318.

B. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I. Supplement with the following (optional) A minimum of eighty five (85%) percent of cement by weight shall pass a 325 screen. Use a single brand of cement throughout the Work.

   a. Fly Ash: ASTM C 618, Class F or C.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

2. Blended Hydraulic Cement: ASTM C 595 - Type IS, portland blast-furnace slag; Type IP, portland-pozzolan; Type I (PM), pozzolan-modified portland; or Type I (SM), slag-modified portland cement.

C. Normal-Weight Aggregates:

1. Provide aggregates from a single source.

2. ASTM C 33, Class 3S coarse aggregate or better, graded.

3. ASTM C 33, Class 4S coarse aggregate or better, graded, for exterior concrete.

4. Maximum Coarse-Aggregate Size:

   a. Slabs on Grade: 1-1/2 inches nominal.
   b. All Other Concrete: 1 inch nominal.

5. Fine Aggregate: ASTM C 33. Free of materials with deleterious reactivity to alkali in cement.

D. Water: ASTM C 1602/C 1602M and potable.

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing chlorides.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Accelerating Admixture: ASTM C 494/C 494M, Type C.
4. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
5. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
6. Mid-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type A or Type F. Water content reduction to be greater than 7%.
7. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
8. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
9. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 FIBER REINFORCEMENT

A. Synthetic Macro-Fiber: Polyolefin macro-fibers (containing no reprocessed olefin materials) engineered and designed for use as secondary reinforcing in concrete, complying with ASTM C 1116/C 1116M, Type III, 1 1/4 to 2-1/4 inches long, varying fiber thickness, and no water absorption.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. 3M; Scotchcast Polyolefin Fibers 2".
b. BASF Construction Chemicals, “MasterFiber MAC” Series
c. Euclid Chemical Company (The), an RPM company; Tuf-Strand SF.
d. FORTA Corporation; FORTA FERRO.
e. Grace Construction Products, W. R. Grace & Co.; Strux 90/40.
f. Nycon, Inc.; XL.
g. Propex Concrete Systems Corp.; Fibermesh 650.
h. Sika Corporation; Sika Fiber MS10.

2.7 WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Carlisle Coatings & Waterproofing, Inc.; MiraSTOP.
b. CETCO; Volclay Waterstop-RX 101.
c. Greenstreak; Swellstop.
d. JP Specialties, Inc.; Earth Shield Type 20.

2.8 VAPOR BARRIER

A. Vapor Barrier: Water-vapor transmission rate (permeance) less than 0.015 perms ($gr/ft^2/hr/in$-Hg), in accordance with ASTM E 1745. The product must meet water-vapor transmission rate (0.01 perms) requirement for both the new material and the ASTM E 1745 mandatory conditioning tests (ASTM E 1745; paragraphs 7.12 through 7.15.) Provide all manufacturers' accessories required for complete installation including mastic and seam tape. Seam tape to be provided with a water-vapor transmission rate of 0.3 perms or lower.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Layfield Construction Materials; VaporFlex 15.
b. Reef Industries, Inc.; Griffolyn Vaporguard.
c. Stego Industries, LLC; Stego Wrap 15 mil Class A.

2.9 SEALED CONCRETE

A. Sealer: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ChemMasters; Chemisil Plus.
b. ChemTec Int'l; ChemTec One.
c. Conspec by Dayton Superior; Intraseal.
d. Curecrete Distribution Inc.; Ashford Formula.
e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
f. Edoco by Dayton Superior; Titan Hard.
g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
h. Kaufman Products, Inc.; SureHard.
i. L&M Construction Chemicals, Inc.; Seal Hard.
j. Meadows, W. R., Inc.; LIQUI-HARD.
k. Metalcrete Industries; Floorsaver.

l. Nox-Crete Products Group; Duro-Nox.
m. Symons by Dayton Superior; Buff Hard.
n. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.
o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS Clear.

2.10 CURING MATERIALS

A. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap–polyethylene sheet.
B. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1-D, Class B, dissipating, with fugitive dye.
C. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
D. The loss of moisture during curing when determined in accordance with the requirements of ASTM C156 shall not exceed 0.055 grams per square centimeter of surface.

2.11 DRAINAGE PANEL

A. Drainage panel shall be constructed of a drainage geotextile and a semi-rigid drainage core.

B. The semi-rigid drainage core shall be constructed of material that will not deteriorate in subsurface conditions, and shall conform to the following physical requirements:

1. Compressive Strength: 20 lbs/sq. in. (ASTM D1621)
2. In-Plane Flow Capacity (gal./min./ft.), minimum: 10 (ASTM D4716)
3. Minimum Core Thickness : 0.25 in
4. Minimum panel width: 4 ft.

C. Drainage panel shall consist of Mirafi G200N or equal as approved by Owner's Representative.

2.12 CURING MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ½-inch rigid, extruded polystyrene insulation (at exterior walls,) ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.

B. Slab Control Joint Sealer: Two-component, self-leveling, flexible, 100 percent solids, epoxy resin and adhesive with a Type A shore durometer hardness of 80 per ASTM D 2240 and conforming to ACI 302.1R (5.12-Joint Materials).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Chem Masters; PolyTops 480.
b. Euclid Chemical Company (The); Euco 800.
c. Sika Corporation; Sikadur 51 SL.

C. Penetrating, Silane Sealer: Single component, minimum 40% silane, waterbased slab sealer that forms chemical bond to the concrete. VOC compliant.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals; Enviroseal 40.
b. Chem Masters; Aquanil Plus 40.
c. Dayton Superior Corporation; Weather Worker 40% J29WB.

D. Bond breakers: Waterborne, VOC compliant form release agent.

E. Grout: ASTM C 1107, factory-packaged, shrinkage-resistant, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

F. Chemical Anchor Adhesives: Heavy duty, two component injectable adhesive designed to be dispensed using double chamber gun with mixing nozzle. Adhesives in capsule form will not be accepted.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Hilti, Inc.; Hit HY 150; Hit-Ice, Hit HY 150 Max.
b. ITW Redhead; Epcon C6.
c. Powers Fasteners, Inc.; AC100+ Gold.

2.13 REPAIR MATERIALS

A. Repair Mortar: Site-mixed Portland-cement mix for vertical and overhead surfaces. Mix dry-pack repair mortar, consisting of one part shrinkage-compensating, Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve by damp, loose volume, using only enough water for handling and placing.

B. Thin Coat Patching Mortar: Polymer modified, Portland cement, suitable for interior and exterior applications. Featheredge up to 3/16 inch. For thicker applications manufacturer's recommendations to extend mix with an aggregate may apply.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Construction Chemicals; Chemrex Levelprep.
b. ChemMasters, Inc.; ChemFlow HS.
c. Euclid Chemical Company (The); Duraltop Flowable Mortar.

C. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations. For thicker applications manufacturer's recommendations to extend mix with an aggregate may apply.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.14 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:

1. Fly Ash: 25 percent, but if used, a minimum of 15 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Ground Granulated Blast-Furnace Slag: 50 percent.
4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing or plasticizing admixture in all concrete. Design mix for optimum placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

3. Use a mid-range, water-reducing admixture in pumped concrete, all concrete slabs (including concrete walks), concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.15 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings, Piers, Foundation Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.

2. Maximum Water-Cementitious Materials Ratio: 0.50.

3. Slump Limit: 4 inches, plus or minus 1 inch; or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.

B. Interior Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 3500 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.50.
3. Minimum Cementitious Materials Content: 470 lb/cu. yd..
4. Slump Limit: 4 inches, plus or minus 1 inch.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
6. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture, at concrete batch facility, at manufacturer's recommended rate, but not less than 3.0 lb/cu. yd..

C. Interior Suspended Slabs: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Minimum Cementitious Materials Content: 520 lb/cu. yd..
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
5. Maximum Water-Cementitious Materials Ratio: 0.50.
6. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture, at concrete batch facility, not less than 4.0 lb/cu. yd..

2.16 CONCRETE MIXTURES FOR EXTERIOR CONCRETE

A. Exterior Slabs (concrete pads, walks and curbs): Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4500 psi at 28 days.

2. Maximum Water-Cementitious Materials Ratio: 0.45.

3. Slump Limit: 4 inches, plus or minus 1 inch; or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

5. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture, at concrete batch facility, at manufacturer's recommended rate, but not less than 3.0 lb/cu. yd..

2.17 CONCRETE MIXTURES FOR PERMANENT SHAFT LINER

A. Permanent Shaft Liner, and Related Structures: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.

2. Maximum Water-Cementitious Materials Ratio: 0.40.

3. Slump Limit: 3 inches, plus or minus 1 inch; or 7 inches, plus or minus 2 inches when adding high-range water-reducing admixture or plasticizing admixture.

4. Air Content: 5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

5. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture, at concrete batch facility, at manufacturer's recommended rate, but not less than 15 pounds per cubic yard of concrete.

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

7. Maximum fine aggregate: 41%

2.18 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.19 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Clean and scale loose material (including loose existing shotcrete) mud, rebound, and other foreign matter from all surfaces which are to receive shotcrete, whether rock or previously shotcreted. Apply shotcrete to moist surfaces only.

B. Install pipes or panning to handle and direct local seepage to nearest adjacent vertical drain panel/composite installation. Remove and dispose of all water resulting from the shotcreting operations.

C. Install vertical drainage panel/composite as shown on Contract Drawings and per manufacturers recommended procedures.

3.2 EXAMINATION

A. Verify that subgrade conditions are satisfactory prior to forming or pouring concrete. Owner's Testing Agency shall inspect, shaft, slab and footing subgrade prior to placing concrete.
B. Verify that reinforcing is properly in place prior to pouring concrete.
C. Verify that formwork is complete and properly secured prior to placing concrete.
D. Proceed with installation only after unsatisfactory conditions have been corrected.
E. Beginning installation constitutes Contractor's acceptance of substrates and conditions.

3.3 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class C, 1/2 inch for rough-formed finished surfaces without additional finish, permanently exposed.
2. Class D, 1 inch for concealed, rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.4 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

2. Install leveling plates, bearing plates, railing sleeves, brackets, and all other embedded steel items shown on Drawings.

3. Install sleeves for pipe, conduit and other items passing through cast-in-place structural concrete. Coordinate with other trades for sleeve details, invert elevations, locations, and sizes.

3.5 REMOVING AND REUSING FORMS

A. General: Formwork for sides of walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.6 VAPOR BARRIERS

A. Place, protect, and repair vapor barrier according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.7 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor barrier. Repair damage and reseal vapor barrier before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Field bending or straightening of bars partially embedded in concrete is permitted only where shown on the Drawings.

G. All openings in concrete walls with a dimension of one foot or greater are to have two #5 bars on all sides of opening, unless noted otherwise.

3.8 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.

2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.

3. Locate joints for slabs in the middle third of spans.

4. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

5. Roughen surface of hardened concrete, wet surface, and immediately pour fresh concrete against wet surface.

C. Vertical Control Joints in Walls: Space vertical control joints in walls that have any portion exposed to public view as shown on Drawings or, if not indicated, at 20 feet maximum.

D. Control joints in Slabs-on-Grade: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks. Space joints as shown on Drawings or, if not indicated, at 12 feet average spacing and not exceeding 15 feet. Locate joints at column centerlines where possible.

E. Isolation Joints in Slabs-on-Grade: Install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

F. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.9 WATERSTOPS

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.10 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, (4.3.2.1 Slump Adjustment.)

1. With each concrete mixture submittal, indicate amounts of mixing water to be withheld for later addition at Project site.

2. Water added must not increase the water-cement ratio past the approved mix design ratio.

3. Add additional water reducer or plasticizer to mix instead of adding water to achieve flowable, workable concrete. Do not add water to concrete after adding these admixtures to mixture.

4. Do not add water after truck is more than half empty.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

4. Concrete placed over steel deck is to have a minimum thickness as shown on the Drawings. Thickness of the slab will be greater at the center of the beam or deck spans as they deflect during casting of the concrete. Estimated deflections of the composite beams due to the wet weight of the concrete are indicated on the plans. Compensate for beam deflection by adding additional concrete as required near the center of the beam span.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.

E. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.Temperature of Concrete: The temperature of concrete when it is being placed shall be not more than ninety (90) degrees F nor less than fifty five (55) degrees F for sections less than twelve (12) inches thick nor less than 50 degrees for all other sections.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and ACI 305R and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.11 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.12 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish.

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view.

    a. For fiber reinforced concrete, to provide consolidation and bury surface fibers, open slab surfaces to be struck off with a vibrating screed or laser screed. Where a laser screed is used, adjust the magnitude of vibration and control the speed of the refracting leveling head to ensure adequate consolidation of the concrete and embedment of the fibers. Magnesium floats in the form of a bullfloat, channel radius float, or highway straightedge to be used to establish a surface and close tears or open areas. Do not use wood floats.

2. Flatness and Levelness: Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

    a. Conventional: Specified overall values of flatness, F(F) 20; and of levelness, F(L) 15; with minimum local values of flatness, F(F) 15; and of levelness, F(L) 10; for all other floor finishes not noted below.

3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch.

4. For all floor finish classifications, also measure floor finish tolerances after slab has cured and dried out, within 2 weeks before installation of floor finish materials to establish compliance with flooring manufacturer's tolerance requirements and to determine if corrective leveling is required.

D. Broom Finish: Apply a broom finish to exterior concrete walks, slabs, platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application. For synthetic fiber reinforced concrete, pull broom in a single direction and do not excessively overlap previously textured concrete.

E. Exposed Architectural Concrete Surfaces: Use the same finish procedure for all pours. All pours to be done in similar weather conditions. Use breathable sealer after set to prevent efflorescence.

F. Exterior Concrete Walks and Slabs: Apply penetrating, silane sealer per manufacturer's instructions.

3.13 FINISHING SHAFT LINER

A. No treatment is required for formed liner surfaces after form removal except for curing, repair of defective concrete, and treatment of surface defects.

1. Surface holes larger than 1/2 inch in diameter or deeper than 1/4-inch are defined as surface defects, and shall be filled in accordance with the requirements specified herein.

B. For unformed surfaces, after the floated surface has hardened sufficiently to prevent excess of fine material from being drawn to the surface, perform steel troweling with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks. The finish shall be smooth and free of all irregularities.

3.14 MISCELLANEOUS CONCRETE ITEMS

A. Filling In (Surface Defects): Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct concrete bases 4 inches high unless otherwise indicated; and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.

3. Minimum Compressive Strength: 4000 psi at 28 days.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete substrate.

6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.15 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 and 305R for hot-weather protection during curing.

B. Slabs: Protect slabs within building from precipitation accumulation. Immediately remove water, snow or ice from surface of slabs within building regardless if source is from precipitation, construction activities, etc.

C. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

E. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

F. Cure concrete according to ACI 308.1, by one of the following methods:

1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Use moisture-retaining covers to cure all interior slabs on grade.

2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

    a. Ensure compatibility of curing compounds with finish flooring and adhesives, prior to use, otherwise provide curing method such as continuous sprinkling, or remove curing compound through blast-tracking or similar method prior to installation of flooring.

3.16 SEALED CONCRETE

A. Sealer: Prepare, apply, and finish sealer according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.

2. Do not apply to concrete that is less than 28 days old.

3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

3.17 JOINT SEALING

A. Prepare, clean, and install slab control joint sealer according to manufacturer's written instructions.

1. Defer joint sealing until concrete has aged at least one month(s). Do not seal joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint sealer full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint sealer flush with top of joint after hardening.

3.18 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with repair mortar before bonding agent has dried. Fill form-tie voids with repair mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, repair mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

C. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with thin coat patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to remain exposed with a repair overlayment. Cut out low areas to ensure a minimum repair overlayment depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair overlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

6. Repair random cracks and single holes 1 inch or less in diameter with repair overlayment. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete. Place repair overlayment before surface has dried. Finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

3.19 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports, except where noted.

B. Contractor to supply all batch tickets to Owner’s testing agency. Batch tickets to note w/c ratio and amount of water allowed to be added at Project site.

C. Inspections:

1. Steel reinforcement placement.

2. Chemical Anchors: Test 5% of all chemical anchors in tension, randomly selected but in varied locations. Testing to be in accordance with ASTM E 488 to the approved manufacturer’s allowable loads. Concrete must cure a minimum of 3 days prior to testing. Do not test anchors until after the anchor manufacturer’s recommended curing time. If an anchor fails during this test additional anchors may be requested to be tested as directed by the Architect.

3. Headed bolts and studs.

4. Verification of use of required design mixture.

5. Concrete placement, including conveying and depositing.

6. Curing procedures and maintenance of curing temperature.

7. Verification of concrete strength before removal of shores and forms from beams and slabs.

8. Vapor barrier inspection after installation. To be performed by the vapor barrier manufacturer. Verify correct installation according to specifications and details. To be performed no more than 48 hours prior to slab pour.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day, nor less than once per each 5000 square foot of surface area of walls or slabs.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Include corresponding concrete mix batch tickets with each test report.

3. Indicate amount of water added to batch at Project site.

4. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change. Measure after slump adjustment. Pumped concrete is to be tested at point of placement, with an additional slump test taken at point of delivery.

5. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

6. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.

7. Density (Unit Weight): ASTM C 138/C 138M, fresh unit weight of concrete. Two tests per truck load; one at beginning of pour and near end of pour.

8. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and standard cure six (6) cylinder specimens for each composite sample.
    b. Autoclave curing and oven-drying of test specimens containing synthetic fiber is not permitted.

9. Compressive-Strength Tests: ASTM C 39/C 39M;

    a. Test two standard cured specimens at 7 days, three specimens at 28 days, and retain one specimen for testing at 56 days as deemed necessary by Architect.

b. Test two field-cured specimens at 28 days.

c. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

d. If one specimen in the test shows evidence of improper sampling, molding or testing, discard the specimen and consider the strength of the remaining cylinders to be the test result. If more than one specimen in a test shows any defects, discard the entire test.

10. Test for workability and air content of each synthetic fiber reinforced concrete mixture composite sample taken according to ASTM C172 (except that wet-sieving is not permitted) and whenever consistency of concrete appears to vary, according to ASTM C 1116.

11. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

12. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

13. Nondestructive Testing: Impact-echo, ultrasonic methods, or other nondestructive methods may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

14. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

15. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

16. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 03310

PART 1 - GENERAL

1.1 SCOPE

A. The Work in these requirements consists of all construction operations relating to the preparation of surfaces, application, finishing, and curing of shotcrete for permanent shaft lining.

B. Where used, the Contractor shall apply shotcrete using the wet-mix process. Shotcrete application using the dry-mix process will only be allowed for small intermittent placement and for patchwork.

1.2 DEFINITIONS

A. Dry-Mix Process: A dry concrete mixture is conveyed through a hose in an air stream at high velocity; water is added at the nozzle to produce a plastic material on impact

B. Nozzleman: Worker who operates the nozzle, controlling water (dry mix) or air (wet mix), and controls the final deposition of the material.

C. Rebound: Wet shotcrete which bounces off a surface against which it is projected.

D. Shotcrete: A method to shoot concrete at a sufficient velocity to achieve proper in-place compaction.

E. Wet-Mix Process: Concrete is pumped through a hose and air is added at the nozzle to accelerate the mixture to a high velocity.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

ACI 506	Guide to Shotcrete.
ACI 506.2	Specification for Shotcrete.
ACI 506.3	Guide to Certification of Shotcrete Nozzleman.
ACI 506.4	Guide for the Evaluation of Shotcrete.
ASTM A82	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
ASTM A185	Standard Specification for Steel Welded Wire Reinforcement, Plain for Concrete.
ASTM C150	Standard Specification for Portland Cement.
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C33	Standard Specification for Concrete Aggregate
ASTM C494	Standard Specifications for Chemical Admixtures for Concrete

ASTM C42 Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

C1116 Standard Specification for Fiber-Reinforced Concrete and Shotcrete.

1.4 QUALITY CONTROL

A. Contractor shall submit its QUALITY Control Plan in accordance with the requirements in Section 01400, Quality Assurance/Quality Control. The Quality Control Plan shall include the following requirements:

1. Qualifications

a. Nozzleman:

1) Minimum 2 years' experience on shotcreting work similar to Project.
2) Current ACI Nozzleman Certification in accordance with ACI 506.3

b. Gunman (if using dry mix)

1) Minimum 6 months' experience with use of shotcrete delivery equipment.

2. Shotcrete Test Panels:

a. Prior to start of the Work produce a test panel for each nozzleman. The Contractor shall develop appropriate criteria for the test panels, including taking of cores for strength and other testing.

3. Certification of aggregate quality.

4. Shotcrete: Transmit the following prior to shooting test panels onsite.

a. Shotcrete mix designs.
b. Aggregate gradation.
c. Independent testing laboratory certification that aggregates used in this shotcrete mixture will not be reactive, and when installed will not result in reactive expansion, cracking, or delamination.
d. Manufacturer certification that admixtures are compatible and appropriate for this application.

5. Shotcrete Delivery Tickets:

a. Furnish with each batch of shotcrete before unloading at site.
b. Information: As stated in Section 16 of ASTM C94, including record of drum revolution counter, type, brand, and amount of admixtures, if used, and information necessary to calculate the total mixing water added by the producer.

1.5 SUBMITTALS

A. In addition to any other Contract requirements, Contractor shall submit the following information before shotcrete operations commence:

1. Product Date for the following

a. Prebagged dry mix shotcrete (if used)
b. Fiber reinforcement.
c. Admixtures, including silica fume, air entraining (dry or liquid), and water reducers (dry or liquid).
d. Accelerators.

2. Manufacturer's Written Instructions:

a. Furnish manufacturer's data, recommendations, and instructions for specific use on this project for the products listed above. Furnish manufacturer's certification that each product is compatible with each other product.
b. Project-specific instructions for mix, mixing, accelerators, application of shotcrete and curing.

B. Shotcrete Records: The Contractor shall submit for information the following documentation within 1 day following each day of shotcrete application:

1. Field Report – original field reports signed by Contractor's QC representative

2. Daily Records – daily shotcrete records with following information:

a. Contractor Name
b. Nozzleman name
c. Helper Name
d. Contractor QC Representative
e. Date
f. Weather
g. Start and End Time
h. Shotcrete Equipment Type
i. Temperature

PART 2 - PRODUCTS

2.1 CEMENT

A. Cement shall conform to ASTM C150, Type V, except that the total alkali content, when determined as the mixed sulfates of sodium and potassium and calculated to sodium oxide, shall not be greater than 0.6 percent.

2.2 AGGREGATES

A. Use normal weight aggregates conforming to ASTM C33, with the combined gradation of coarse and fine aggregates conforming to the gradations shown below. Import aggregates if required to meet reactivity criteria specified herein.

Percent Passing by Weight	
Sieve Size	Gradation
3/8-inch	90 - 100
No. 4	70 - 85
No. 8	50 - 70
No. 16	35 - 55
No. 30	20 - 35
No. 50	8 - 20
No. 100	2 - 10

B. Rebound materials shall not be reused in any form for shotcrete work, worked into the construction or otherwise incorporated into the Work.

C. Specific gravity. 2.55 minimum.

2.3 WATER

A. Water shall be clean, potable, containing less than 5 ppm chlorides, and free from oil, acid, alkali, organic matter, or other deleterious substances.

2.4 ADMIXTURES

A. Water-Reducers: ASTM C494/C494M, Type A or D.

B. Air-Entraining: ASTM C260 and ASTM C457, nontoxic after 30 days and contain no chlorides or other chemicals causing corrosion.

C. Silica Fume: ASTM C1240.

D. Accelerator: ASTM D98 and ASTM C494, Type C or E

2.5 FIBERS

A. Polypropylene fibers shall have a nominal length of ¾ inch and shall conform to the requirements of ASTM C 1116, Type III, Section 4.1.3.

2.6 DRAINAGE PANEL

A. Drainage panel shall be constructed of a drainage geotextile and a semi-rigid drainage core.

B. The semi-rigid drainage core shall be constructed of material that will not deteriorate in subsurface conditions, and shall conform to the following physical requirements:

Compressive Strength: 20 lbs/sq. in. (ASTM D1621)
In-Plane Flow Capacity (gal./min./ft.), minimum: 10 (ASTM D4716)
Minimum Core Thickness : 0.25 in
Minimum panel width: 4 ft.

C. Drainage panel shall consist of Mirafi G200N or equal as approved by Owner's Representative.

2.7 FIBER REINFORCING

A. Fiber reinforcing shall be polypropylene.

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall develop a shotcrete mix and select plant for its production and application. Conform to ACI 506.2-90, Specification for Materials, Proportioning, and Application of Shotcrete, and to these Requirements.

B. For application as permanent shaft liner, apply the shotcrete using the wet mix process. Shotcrete strength and testing shall be as specified herein.

C. Provide for adequate ventilation and protection for workmen and others. Conform to all applicable health and safety requirements. Provide safe access for inspection of the work by the OWNER.

3.2 SURFACE PREPARATION

A. Clean and scale loose material (including loose existing shotcrete) mud, rebound, and other foreign matter from all surfaces which are to receive shotcrete, whether rock or previously shotcreted. Apply shotcrete to moist surfaces only.

B. Install pipes or panning to handle and direct local seepage to nearest adjacent vertical drain panel/composite installation. Remove and dispose of all water resulting from the shotcreting operations.

C. Install vertical drainage panel/composite as shown on Contract Drawings and per manufacturers recommended procedures.

3.3 MANUFACTURER'S SERVICES

A. Admixture manufacturer, including microsilica and water-reducing agent manufacturer shall provide technical assistance during the design of the shotcrete mix.

B. Admixture manufacturer, including microsilica and water-reducing agent manufacturer shall provide technical representative onsite during preconstruction testing to aid in developing admixture dosage and in placing and finishing procedures.

3.4 PROPORTIONING AND MIXING

A. General:

1. Minimum strength of 4,000 pounds per square inch (psi) at 28 days.

2. Weight measuring equipment and tolerances in accordance with ASTM C94.

3. The minimum polypropelene fiber content for fiber-reinforced shotcrete shall be 15 pounds per cubic yard of shotcrete.

4. Proportion and introduce fibers so as to preclude the formation of fiber balls in the shotcrete mixture.

B. Wet Mix Process:

1. Design mix in accordance with ACI 211.1 with aggregate content correction for pumped concrete.

2. Mix shotcrete in stationary plant, portable batch type, or truck mixers.

3. Addition of the reinforcing fibers shall be at the site.

4. Mixing equipment and mixing procedures shall be subject to the approval of the OWNER.

3.5 EQUIPMENT

A. Wet Mix Process:

1. Use delivery equipment of an approved design and size which has given satisfactory results in similar previous work.

2. Use equipment capable of discharging mixed material into the hose under close control, and that is able to deliver a continuous smooth stream of uniformly mixed material at the proper velocity to the discharge nozzle, free from slugs of any kind.

3. Use a nozzle of a design and size that will ensure a smooth and uninterrupted flow of materials.

4. Thoroughly clean delivery equipment at the end of each shift.

5. Regularly inspect and replace equipment parts as required.

3.6 QUALITY ASSURANCE TESTING

A. Responsibility for Test: Routine testing services will be performed by a testing agency selected and hired by the Contractor.

B. Testing Service: The testing agency will perform the following:

1. Test the proposed materials, including water, for compliance with specifications.

2. Review and check proposed mix proportions.

3. Test preconstruction test specimens as specified herein.

4. Secure production samples of materials at plants or stockpiles during construction and test for compliance with specifications.

5. Test the strength of the shotcrete, as work progresses.

C. Construction Test: The costs for all material, labor, and other work required for obtaining curing and testing samples shall be included in the Contractor's proposal amount. The designated testing agency will test the strength of the shotcrete by the following method:

1. Provide three NX (approximately 2 inch diameter) cored samples of the proposed shotcrete mix from either a test panel or from an initial shotcrete installation in the shaft.

2. If the test results meet the strength requirements, the shotcrete mix can be applied in other parts of the shaft with quality assurance testing for each additional 50 cubic yards of shotcrete applied. If the test results do not meet these strength requirements, additional testing to confirm the shotcrete quality will be required, or require the shotcrete to be removed and replaced with suitable quality shotcrete.

   a. When the length of a core is less than twice the diameter, apply the correction factors given in ASTM C42 to obtain the compressive strength of individual cores.
   b. The Contractor shall determine the required compressive strength at 7 days, so that the minimum required strength can be attained at 28 days. The average compressive strength of three cores taken from the test panel must equal or exceed the 7-day strength.

3. Where the compressive strengths fail to meet the 7-day requirements, test the samples for cement content, in accordance with ASTM C1084.

4. Thoroughly sound each intermediate layer and the final surface with a hammer. Remove and replace hollow areas.

5. Final acceptance of the shotcrete will be based on results obtained from cores. Use of data obtained from impact hammers, ultrasonic equipment, or other nondestructive testing devices will not be permitted for final acceptance of the shotcrete. The Contractor shall be responsible for removing and replacing shotcrete found not to meet these tests, or shall cut cores and further test the shotcrete for acceptance, or provide a repair or replacement.

3.7 PLACING AND FINISHING

A. General:

1. Apply shotcrete in accordance with ACI 505.2.

2. Place drainage panels as shown on Contract Drawings.

B. Shotcrete shall be applied only by nozzle man/operators whose qualifications have been approved and who have fabricated test panels from which shotcrete test results were obtained and found acceptable under this section.

C. Hold the nozzle at a distance and position such that the stream of flowing material will impinge as nearly as possible at right angles to the receiving surface. Apply shotcrete in a circular fashion to build up the required layer thickness. Apply mixed material within 45 minutes after adding cement.

D. Shotcrete shall flow from the nozzle in a steady, uninterrupted flow. When flow becomes intermittent, it shall be directed away from the work area until it becomes steady.

E. Provide equipment to allow application of shotcrete to surfaces at an approximate range of three to six feet from the nozzle. The surface of each shotcrete layer shall be uniform and free of sags, drips or runs.

F. The maximum thickness of any individual shotcrete application shall be 2 inches. Build up layers as required to achieve the required thickness. Install approved measuring pins to indicate the thickness of the shotcrete layer(s). Install pins on six-foot centers longitudinally and transversely, with no less than two pins per increment of surface area to receive the shotcrete.

G. Remove laitance, loose material and rebound. Rebound shall be promptly removed from the work area.

H. Allow sufficient time for each layer of shotcrete to set up, so that it may take the next layer without sagging.

I. Roughen shotcrete layers after initial set, if required, to increase bond of next shotcrete coat.

J. Dry sandblast with silica sand the surfaces that were not roughened after immediately after initial set.

K. Before applying any new layer of shotcrete on previously applied shotcrete coatings, thoroughly sound the surface with a hammer for hollow areas. Remove and replace any voids before additional shotcrete coatings are applied.

G. Protect and maintain access to instrumentation devices, such as convergence reference points, during shotcreting operations.

K. Acceptable shotcrete shall consist of a dense and uniform mixture without rebound inclusions, segregation, or discernible weakness of bond between layers, prepared and applied in strict compliance with these specifications.

3.8 EXPOSED SHOTCRETE

A. Shotcrete shall be protected and cured in accordance with ACI 506.2.

B. Keep shotcrete surfaces moist and covered whenever ambient outside temperature at the exposed shotcrete sections reach or exceed 80°F at any time during curing.

C. If necessary, apply curing compound to exposed shotcrete surfaces. Apply in accordance with curing compound manufacturer's recommendations.

END OF SECTION 03361

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Shelf angles.
4. Miscellaneous steel trim.
5. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section:

1. Anchor bolts indicated to be cast into concrete or built into unit masonry.

1.3 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1.4 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Paint products.
2. Grout.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.
B. Welding certificates.
C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.7 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.8 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

D. Steel Tubing: ASTM A 500, cold-formed steel tubing.
E. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Postinstalled Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 unless otherwise indicated.

2. Chemical Anchor Adhesives: Heavy duty, two component injectable adhesive designed to be dispensed using double chamber gun with mixing nozzle. Adhesives in capsule form will not be accepted.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Hilti, Inc.; Hit HY 150; Hit-Ice, Hit HY 150 Max.
2) ITW Redhead; Epcon C6.
3) Powers Fasteners, Inc.; AC100+ Gold.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Alkyd Primer: Modified-alkyd primer compatible with topcoat.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Tnemec Company, Inc.; Series 10: 10-1009 Gray.

C. Urethane Primer: Moisture-cured, aromatic urethane primer compatible with topcoat.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Tnemec Company, Inc.; Omnithane Series 530.

D. Zinc-Rich Primer: Zinc-rich, aromatic urethane primer compatible with topcoat.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Tnemec Company, Inc.; Tneme-Zinc 90-97.

E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

G. Isolation Barrier membrane: Self-adhering, high-temperature sheet, minimum 15 mils thick, consisting of cross-laminated polyethylene-film top surface laminated to layer of butyl adhesive, with release-liner backing; cold applied, in roll width to match or exceed width of area to be protected. Provide primer when recommended by membrane manufacturer.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Grace Construction Products, a unit of W. R. Grace & Co.; “Vycor Pro”.
b. Equivalents meeting requirements of specified products.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Furnish inserts for units installed after concrete is placed.

C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

2.7 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.8 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.9 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
B. Finish metal fabrications after assembly.
C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.10 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Metal Fabrications: For all iron and steel items (except those noted below), shop prime with alkyd primer.
2. Exterior Wall Metal Fabrications: For all iron and steel items occurring in exterior walls, shop prime with urethane primer.

C. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 3, "Power Tool Cleaning," unless noted otherwise below.

2. ASTM D 6386, “Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting,” for galvanized surfaces noted to be painted.

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

D. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

E. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

F. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Extruded Aluminum: Isolation barrier membrane.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

3.3 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05500

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal bar gratings.
2. Formed-metal plank gratings.
3. Formed-metal plank grating stair treads.
4. Formed-metal plank grating ladder rungs

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals and informational submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Welded bar gratings.
2. Formed-metal plank gratings.
3. Formed-metal plank grating stair treads.
4. Formed-metal plank grating ladder rungs
5. Clips and anchorage devices for gratings.

B. Shop Drawings: Include plans, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual."

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
B. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
C. Wire Rod for Bar Grating Crossbars: ASTM A 510.
D. Uncoated Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30.
E. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 33, with G90 coating.

2.2 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 1.

D. Plain Washers: Round, ASME B18.22.1.

E. Lock Washers: Helical, spring type, ASME B18.21.1.

2.3 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy that is welded.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

2.4 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.

E. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

2.5 METAL BAR GRATINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. All American Grating.
2. Borden Metal Products (Canada) Limited.
3. IKG Industries; a division of Harsco Corporation.
4. Marwas Steel Co.; Laurel Steel Products Division.

B. Welded Steel Grating:

1. Bearing Bar Spacing: 1-3/16 inches o.c.
2. Bearing Bar Depth: 1-3/4 inches.
3. Bearing Bar Thickness: 3/16 inch.
4. Crossbar Spacing: 4 inches o.c.

5. Traffic Surface: Plain.
6. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. of coated surface.

C. Band Bars: Weld to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

D. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

1. Provide no fewer than four saddle clips for each grating section composed of rectangular bearing bars 3/16 inch or less in thickness and spaced 15/16 inch or more o.c., with each clip designed and fabricated to fit over two bearing bars.

2. Furnish threaded bolts with nuts and washers for securing grating to supports.

3. Furnish self-drilling fasteners with washers for securing grating to supports.

4. Furnish galvanized malleable-iron flange clamp with galvanized bolt for securing grating to supports. Furnish as a system designed to be installed from above grating by one person.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Kee Industrial Products, Inc.; Grating Clip.
2) Lindapter North America, Inc.; Grate-Fast.

E. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.

F. Do not notch bearing bars at supports to maintain elevation.

2.6 FORMED-METAL PLANK GRATINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
2. Fisher & Ludlow; Division of Harris Steel Limited.
3. GS Metals Corp.
4. IKG Industries; a division of Harsco Corporation.
5. Morton Manufacturing Company.
6. Unistrut.

B. C-shaped channels rolled from heavy sheet metal of thickness indicated, and punched in serrated diamond shape to produce raised slip-resistant surface and drainage holes.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Alabama Metal Industries Corporation, a Gibraltar Industries company; Diamond Grip.
b. Fisher & Ludlow, Division of Harris Steel Limited; Grip Span.
c. GS Metals Corp.; Grip Strut.
d. IKG Industries, a division of Harsco Corporation; Deck Span.
e. Morton Manufacturing Company; Grip-Tac.
f. Unistrut; United Interlock Grating.

2. Channel Width: 24 inches.

3. Channel Depth: 2 inches.

4. Material: 0.079-inch-thick, hot-dip galvanized-steel sheet.

C. Where gratings are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a strap collar not less than 1/8 inch thick to the cut ends. Divide panels into sections only to extent required for installation where grating platforms and runways are to be placed around previously installed pipe, ducts, and structural members.

D. Formed-metal plank grating stair treads: Treads to match plank grating above.

1. Tread Width: 11.75 inches.
2. Channel Depth: 2 inches.
3. Material: 0.079-inch-thick, hot-dip galvanized-steel sheet.
4. Secure treads to stringers with bolts.

E. Formed-metal plank grating ladder rungs: Rungs to match plank grating above:

1. Rung Width: 2.5 inches.
2. Rung Depth: 1.125 inches.
3. Material: 0.079-inch-thick, hot-dip galvanized-steel sheet.
4. Secure rungs to verticals with appropriate clips.

2.7 STEEL FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
B. Finish gratings, frames, and supports after assembly.
C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
B. Proceed with installation only after unsatisfactory conditions have been corrected.
C. Beginning installation constitutes Contractor's acceptance of substrates and conditions.

3.2 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.3 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.4 INSTALLING METAL PLANK GRATINGS

A. General: Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard anchor clips and hold-down devices for bolted connections.
B. Attach removable units to supporting members by bolting at every point of contact.
C. Attach nonremovable units to supporting members by welding unless otherwise indicated. Comply with manufacturer's written instructions for size and spacing of welds.

3.5 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05530

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals (except Samples for Verification) and informational submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

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

1. Single-component, nonsag, neutral-curing silicone joint sealant.
2. Mildew-resistant, single-component, acid-curing silicone joint sealant.
3. Single-component, nonsag, urethane joint sealant.
4. Single-component, pourable, traffic-grade, urethane joint sealant.
5. Multicomponent, pourable, traffic grade, urethane joint sealant.
6. Multicomponent, nonsag, urethane joint sealant.
7. Latex joint sealant.
8. Cylindrical sealant backings.
9. Bond-breaker tape.
10. Primer.
11. Cleaners for nonporous surfaces.
12. Masking tape.

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

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

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

1.7 PROJECT CONDITIONS

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

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

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

B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 790.
b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
c. Pecora Corporation; 890.
d. Tremco Incorporated; Spectrem 1.

B. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Building Systems; Omniplus.
b. Dow Corning Corporation; 786 Mildew Resistant.
c. GE Advanced Materials - Silicones; Sanitary SCS1700.

2.3 URETHANE JOINT SEALANTS

A. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Building Systems; Sonolastic NP1.
b. Pecora Corporation; Dynatrol I-XL.
c. Sika Corporation, Construction Products Division; Sikaflex - 1a.
d. Tremco Incorporated; Dymonic.

B. Single-Component, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Building Systems; Sonolastic SL 1.
b. Bostik, Inc.; Chem-Calk 950.
c. Pecora Corporation; Urexpan NR-201.
d. Tremco Incorporated; Vulkem 45.

C. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade P, Class 25, for Use T.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Building Systems; Sonolastic SL 2.
b. Bostik, Inc.; Chem-Calk 550.
c. Pecora Corporation; Dynatrol II-SG.
d. Tremco Incorporated; THC-900/901.

D. Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Building Systems; Sonolastic NP 2.
b. Pecora Corporation; Dynatred.
c. Sika Corporation, Construction Products Division; Sikaflex - 2c NS.
d. Tremco Incorporated; Vulkem 227.

2.4 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Building Systems; Sonolac.
b. Bostik, Inc.; Chem-Calk 600.
c. Pecora Corporation; AC-20+.
d. Tremco Incorporated; Tremflex 834.

2.5 PREFORMED JOINT SEALANTS

A. Preformed Foam Joint Sealant: Manufacturer's standard preformed, precompressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dayton Superior Specialty Chemicals; Polytite Standard.
b. EMSEAL Joint Systems, Ltd.; Emseal 25V.
c. Sandell Manufacturing Co., Inc.; Polyseal.

2.6 JOINT SEALANT BACKING

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

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or Type O (open-cell material), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

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

2.7 MISCELLANEOUS MATERIALS

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

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

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

C. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 PREPARATION

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

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

2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.

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

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

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

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

3.3 INSTALLATION OF JOINT SEALANTS

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

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

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

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

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

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

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

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

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

G. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.

3.4 CLEANING

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

3.5 PROTECTION

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

3.6 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints 1 to 2 inches wide in horizontal traffic surfaces.

1. Joint Locations:

a. Isolation and contraction joints in cast-in-place concrete slabs.
b. Joints between different materials listed above.

2. Joint Sealant: Multicomponent, pourable, traffic grade, urethane joint sealant.

B. Joint-Sealant Application: Exterior joints up to 1 inch wide in horizontal traffic surfaces.

1. Joint Locations:

a. Isolation and contraction joints in cast-in-place concrete slabs.
b. Joints between different materials listed above.
c. Other joints as indicated.

2. Joint Sealant: Single component, pourable, traffic grade, urethane joint sealant.

C. Joint-Sealant Application: Exterior joints 1 to 2 inches wide in horizontal nontraffic surfaces.

1. Joint Locations:

a. Control and expansion joints in ceilings and other overhead surfaces.
b. Other joints as indicated.

2. Joint Sealant: Multicomponent, nonsag, urethane joint sealant.

D. Joint-Sealant Application: Exterior joints up to 1 inch wide in horizontal nontraffic surfaces.

1. Joint Locations:

a. Control and expansion joints in ceilings and other overhead surfaces.
b. Other joints as indicated.

2. Joint Sealant: Single component, nonsag, urethane joint sealant.

E. Joint-Sealant Application: Exterior joints in vertical surfaces.

1. Joint Locations:

a. Joints between metal panels.
b. Joints between different materials listed above.
c. Perimeter joints between materials listed above and frames of doors windows and louvers.
d. Other joints as indicated.

2. Joint Sealant: Single component, nonsag, neutral curing, silicone joint sealant**.**

F. Joint-Sealant Application: Interior joints 1 to 2 inches wide in horizontal traffic surfaces.

1. Joint Locations:

a. Isolation joints in cast-in-place concrete slabs.
b. Other joints as indicated.

2. Joint Sealant: Multicomponent, pourable, traffic grade, urethane joint sealant.

G. Joint-Sealant Application: Interior joints up to 1 inch wide in horizontal traffic surfaces.

1. Joint Locations:

a. Isolation joints in cast-in-place concrete slabs.
b. Other joints as indicated.

2. Joint Sealant: Single component, pourable, traffic grade, urethane joint sealant.

H. Joint-Sealant Application: Interior joints 1 to 2 inches wide in horizontal nontraffic surfaces.

1. Joint Locations:

a. Control and expansion joints in ceilings and other overhead surfaces.
b. Other joints as indicated.

2. Joint Sealant: Multicomponent, nonsag, urethane joint sealant.

I. Joint-Sealant Application: Interior joints up to 1 inch wide in horizontal nontraffic surfaces.

1. Joint Locations:

a. Control and expansion joints in overhead surfaces.
b. Other joints as indicated.

2. Joint Sealant: Single component, nonsag, urethane joint sealant.

END OF SECTION 07900

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM), 100 Bar Harbor Drive, West Conshocken, PA 19428-2959; (610) 832-9585, fax (610) 832-9555

1. ASTM A 36-93a: Standard Specification for Structural Steel

1.3 SUBMITTALS

A. Product Data: Provide manufacturer's product data for all materials in this specification.

B. Shop Drawings: Show profiles, accessories, location, and dimensions.

C. Samples: Manufacturer to provide upon request; sized to represent material adequately.

D. Contract Closeout: Vault access door manufacturer shall provide the manufacturer's Warranty prior to the contract closeout, if applicable.

E. All applicable Submittals required as per Section 01330.

1.4 PRODUCT HANDLING

A. All materials shall be delivered in manufacturer's original packaging.

B. Store materials in a dry, protected, well-vented area. The contractor shall thoroughly inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

C. Remove protective wrapping immediately after installation, if applicable.

1.5 SUBSTITUTIONS

A. Proposals for substitution products shall be accepted only from bidding contractors and not less than ten working days before bid due date. Contractor guarantees that proposed substitution shall meet the performance and quality standards of this specification.

1.6 JOB CONDITIONS

A. Verify that other trades with related work are complete before installing vault access door(s).

B. Mounting surfaces shall be straight and secure; substrates shall be of proper width.

C. Refer to the construction documents, shop drawings, and manufacturer's installation instructions.

D. Observe all appropriate OSHA safety guidelines for this work.

1.7 WARRANTY/GUARANTEE

A. Manufacturer's standard warranty: Materials shall be free of defects in material and workmanship for a period of (5) five years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge. Electrical motors, special finishes, and other special equipment (if applicable) shall be warranted separately by the manufacturers of those products.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. The BILCO Company, P.O. Box 1203, New Haven, CT 06505; 1-203-934-6363, Fax: 1-203-933-8478, Web: www.bilco.com, or approved equal.

2.2 ACCESS DOOR

A. Basis of Design: BILCO Company, Aluminum, Type KD, size: width 24 inches x length 30 inches. Width denotes hinge side. The vault access door shall be single leaf. The vault access door shall be pre-assembled from the manufacturer.

B. Performance characteristics:

1. Covers: Shall be reinforced to support a minimum live load of 150 psf (732 kg/m2) with a maximum deflection of 1/150th of the span.

2. Operation of the covers shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.

3. Operation of the covers shall not be affected by temperature.

C. Covers: Shall be 1/4-inch (6.3 mm) aluminum diamond pattern plate.

D. Frame: Shall be 1/4-inch (6.3 mm) extruded aluminum with strap anchors bolted to the exterior.

E. Hinges: Shall be specifically designed for horizontal installation and shall be bolted to the underside of covers.

F. Lifting mechanisms: Cam-action hinges shall pivot on torsion bars to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing.

G. A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the covers.

H. Hardware:

1. Hinges: Cast steel cam-action hinges that pivot on torsion bars shall be provided.

2. Covers shall be equipped with a steel hold open arm that automatically locks the cover in the open position.

3. Covers shall be fitted with the required number and size of torsion bars.

4. A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the cover.

5. Hardware: Shall be zinc plated and chromate sealed. Type 316 stainless steel hardware is available for installation in corrosive environments.

I. Finishes: Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of the frame.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that the vault access door installation will not disrupt other trades. Verify that the substrate is dry, clean, and free of foreign matter. Report and correct defects prior to any installation.

3.2 INSTALLATION

A. Submit product design drawings for review and approval to the Engineer/Architect or specifier before fabrication.

B. The installer shall check as-built conditions and verify the manufacturer’s vault access door details for accuracy to fit the application prior to fabrication. The installer shall comply with the vault access door manufacturer’s installation instructions.

C. The installer shall furnish mechanical fasteners consistent with the vault access door manufacturer’s instructions.

END OF SECTION 08310

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and application of paint systems, for the following:

1. Exterior applications.

2. Interior applications.

a. Painting systems indicated on Drawings and in Schedules applied to new and existing exterior and interior surfaces and related components including but not limited to items such as hollow metal doors frames, doors, access doors, trim pieces, window sash and trim etc., unless otherwise indicated, including appropriate surface preparation for all new or existing surfaces to be painted including previously painted surfaces and surfaces with existing wall coverings

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals (except Samples for Verification) and informational submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product for substrates indicated. Include preparation requirements and application instructions. Include all paint products under one cover sheet.

1. Exterior steel.
2. Exterior galvanized-metal.
3. Exterior aluminum (where indicated).
4. Interior concrete, vertical surfaces.
5. Interior concrete, vertical surfaces (deep tone accent colors).
6. Interior steel.
7. Interior steel (deep tone accent colors).
8. Interior steel piping, piping supports and hangers.
9. Interior galvanized-metal.
10. Interior galvanized-metal (metal deck).
11. Interior galvanized metal (metal deck, deep tone accent colors).
12. Interior aluminum (where indicated).
13. Interior wood.
14. Interior wood (deep tone accent colors).

15. Interior gypsum board.
16. Interior gypsum board (deep tone accent colors).
17. Interior insulation-covering.

B. Samples for Initial Selection: For each type of product indicated.

C. Samples for Verification: For each type of finish system and in each color and gloss of finish indicated.

1. Submit Samples on rigid backing, 8 inches square.

a. For wood finishes, submit Samples on representative samples of actual wood substrates, 8 inches square.

2. Step coats on Samples to show each coat required for system.

3. Label each coat of each Sample.

4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. VOC content.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For applicator.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 10 percent, but not less than 1 gal. of each material and color applied.
2. Stains and Transparent Finishes: 10 percent, but not less than 1 gal. of each material and color applied.

1.7 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual, experienced in applying finishes specified in this Section, who has successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; familiar with special requirements indicated; and with sufficient trained staff to apply manufacturer's products according to specified requirements.

B. Mockups: Apply mockups of each finish system indicated to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each finish system specified in Part 3.

    a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft.
    b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

    a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.9 FIELD CONDITIONS

A. Apply finishes only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.
B. Do not apply finishes when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
C. Do not apply exterior finishes in snow, rain, fog, or mist.
D. Lighting: Do not install finishes until a lighting level of not less than 80 fc is provided on the surfaces to receive finishing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, by a single source manufacture, but are not limited to, the following:

1. Benjamin Moore & Co.
2. PPG Architectural Finishes, Inc.
3. Sherwin-Williams Company (The).

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in Part 3 articles for the application indicated.

2.2 MATERIALS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each finish system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a finish system, provide products recommended in writing by manufacturers of topcoat for use in finish system and on substrate indicated.

3. Provide products of same manufacturer for each coat in a finish system.

B. VOC Compliance: All paint products shall meet New York requirements for Volatile Organic Compound (VOC) and Ozone Transport Commission (OTC) regulations, January 2005.

C. Colors: As selected by Architect from manufacturer's full range.

1. 25 percent of surface area will be painted with deep tones.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

a. Concrete: 12 percent.
b. Masonry (Clay and CMU): 12 percent.
c. Wood: 15 percent.
d. Gypsum Board: 12 percent.

B. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be finished. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.

1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

B. Clean substrates of substances that could impair bond of finishes, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce finish systems indicated.

C. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following**:**

1. SSPC-SP 3, "Power Tool Cleaning."
2. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

H. Galvanized Metal/Galvanized Deck, Factory Primed Surface-Coordinate with approved paint manufacture on compatibility of paint finish coats to factory prime surface.

I. Aluminum Substrates: Remove loose surface oxidation.

J. Wood Substrates:

1. Scrape and clean knots. Before applying primer apply coat of knot sealer recommended in writing by topcoat manufacturer for coating system indicated.
2. Apply wood filler paste to open-grain woods to produce smooth, glasslike finish.
3. Sand surfaces that will be exposed to view and dust off.
4. Prime edges, ends, faces, undersides, and back sides of wood.
5. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

L. Alteration Work: Comply with applicable surface preparation requirements specified and as recommended by finish materials manufacturer for existing surfaces to receive paint or other finishes, including cleaning, sanding, and roughening as required for proper adherence of new finish material.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions.

1. Use applicators and techniques suited for finish and substrate indicated.

2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

3. Paint back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

4. Do not apply paints over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

E. Alterations: Finish new surfaces adjacent to unaltered existing surfaces with finish of same type and surface texture as corresponding adjacent surfaces, unless otherwise indicated. Finish patched, damaged, or extended surfaces to match existing surfaces.

F. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

a. Equipment, including panelboards and switch gear.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.

g. Tanks that do not have factory-applied final finishes.
h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

2. Paint the following work where exposed in occupied spaces:

a. Equipment, including panelboards.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
h. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner will engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.

2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from finish operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. First Coat:

a. Benjamin Moore & Co.; Acrylic Metal Primer P04.
b. PPG Architectural Finishes; Inc.; Pitt-Tech Interior/Exterior Industrial DTM Primer/Finish Enamel 90-712.
c. Sherwin-Williams Company (The); DTM Acrylic Primer Finish B66W1.

2. Second and Third Coats:

a. Benjamin Moore & Co.; DTM Acrylic Gloss or S/G Enamel P28 or P29.
b. PPG Architectural Finishes; Inc.; Pitt-Tech Industrial DTM Acrylic Gloss 90-374.
c. Sherwin-Williams Company (The); DTM Acrylic Coating S/G (B66-200 Series) or Gloss (B66-100 Series).

B. Galvanized-Metal Substrates:

1. First Coat:

a. Benjamin Moore & Co.; Acrylic Metal Primer P04.
b. PPG Architectural Finishes; Inc.; Pitt-Tech Interior/Exterior Industrial DTM Primer/Finish Enamel 90-712.
c. Sherwin-Williams Company (The); DTM Acrylic Primer Finish B66W1.

2. Second and Third Coats:

a. Benjamin Moore & Co.; DTM Acrylic Semi-Gloss P29.
b. PPG Architectural Finishes; Inc.; Speedhide Exterior Acrylic Latex Semi-Gloss 6-900.
c. Sherwin-Williams Company (The); A100 Exterior Latex Satin (A82) or Gloss (A8).

C. Aluminum Substrates (Where Indicated):

1. First Coat:

a. Benjamin Moore & Co.; Super Spec HP Acrylic Metal Primer P04.
b. PPG Architectural Finishes; Inc.; Pitt-Tech Interior/Exterior Industrial DTM Primer/Finish Enamel 90-712.
c. Sherwin-Williams Company (The); DTM Acrylic Primer Finish B66W1.

2. Second and Third Coats:

a. Benjamin Moore & Co.; DTM Acrylic Gloss Enamel P28.
b. PPG Architectural Finishes; Inc.; Pitt-Tech Industrial DTM Acrylic Gloss 90-374.
c. Sherwin-Williams Company (The); DTM Acrylic Coating S/G (B66-200 Series) or Gloss (B66-100 Series).

D. Wood Substrates (Bleeding Woods and Knots):

1. First Coat:

a. Benjamin Moore & Co.; Super Spec Alkyd Exterior Primer 176.
b. PPG Architectural Finishes; Inc.; Seal Grip Alkyd Universal Primer 17-941.
c. Sherwin-Williams Company (The); Exterior Oil-Based Wood Primer (Y24W8020).
d. Second and Third Coats:
e. Benjamin Moore & Co.; Moorcraft Super Spec Latex House and Trim Paint 170.
f. PPG Architectural Finishes; Inc.; Speedhide Exterior Acrylic Semi-Gloss 6-900.
g. Sherwin-Williams Company (The); A100 Exterior Latex Satin (A82) or Gloss (A8).
h. Sherwin-Williams Company (The); DTM Acrylic Coating Semi-Gloss, B66.
i. Sherwin-Williams Company (The); A100 Latex Flat House Paint A6.

3.7 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Vertical Surfaces:

1. First Coat:

a. Benjamin Moore & Co.; Moore's Acrylic Masonry Primer 066.
b. PPG Architectural Finishes; Inc.; Perma-Crete Alkali-Resistant Primer 4-603.
c. Sherwin-Williams Company (The); Loxon Concrete & Masonry Primer (A24W8300.)

2. Second and Third Coats (Semi-Gloss):

a. Benjamin Moore & Co.; Moorcraft Super Spec Latex Semi-Gloss 276.
b. PPG Architectural Finishes; Inc.; Speedhide Interior Semi-Gloss Latex 6-500.
c. Sherwin-Williams Company (The); Pro Mar 200 Interior Latex S/G B31 Series.

B. Concrete Substrates, Vertical Surfaces (Deep Tone Accent Colors):

1. First Coat: Use tinted primer.

a. Benjamin Moore & Co.; Moore's Acrylic Masonry Primer 066.
b. PPG Architectural Finishes; Inc.; Perma-Crete Alkali-Resistant Primer 4-603.
c. Sherwin-Williams Company (The); Loxon Concrete & Masonry Primer (A24W8300.)

2. Second and Third Coats (Semi-Gloss): Additional coats may be required.

a. Benjamin Moore & Co.; DTM Acrylic Semi-Gloss P29.
b. PPG Architectural Finishes; Inc.; Speedhide Interior Semi-Gloss Latex 6-500.
c. Sherwin-Williams Company (The); DTM Acrylic Coating S/G (B66-200 Series) or Gloss (B66-100 Series).

C. Steel Substrates:

1. First Coat:

a. Benjamin Moore & Co.; Acrylic Metal Primer P04.
b. PPG Architectural Finishes; Inc.; Pitt-Tech Interior/Exterior Industrial DTM Primer/Finish Enamel 90-712.
c. Sherwin-Williams Company (The); DTM Acrylic Primer Finish B66W1.

2. Second and Third Coats (Semi-Gloss):

a. Benjamin Moore & Co.; DTM Acrylic Semi-Gloss P29.
b. PPG Architectural Finishes; Inc.; Pitt-Tech Industrial DTM Acrylic Satin 90-474.
c. Sherwin-Williams Company (The); DTM Acrylic Coating S/G (B66-200 Series) or Gloss (B66-100 Series.)

D. Steel Substrates (Deep Tone Accent Colors):

1. First Coat: Use tinted primer.

a. Benjamin Moore & Co.; Acrylic Metal Primer P04.
b. PPG Architectural Finishes; Inc.; Pitt-Tech Interior/Exterior Industrial DTM Primer/Finish Enamel 90-712.
c. Sherwin-Williams Company (The); DTM Acrylic Primer Finish B66W1.

2. Second and Third Coats (Semi-Gloss): Additional coats may be required.

a. Benjamin Moore & Co.; DTM Acrylic Semi-Gloss P29.
b. PPG Architectural Finishes; Inc.; Pitt-Tech Industrial DTM Acrylic Satin 90-474.
c. Sherwin-Williams Company (The); DTM Acrylic Coating S/G (B66-200 Series) or Gloss (B66-100 Series.)

E. Steel Piping, Piping Supports and Hangers:

1. First Coat:

a. Benjamin Moore & Co.; Acrylic Metal Primer P04.
b. PPG Architectural Finishes; Inc.; Pitt-Tech Interior/Exterior Industrial DTM Primer/Finish Enamel 90-712.
c. Sherwin-Williams Company (The); DTM Acrylic Primer Finish B66W1.

2. Second and Third Coats (Eggshell):

a. Benjamin Moore & Co.; Moorcraft Super Spec Latex Eggshell C274.
b. PPG Architectural Finishes; Inc.; Speedhide Interior Latex Eggshell 6-411.
c. Sherwin-Williams Company (The); Pro Mar 200 Interior Latex Eg-Shell B20 Series.

F. Galvanized-Metal Substrates:

1. First Coat:

a. Benjamin Moore & Co.; Acrylic Metal Primer P04.
b. PPG Architectural Finishes; Inc.; Pitt-Tech Interior/Exterior Industrial DTM Primer/Finish Enamel 90-712.
c. Sherwin-Williams Company (The); DTM Acrylic Primer Finish B66W1.

2. Second and Third Coats:

a. Benjamin Moore & Co.; DTM Acrylic Semi-Gloss P29.
b. PPG Architectural Finishes; Inc.; Pitt-Tech Industrial DTM Acrylic Satin 90-474.
c. Sherwin-Williams Company (The); A100 Exterior Latex Satin (A82) or Gloss (A8).

G. Galvanized-Metal Substrates (Metal Deck):

1. First Coat:

a. Benjamin Moore & Co.; Acrylic Metal Primer P04.
b. PPG Architectural Finishes; Inc.; Pitt-Tech Interior/Exterior Industrial DTM Primer/Finish Enamel 90-712.
c. Sherwin-Williams Company (The); Waterborne Acrylic Dry Fall Eg-Shell B42W2.

2. Second and Third Coats:

a. Benjamin Moore & Co.; DTM Acrylic Semi-Gloss P29.
b. PPG Architectural Finishes; Inc.; Speedhide Latex Dry Fog Spray Paint 6-714.
c. Sherwin-Williams Company (The); Waterborne Acrylic Dry Fall Eg-Shell B42W2.

H. Galvanized-Metal Substrates (Metal Deck, Deep Tone Accent Colors):

1. First Coat: Use tinted primer.

a. Benjamin Moore & Co.; Acrylic Metal Primer P04.
b. PPG Architectural Finishes; Inc.; Pitt-Tech Interior/Exterior Industrial DTM Primer/Finish Enamel 90-712.
c. Sherwin-Williams Company (The); DTM Acrylic Primer Finish B66 Series.

2. Second and Third Coats (Semi-Gloss):

a. Benjamin Moore & Co.; DTM Acrylic Semi-Gloss P29.
b. PPG Architectural Finishes; Inc.; Pitt-Tech Interior /Exterior Satin DTM Industrial Enamel 90-474.
c. Sherwin-Williams Company (The); DTM Acrylic Coating S/G or Gloss B66 Series.

I. Aluminum Substrates (Where Indicated):

1. First Coat:

a. Benjamin Moore & Co.; Acrylic Metal Primer P04.
b. PPG Architectural Finishes; Inc.; Pitt-Tech Interior/Exterior Industrial DTM Primer/Finish Enamel 90-712.
c. Sherwin-Williams Company (The); DTM Acrylic Primer Finish B66W1.

2. Second and Third Coats (Eggshell):

a. Benjamin Moore & Co.; Moorcraft Super Spec Latex Eggshell C274.
b. PPG Architectural Finishes; Inc.; Speedhide Interior Latex Eggshell 6-411.
Sherwin-Williams Company (The); Pro Mar 200 Interior Latex Eg-Shell B20 Series.

J. Gypsum Board Substrates:

1. First Coat:

a. Benjamin Moore & Co.; Moorcraft Super Spec Latex Enamel Underbody 253.
b. PPG Architectural Finishes; Inc.; Speedhide Interior Latex Primer/Sealer 6-2
c. Sherwin-Williams Company (The); Pro Mar 200 Wall Primer (B28W8200.)

2. Second and Third Coats (Eggshell):

a. Benjamin Moore & Co.; Moorcraft Super Spec Latex Eggshell C274.
b. PPG Architectural Finishes; Inc.; Speedhide Interior Latex Eggshell 6-411.
c. Sherwin-Williams Company (The); Pro Mar 200 Interior Latex Low Sheen (B20-Series.)

K. Gypsum Board Substrates (Deep Tone Accent Colors):

1. First Coat: Use tinted primer.

a. Benjamin Moore & Co.; Moorcraft Super Spec Latex Enamel Underbody 253.
b. PPG Architectural Finishes; Inc.; Speedhide Interior Latex Primer/Sealer 6-2.
c. Sherwin-Williams Company (The); Pro Mar 200 Wall Primer (B28W8200).

2. Second and Third Coats (Eggshell): Additional coats may be required.

a. Benjamin Moore & Co.; Moorcraft Super Spec Latex Eggshell C274.
b. PPG Architectural Finishes; Inc.; Speedhide Interior Latex Eggshell 6-411.
c. Sherwin-Williams Company (The); Pro Mar 200 0 VOC Interior Latex Low Sheen (B24-2600 Series).

L. Insulation-Covering Substrates:

1. First Coat:

a. Benjamin Moore & Co.; Moorcraft Super Spec Latex Enamel Underbody 253.
b. PPG Architectural Finishes; Inc.; Speedhide Interior Latex Primer/Sealer 6-2.
c. Sherwin-Williams Company (The); Prep Rite 200 Interior Latex Primer B28W200.

2. Second and Third Coats (Semi-Gloss):

a. Benjamin Moore & Co.; Moorcraft Super Spec Latex Semi-Gloss 276.
b. PPG Architectural Finishes; Inc.; Speedhide Interior Semi-Gloss Latex 6-500.
c. Sherwin-Williams Company (The); Pro Mar 200 Interior Latex S/G (B31-Series.).

END OF SECTION 09900

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and application of high-performance coating systems, for the following:

1. General use interior applications.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals (except Samples for Verification) and informational submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product for substrates indicated. Include preparation requirements and application instructions. Include all paint products under one cover sheet.

1. Interior steel, galvanized-metal, and non-ferrous metal.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of coating system and in each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. VOC content.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For applicator.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Coatings: 10 percent, but not less than 1 gal. of each material and color applied.

1.7 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual, experienced in applying high performance coatings specified in this Section, who has successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; familiar with special requirements indicated; and with sufficient trained staff to apply manufacturer's products according to specified requirements.

B. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each coating system specified in Part 3.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.9 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F.

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Lighting: Do not install high-performance coatings until a lighting level of not less than 80 fc is provided on the surfaces to receive coating.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Benjamin Moore & Co.
2. Sherwin-Williams Company (The).
3. Tnemec Inc.

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in Part 3 articles for the application indicated.

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.

3. Provide products of same manufacturer for each coat in a coating system.

B. VOC Compliance: Provide coating products complying with New York requirements for Volatile Organic Compound (VOC) and Ozone Transport Commission (OTC) regulations, January 2005.

C. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

C. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

B. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

C. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."

D. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

E. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

F. Aluminum Substrates: Remove loose surface oxidation.

G. Galvanized Metal/Galvanized Deck- Factory Primed Surface: Coordinate with approved paint manufacturer on compatibility of paint finish coats to factory prime surface.

H. After removing all surface contamination, the surface should be scuff sanded or scrubbed with an abrasive cleaner to dull the surface for best adhesion.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions.

1. Use applicators and techniques suited for coating and substrate indicated.

2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.

3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner will engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

1. Contractor shall touch up and restore coated surfaces damaged by testing.

2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE: GENERAL USE

A. Steel, Galvanized-Metal, and Non-Ferrous Metal Substrates:

1. First Coat: 2.0 to 3.0 mils DFT.

a. Benjamin Moore & Co.; M45/M46 Epoxy Mastic Coating.
b. Sherwin-Williams Company (The); Epolon II Multi-Mil Epoxy.
c. Tnemec Inc.; Series N69 Hi-Build Epoxoline II.

2. Second and Third Coats: 2.0 to 3.0 mils DFT each.

a. Benjamin Moore & Co.; M42 Waterborne Polyamide Epoxy Gloss Coating.
b. Sherwin-Williams Company (The); Epolon II Multi-Mil Epoxy.
c. Tnemec Inc.; Series N69 Hi-Build Epoxoline II.

END OF SECTION 09960

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Signage accessories.

1.3 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.4 SUBMITTALS, GENERAL

A. General: Submit all action submittals (except Samples for Verification) and informational submittals required by this Section concurrently.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Data: Submit manufacturer's technical data and installation instructions for each type of sign required, including construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.

C. Shop Drawings: Submit shop drawings for fabrication and erection of interior signs, including plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, mounting heights, layout, spacing, reinforcement, accessories, and installation details. Shop drawings are to including but not limited to:

1. Large-scale details of wording, lettering artwork and Braille layout.
2. Photocopies of Tetra Tech documentation not acceptable.
3. Adhesives.

D. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

E. Samples for Verification: For each type of sign assembly showing all components and with the required finishes, in manufacturer's standard size unless otherwise indicated and as follows:

1. Panel Signs: Full-size Sample.

F. Sample Warranty: For special warranty.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.
B. Warranty: Executed special warranty.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Qualifications

a. Manufacturer: Obtain each sign type and all associated accessories through one source from single manufacturer.
b. Installer: Workers to be approved by signage manufacturer and supply list of recently completed installations.

2. Regulatory Requirements

a. ADA Compliance: Comply with the Americans with Disabilities Act (ADA), and with code provisions as adopted by authorities having jurisdiction.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Deterioration of graphic image.
c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities, ICC A117.1, and building code in effect for Project, for signs.

B. Fire Rating: Provide sign material with Class 1A fire rating.

2.2 SIGNS

A. Basis-of-Design Product: For convenience detail and specifications have been based on “Embossed” by ASI Signage Systems, Grand Island, New York. Other manufactures offering comparable product by one of the following:

1. Andco Industries Corp.; Greensboro, North Carolina
2. Mohawk Engraving Co.; Schenectady, New York
3. Best Sign Systems Inc.

2.3 IDENTIFICATION SIGN SYSTEM

A. Exterior Signage Types: New York: Not all types may be applicable for project. Refer to Signage Schedule for specific text and quantities:

Type 1: “CAUTION” Plaque with sliding window: 10"x6" sign.

a. Text: Printed in minimum 1" high sans serif lettering and two lines, where needed. Sliding “OCCUPIED/ UNOCCUPIED “printed in minimum 5/8" high lettering.

2.4 ACCESSORIES

A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Provide inserts, as required, to be set into concrete or masonry work.

B. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:

1. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
2. Exposed Metal-Fastener Components, General:

C. Adhesives: As recommended by sign manufacturer and with a VOC used inside the weatherproofing system and applied on-site when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

2.5 FABRICATION

A. Fabrication: Comply with requirements of The Americans Disabilities Act (ADA) of 1990 and dimensions and characteristic given below and in 'Interior Signage Types'.

1. Braille Characters: Grade 2 Braille (literary Braille) consisting of 189 part words or whole word contractions, in addition to 63 Grade 1 Braille characters.
2. Character Height (based on upper case): 5/8-inch minimum; 3 inches maximum.
3. Tactile Characters: Raised 1/32-inch minimum thickness.
4. Type Style: All upper case letters, without serifs or with simple serifs.
5. Symbols: Provide border around symbol (not required to be raised) with verbal description placed directly below symbol in 1/32 inch raised and Braille characters.
6. Color: Up to 5 colors throughout school, as selected by Architect from manufacturer's full color range.

B. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

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

D. Beginning installation constitutes Contractor's acceptance of substrates and conditions.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.

2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. Mounting Locations: As Indicated.

C. Mounting Methods:

1. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10440

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.3 SUBMITTALS, GENERAL

A. General: Submit all action submittals required by this Section concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

1. Multipurpose dry-chemical type in steel container (ABC).
2. Mounting brackets.
3. Identification.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1.7 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Provide fire extinguisher type, size, and capacity for each location indicated.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product listed or comparable product by one of the following:

a. Amerex Corporation.
b. Ansul Incorporated; Tyco International Ltd.
c. Badger Fire Protection; a Kidde company.
d. Buckeye Fire Equipment Company.
e. Fire End & Croker Corporation.
f. J. L. Industries, Inc.; a division of Activar Construction Products Group.
g. Larsen's Manufacturing Company.
h. Potter Roemer LLC.
i. Pyro-Chem; Tyco Safety Products.

B. Multipurpose Dry-Chemical Type in Steel Container (ABC): UL-rated 4-A:80-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

1. Basis-of-Design Product: Fire End & Croker Corporation; Figure No. 4010.

C. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Horizontal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

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

C. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets as follows:

1. Multipurpose Dry-Chemical Type in Steel Container (ABC): Install on mounting bracket.

a. Provide in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

1. Mounting Brackets: 40 inches above finished floor to top of fire extinguisher.

END OF SECTION 10520

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This specification covers pre-manufactured chemical storage buildings and accessories as specified herein. The building unit shall be designed and furnished in accordance with the all the applicable building code requirements.

B. Related Sections include the following:

1. Section 03310, Cast-in-place concrete

1.3 SUBMITTALS

A. Product Data: For each type of building system component. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

1. Framing system.
2. Metal roof panels.
3. Metal wall panels.
4. Metal liner panels.
5. Insulation.
6. Flashing and trim.
7. Accessories including electrical components, heater, hardware,etc.

B. Shop Drawings: For the following metal building system components. Include plans, elevations, sections, details, and attachments to other work.

1. Anchor-Bolt Plans: Submit anchor-bolt plans and templates before foundation work begins. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation.

2. Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.

3. Metal Roof and Wall Panel Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.

C. Delegated-Design Submittal: For building systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified erector, manufacturer, and professional engineer.

B. Welding certificates.

C. Metal Building System Certificates: For each type of metal building system, from manufacturer.

1. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:

a. Name and location of Project.

b. Order number.

c. Name of manufacturer.

d. Name of Contractor.

e. Building dimensions including width, length, height, and roof slope.

f. Governing building code and year of edition.

g. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).

h. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.

i. Building-Use Category: Indicate category of building use and its effect on load importance factors.

D. Manufacturer Certificates: For each product, from manufacturer.

E. Material Test Reports: For each of the following products:

1. Steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Shop primers and finish paints.
4.

F. Warranties: Sample of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Field quality-control reports.
B. Maintenance Data: For metal panel finishes to be included in maintenance manuals.
C. Warranties: Executed special warranties.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver building and its accessory items so as not to be damaged or deformed. Package for protection during transportation and handling.
B. Unload, store, and erect building in a manner to prevent bending, warping, twisting, and surface damage.

1.7 COORDINATION

A. Coordinate sizes and locations of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

1.8 WARRANTY

A. Manufacturer's standard warranty of 1 year for defects in materials or workmanship with the exception of the structural integrity which shall be warrantied against materials and workmanship for a minimum of 15 years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Description: Provide a complete, integrated storage building assembly system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior

1. FM Approved Prefabricated Hazardous Materials Storage Building with Secondary Containment: Non Fire Rated, Non-Combustible

a. Floor Load: 500 PSF
b. Snow Load: 40 PSF
c. Wind Load: 90-MPH Exp. C

2. Locker Construction: Non-Combustible weatherproof construction with welded exterior 12-gauge steel panels and 10-gauge sump for maximum durability and strength. Wall studs are 3-1/2" by 2" for superior strength, manufactured from 12 gauge steel and producing a 3-1/2" wall cavity ready to accept standard insulation if required. Continuously welded roof and sump sections provide added rigidity in transit and use.

3. Roof/Ceiling: Noncombustible weatherproof construction same as building walls. Continuously welded 12-gauge steel roof permanently attached to building. Equipped with rain shield over door.

4. Spill Containment Sump Construction: Built in 7" deep leak tight secondary containment sump surpasses FM spill containment requirements. Heavy-duty construction utilizes 10-gauge steel for superior structural support. Removable galvanized steel floor grating rated 500psf for heavy drum/pallet loads. Structural steel floor supports are easily removed for clean-up of spills within the sump.

5. Building Base: Open channel construction for under-sump inspection. Steel C-channels and hold down brackets provided for ease of offloading and securing to site. Attains seismic and wind load anchoring.

6. Static Grounding System: Three (3) Interior grounding lugs, one (1) exterior static grounding connection and one (1)

7. galvanized steel grounding rod for prevention of explosive sparking hazards.

8. Ventilation: Gravity Air Flow Vents in both high and low positions, with weatherproof galvanized steel frame and louvers to provide adequate air flow and natural draft. Interior screened openings prevent pest entry.

9. Signage: Permanent D.O.T. metal flip placard with rust proof aluminum holder and stainless steel clips. One (1) pressure sensitive NFPA 704 Hazard Rating sign on door.

10. Certifications: Factory Mutual (FM) Approval and Warnock Hersey labels affixed.

11. Building Finish: After an extensive cleaning process the interior and exterior surfaces are protected with a high solids alkyd universal metal primer (primer) and a high solid acrylic alkyd enamel top coat providing proven interior chemical resistance as well as exterior abrasion, corrosion, UV resistance and exceptional durability.

12. Base Penetration: Alteration of Spill containment base in order to install building over existing ground water well heads. Penetration and collar in the base. Size estimated as 12" in diameter.

13. Standard Colors: As selected by the owner.

14. Forced Air Heater, Non-Explosion 17,060 BTU (240V, 1 Phase)

15. Non Explosion proof fan forced heater, 5.0 KW 17,060 BTU, 240V, 1 Phase. TEFC motor, individually adjustable louvers for directional control of air flow. Wall or ceiling mount. Built in thermostat.

16. Insulation: R11 insulation provided in the ceiling and walls, protected by a steel lining.

17. Load Center, 240V 1 Phase 100 Amp, 8 Space UL Listed, Single Phase, 3 Wire, 120/240V 100 Amp 8 Space Load Center (NEMA 3R). Rainproof and Sleet-(Ice) Resistant- Outdoor enclosures are intended for use outdoors to protect the enclosed equipment against rain and meet the requirements of Underwriters' Laboratories, Inc., Publication No. UL 508, Applying to

18. Non Explosion Proof Fluorescent Fixture – Interior, Low profile wraparound flourescent fixture, Lamp power rating 40 watts fixture rating 72 watts, 120 volts, 2 lamp, 48" Long 10" Wide and 3" High. Includes two fluorescent lamps @ 34 watts.

19. Single Door, 36" Wide x 80" Tall, Non Fire Rated, UL Classified & Labeled, non fire-rated 36"W x 80"H Single Door. Equipped with a UL listed door closer and a UL Listed exterior keyed lock. Door serves as an entrance and exit door.

2.2 APPROVED MANUFACTURER

A. The chemical storage building shall be manufactured by U.S. Chemical Storage, Inc., 355 Industrial Park Drive, Boone, NC 28607. Phone: 800-233-1480, Fax: 800-295-1653 www.uschemicalstorage.com.

END OF SECTION 13121

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Structural-steel framing.
2. Metal roof panels.
3. Metal soffit panels.
4. Accessories.

1.3 DEFINITIONS

A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in referenced standards.

1.4 SUBMITTALS, GENERAL

A. General: Submit all action submittals (except Samples for Verification) and informational submittals required by this Section concurrently.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of metal building system component. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

1. Structural-steel-framing system.
2. Metal roof panels.
3. Metal soffit panels.
4. Flashing and trim.
5. Accessories.

B. Shop Drawings: For the following metal building system components. Include plans, elevations, sections, details, and attachments to other work.

1. Anchor-Bolt Plans: Submit anchor-bolt plans and templates before foundation work begins. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation.

2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.

3. Metal Roof and Soffit Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.

   a. Show roof-mounted items.
   b. Show wall-mounted items.

4. Coordination Drawings: Show layouts of building and related components such as cranes, foundations and existing structures as well as their key dimensions. Indicate critical clearances, connection points and details.

C. Samples for Initial Selection: For units with factory-applied color finish.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below:

1. Metal Panels: Nominal 12 inches long by actual panel width. Include fasteners, closures, and other exposed panel accessories.

E. Delegated-Design Submittal: For metal building systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Column Reactions: Submit all reactions required for final design of foundations for metal building systems not fewer than 14 days prior to beginning of construction of foundation components.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified erector, manufacturer, and professional engineer.

B. Manufacturer Accreditation: Statement that metal building system and components were designed and produced by a manufacturer accredited according to the International Accreditation Service's AC472.

C. Welding certificates.

D. Metal Building System Certificates: For each type of metal building system, from manufacturer.

1. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:

a. Name and location of Project.

b. Order number.

c. Name of manufacturer.

d. Name of Contractor.

e. Building dimensions including width, length, height, and roof slope.

f. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.

g. Governing building code and year of edition.

h. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).

i. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.

j. Building-Use Category: Indicate category of building use and its effect on load importance factors.

E. Erector Certificates: For each product, from manufacturer.

F. Manufacturer Certificates: For each product, from manufacturer.

G. Material Test Reports: For each of the following products:

1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shop primers.
5. Nonshrink grout.

H. Warranties: Sample of special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Field quality-control reports.
B. Maintenance Data: For metal panel finishes to be included in maintenance manuals.
C. Warranties: Executed special warranties.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer and member of MBMA.

1. Accreditation: According to the International Accreditation Service's AC472.

2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.

B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

D. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings," for design requirements and allowable stresses.

E. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.

F. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to metal building systems including, but not limited to, the following:

a. Condition of foundations and other preparatory work performed by other trades.
b. Structural load limitations.
c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress.
d. Required tests, inspections, and certifications.
e. Unfavorable weather and forecasted weather conditions.

2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:

a. Compliance with requirements for purlin and rafter conditions, including flatness and attachment to structural members.
b. Structural limitations of purlins and rafters during and after roofing.
c. Flashings, special roof details, roof drainage, roof penetrations, and condition of other construction that will affect metal roof panels.
d. Temporary protection requirements for metal roof panel assembly during and after installation.
e. Roof observation and repair after metal roof panel installation.

3. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:

    a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
    b. Structural limitations of girts and columns during and after wall panel installation.
    c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
    d. Temporary protection requirements for metal wall panel assembly during and after installation.
    e. Wall observation and repair after metal wall panel installation.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.10 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements:

1. Established Dimensions for Foundations: Comply with established dimensions on approved anchor-bolt plans, establishing foundation dimensions and proceeding with fabricating structural framing without field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.

2. Established Dimensions for Metal Panels: Where field measurements cannot be made without delaying the Work, either establish framing and opening dimensions and proceed with fabricating metal panels without field measurements, or allow for field trimming metal panels. Coordinate construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.11 COORDINATION

A. Coordinate sizes and locations of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

B. Coordinate installation of and loading from attachment of bridge crane to building columns/frames.

C. Coordinate metal panel assemblies with flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

A. Special Warranty on Metal Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.

1. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Behlen Mfg. Co.
2. Butler Manufacturing Company; a BlueScope Steel company.
3. Ceco Building Systems; Division of NCI Building Systems, L.P.
4. Metallic Building Company; Division of NCI Building Systems, L.P.
5. Star Building Systems; an NCI company.
6. VP Buildings; a United Dominion company.

2.2 METAL BUILDING SYSTEMS

A. Description: Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.

1. Provide metal building system of size and with bay spacings, roof slopes, and spans indicated.

B. Primary-Frame Type:

1. Rigid Modular: Solid-member, structural-framing system with interior columns.
2. Truss-Frame Modular: Truss-member, structural-framing system with interior columns.
3. Long-Bay Frames: Solid-member, structural framing system for bays longer than 30’-0” in length, with interior columns.

C. Secondary-Frame Type: Manufacturer's standard purlins and joists and exterior-framed (bypass) girts.

D. Roof System: Manufacturer's standard tapered-rib-profile, lap-seam metal roof panels.

2.3 METAL BUILDING SYSTEM PERFORMANCE

A. Delegated Design: Design metal building system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."

1. Design Loads: As indicated on Drawings and in accordance with the Building Code of New York State and as required by ASCE/SEI 7.

a. Loads to include reactions from elevated steel framing attachment to columns. Reactions shown on plan are factored.
b. Loads to include reactions from bridge crane attachment to columns. Coordinate reactions with crane manufacturer.

2. Crane Loads:

a. Crane loads shall be a function of the Service Class as defined by the governing code and Crane Manufacturers Association of America (CMAA) and the rated tonnage (A- Standby or Infrequent service, B- Light service, C- Moderate service, D- Heavy Service, E- Severe Service, F- Continuous Severe Service).

1) Refer to specification section 14630 “Bridge Cranes” for information in regards to Service Class, deflection and other criteria.

b. Maximum crane loads are indicated on the contract documents, however specific information must be coordinated with the crane manufacturer.

c. Building structure shall be designed for the crane loads in accordance with the governing code.

3. Load Combinations: As required by governing building code. Design to worst-case combination.

4. Deflection Limits: Design metal building system assemblies to withstand design loads with deflections no greater than the following:

a. Purlins and Rafters: Vertical deflection of 1/240 of the span for total load; 1/360 of the span for live load.
b. Girts: Horizontal deflection of 1/240 of the span.
c. Metal Roof Panels: Vertical deflection of 1/240 of the span for total load; 1/360 of the span for live load.
d. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.

5. Drift Limits: Engineer building structure to withstand design loads with drift limits no greater than the following:

a. Lateral Drift: Maximum of 1/400 of the building height.

6. Metal panel assemblies shall withstand the effects of gravity loads and loads and stresses within limits and under conditions indicated according to ASTM E 1592.

C. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Air Infiltration for Metal Roof Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of roof area when tested according to ASTM E 1680 at negative test-pressure difference of 1.57 lbf/sq. ft..

E. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 at test-pressure difference of 2.86 lbf/sq. ft..

F. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for Class 30.

G. Energy Performance: Provide roof panels that are listed on the DOE's ENERGY STAR Roof Products Qualified Product List for low-slope roof products.

H. Energy Performance: Provide roof panels with initial solar reflectance not less than 0.70 and emissivity not less than 0.75 when tested according to CRRC.

2.4 STRUCTURAL-STEEL FRAMING

A. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse frames; rafter, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.

1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.

a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by Architect.

2. Rigid Modular Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from shop-welded, built-up steel plates or structural-steel shapes.

3. Truss-Frame Modular Frames: Rafter frames fabricated from joist girders, and I-shaped column sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from shop-welded, built-up steel plates or structural-steel shapes.

4. Long-Bay Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from round steel pipes or tubes, or shop-welded, built-up steel plates.

5. Exterior Column Type: Uniform depth or tapered.

6. Rafter Type: Uniform depth or tapered.

B. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:

1. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch-wide flanges.

a. Depth: As needed to comply with system performance requirements.

2. Purlins: Steel joists of depths indicated.

3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.

4. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch-diameter, cold-formed structural tubing to stiffen primary-frame flanges.

5. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.

6. Base or Sill Angles: Minimum 3-by-2-inch zinc-coated (galvanized) steel sheet.

7. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.

8. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from zinc-coated (galvanized) steel sheet.

9. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.

10. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.

C. Bracing: Provide adjustable wind bracing as follows:

1. Rods: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50; or ASTM A 529/A 529M, Grade 50; minimum 1/2-inch-diameter steel; threaded full length or threaded a minimum of 6 inches at each end.

2. Cable: ASTM A 475, 1/4-inch-diameter, extra-high-strength grade, Class B, zinc-coated, seven-strand steel; with threaded end anchors.

3. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.

4. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.

5. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.

D. Bolts: Provide plain-finish bolts for structural-framing components that are primed or finish painted. Provide hot-dip galvanized bolts for structural-framing components that are galvanized.

E. Materials:

1. W-Shapes: ASTM A 992/A 992M; ASTM A 572/A 572M, Grade 50 or 55; or ASTM A 529/A 529M, Grade 50 or 55.

2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55; or ASTM A 529/A 529M, Grade 50 or 55.

3. Plate and Bar: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55; or ASTM A 529/A 529M, Grade 50 or 55.

4. Structural-Steel Sheet: Hot-rolled, ASTM A 1011/A 1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low-Alloy Steel (HSLAS), Grades 45 through 70; or cold-rolled, ASTM A 1008/A 1008M, Structural Steel (SS), Grades 25 through 80, or High-Strength Low-Alloy Steel (HSLAS), Grades 45 through 70.

5. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80, or High-Strength Low-Alloy Steel (HSLAS), Grades 50 through 80; with G60 coating designation; mill phosphatized.

6. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

    a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 or High-Strength Low-Alloy Steel (HSLAS), Grades 50 through 80; with G90 coating designation.

7. Non-High-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A, carbon-steel, hex-head bolts; ASTM A 563 carbon-steel hex nuts; and ASTM F 844 plain (flat) steel washers.

    a. Finish: Plain.

8. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563 heavy-hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

    a. Finish: Plain.

9. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts; ASTM A 563 heavy-hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers, plain.

    a. Finish: Plain.

10. Unheaded Anchor Rods: ASTM F 1554, Grade 36.

    a. Configuration: Straight.
    b. Nuts: ASTM A 563 heavy-hex carbon steel.
    c. Plate Washers: ASTM A 36/A 36M carbon steel.
    d. Washers: ASTM F 436 hardened carbon steel.
    e. Finish: Plain.

11. Headed Anchor Rods: ASTM F 1554, Grade 36.

    a. Configuration: Straight.
    b. Nuts: ASTM A 563 heavy-hex carbon steel.
    c. Plate Washers: ASTM A 36/A 36M carbon steel.
    d. Washers: ASTM F 436 hardened carbon steel.
    e. Finish: Plain.

12. Threaded Rods: ASTM A 36/A 36M.

    a. Nuts: ASTM A 563 heavy-hex carbon steel.
    b. Washers: ASTM F 436 hardened carbon steel.
    c. Finish: Plain.

13. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

F. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.

1. Provide High Performance Coating system per specification Section09960.

2.5 METAL ROOF PANELS

A. Tapered-Rib-Profile, Lap-Seam Metal Roof Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.

1. Material: Aluminum-zinc alloy-coated steel sheet, 0.022-inch nominal thickness.

a. Exterior Finish: Fluoropolymer.
b. Color: As selected by Architect from manufacturer's full range.

2. Major-Rib Spacing: 12 inches o.c.

3. Panel Coverage: 36 inches.

4. Panel Height: 1.5 inches.

B. Materials:

1. Metallic-Coated Steel Sheet: Restricted-flatness steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

a. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Class AZ50 coating designation, Grade 40; structural quality.
b. Surface: Smooth, flat finish.

C. Finishes:

1. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.6 METAL SOFFIT PANELS

A. General: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.

B. Concealed-Fastener Metal Soffit Panels: Formed with vertical panel edges and flush surface; with flush joint between panels; with 1-inch- wide flange for attaching interior finish; designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps.

1. Material: Aluminum-zinc alloy-coated steel sheet, 0.034-inch nominal thickness.

   a. Exterior Finish: Fluoropolymer.
   b. Color: As selected by Architect from manufacturer's full range.

2. Panel Coverage: 16 inches.

3. Panel Height: 1 inch.

2.7 ACCESSORIES

A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.

1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.

2. Clips: Manufacturer's standard, formed from stainless-steel sheet, designed to withstand negative-load requirements.

3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from stainless-steel sheet or nylon-coated aluminum sheet.

4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch standoff; fabricated from extruded polystyrene.

C. Flashing and Trim: Formed from 0.022-inch nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating; finished to match adjacent metal panels.

1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.

2. Opening Trim: Formed from 0.022-inch nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.

D. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

E. Materials:

1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.

a. Fasteners for Metal Roof Panels: Self-drilling, Type 410 stainless-steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM washer under heads of fasteners bearing on weather side of metal panels.

b. Fasteners for Metal Wall Panels: Self-drilling, Type 410 stainless-steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head.

c. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.

d. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

4. Metal Panel Sealants:

   a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.

   b. Joint Sealant: ASTM C 920; one-part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

2.8 FABRICATION

A. General: Design components and field connections required for erection to permit easy assembly.

1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.

B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.

C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.

1. Make shop connections by welding or by using high-strength bolts.

2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.

3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.

4. Weld clips to frames for attaching secondary framing.

5. Shop Priming: Shop prime primary framing with specified primer after fabrication. Prepare surfaces for shop priming according to SSPC-SP 2 unless note otherwise below.

D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll-forming or break-forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.

1. Make shop connections by welding or by using non-high-strength bolts.
2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.

E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

F. Galvanizing

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.

C. Proceed with erection only after unsatisfactory conditions have been corrected.

D. Beginning installation constitutes Contractor’s acceptance of substrates and conditions.

3.2 PREPARATION

A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.

B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING

A. Erect metal building system according to manufacturer's written erection instructions and erection drawings.

B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.

C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.

D. Base Plates: Clean concrete-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.

2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.

3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

F. Primary Framing : Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.

1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for bolt type and joint type specified.

a. Joint Type: Snug tightened or pretensioned.

G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.

1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
2. Locate and space wall girts to suit openings such as doors and windows.
3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.

H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.

1. Tighten rod and cable bracing to avoid sag.
2. Locate interior end-bay bracing only where indicated.

I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.

J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.4 METAL PANEL INSTALLATION, GENERAL

A. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.

1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.

B. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.

a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.

2. Install metal panels perpendicular to structural supports unless otherwise indicated.

3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.

4. Locate and space fastenings in uniform vertical and horizontal alignment.

5. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment.

6. Lap metal flashing over metal panels to allow moisture to run over and off the material.

C. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.

1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.

D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

E. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.

1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

3.5 METAL ROOF PANEL INSTALLATION

A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.

1. Install ridge caps as metal roof panel work proceeds.
2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.

B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.

1. Install clips to supports with self-drilling or self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
4. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
5. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels for fasteners.
6. Provide metal closures at peaks rake edges rake walls and each side of ridge and hip caps.

C. Lap-Seam Metal Roof Panels: Fasten metal roof panels to supports with exposed fasteners at each lapped joint, at location and spacing recommended by manufacturer.

1. Provide metal-backed sealing washers under heads of exposed fasteners bearing on weather side of metal roof panels.

2. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.

3. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps and on side laps of nesting-type metal panels, on side laps of ribbed or fluted metal panels, and elsewhere as needed to make metal panels weatherproof to driving rains.

4. At metal panel splices, nest panels with minimum 6-inch end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.

D. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

E. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 METAL SOFFIT PANEL INSTALLATION

A. Provide metal soffit panels the full width of soffits. Install panels perpendicular to support framing.

B. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

3.7 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

C. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.8 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Steel construction.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Tests and Inspections:

1. High-Strength, Field-Bolted Connections: Connections shall be tested and inspected during installation according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

2. Welded Connections: In addition to visual inspection, field-welded connections shall be tested and inspected according to AWS D1.1/D1.1M.

D. Record position and alignment of erected steel. Compare with required tolerances.

E. Product will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.9 CLEANING AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

C. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing and accessories.

1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

D. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

E. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 13340

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this Section.

1.2 SUMMARY

A. This specification covers furnishing and installing top running bridge crane utilized for personnel lifting and all accessories including crane rail, final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation, including wiring and switching between equipment and utilities.

1.3 REFERENCES

A. American Gear Manufacturers Association (AGMA)

1. AGMA ISO 10064-6 (2010) Code of Inspection Practice – Part 6: Bevel Gear Measurement Methods
2. AGMA ISO 17485 (2008; Supplement 2008) Bevel Gears – ISO System of Accuracy (Including Supplement - Tolerance Tables 2008)
3. ANSI/AGMA 2001 (2004D; R 2010) Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth
4. ANSI/AGMA 2011 (1998A; R 2004) Cylindrical Wormgearing Tolerance and Inspection Methods
5. ANSI/AGMA 2015-1 (2001A; R 2008) Accuracy Classification System - Tangential Measurements for Cylindrical Gears
6. ANSI/AGMA 6013 (2006A; R 2011) Standard for Industrial Enclosed Gear Drives
7. ANSI/AGMA 6113 (2006A; R 2011) Standard for Industrial Enclosed Gear Drives (Metric Edition)

B. American Institute of Steel Construction (AISC)

1. AISC 325 (2011) Steel Construction Manual
2. AISC 360 (2010) Specification for Structural Steel Buildings

C. American Welding Society (AWS)

1. AWS D1.1/D1.1M (2010; Errata 2010) Structural Welding Code - Steel
2. AWS D14.1/D14.1M (2005) Specification for Welding Industrial and Mill Cranes and Other Material Handling Equipment

D. ASME International (ASME)

1. ASME B1.1 (2003; R 2008) Unified Inch Screw Threads (UN and UNR Thread Form)
2. ASME B18.2.2 (2010) Standard for Square and Hex Nuts
3. ASME B30.10 (2009) Hooks
4. ASME B30.11 (2010) Monorails and Underhung Cranes – Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings
5. ASME B30.16 (2007) Overhead Hoists (Underhung)
6. ASME B30.17 (2006) Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoists)
7. ASME B30.2 (2011) Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
8. ASME B30.23 (2011) Personnel Lifting Systems – Safety standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks and Slings
9. ASME NOG-1 (2010) Rules for Construction of Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)
10. ASME HST-4 (1999; R 2010) Performance Standard for Overhead Electric Wire Rope Hoists

E. ASTM International (ASTM)

1. ASTM A194/A194M (2011) Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
2. ASTM A275/A275M (2008) Standard Test Method for Magnetic Particle Examination of Steel Forgings
3. ASTM A307 (2010) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
4. ASTM A325 (2010) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
5. ASTM A563 (2007a) Standard Specification for Carbon and Alloy Steel Nuts
6. ASTM A668/A668M (2004; R 2009) Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
7. ASTM A931 (2008) Standard Test Method for Tension Testing of Wire Ropes and Strand
8. ASTM A1023/A1023M (2009) Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes
9. ASTM F436 (2011) Hardened Steel Washers
10. ASTM E125 (1963; R 2008) Photographs for Magnetic Particle Indications on Ferrous Castings
11. ASTM E543 (2009) Standard Practice for Agencies Performing Non-Destructive Testing

F. Crane Manufacturers Association of America (CMAA)

1. CMAA 74 (2010) Specifications for Top Running and Under Running Single Girder Electric Overhead Cranes Utilizing Under Running Trolley Hoist, No. 74

G. National Electrical Manufacturers Association (NEMA)

1. NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
2. NEMA ICS 3 (2005; R 2010) Medium-Voltage Controllers Rated 2001 to 7200 V AC
3. NEMA ICS 6 (1993; R 2011) Enclosures
4. NEMA ICS 8 (2011) Crane and Hoist Controllers
5. NEMA MG 1 (2011) Motors and Generators

H. National Fire Protection Association (NFPA)

1. NFPA 70 (2011; Errata 2 2012) National Electrical Code

I. U.S. National Archives And Records Administration (NARA)

1. 29 CFR 1910 Occupational Safety and Health Standards
2. 29 CFR 1910.147 Control of Hazardous Energy (Lock Out/Tag Out)
3. 29 CFR 1910.179 Overhead and Gantry Cranes
4. 29 CFR 1910.306 Specific Purpose Equipment and Installations

J. Underwriters Laboratories (UL)

1. UL 1004-1 (2008; Corrections 2008) Standard for Safety Rotating Electrical Machines
2. UL 1449 (2006; Reprint Feb 2011) Surge Protective Devices
3. UL 489 (2009; Reprint Jun 2011) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
4. UL 50 (2007; Reprint Apr 2012) Enclosures for Electrical Equipment, Non-environmental Considerations
5. UL 943 (2006; Reprint May 2010) Ground-Fault Circuit-Interrupters

1.4 DEFINITIONS

A. Crane Bridge: That part of an overhead crane system consisting of girder(s), end trucks, end ties, walkway, and drive mechanism which carries the trolley(s) and travels along the runway rails parallel to the runway.

B. Crane Runway: The track system along which the crane operates horizontally, including track hangar rods, track connection devices, and runway structural supports.

C. Dead Loads: The loads on a structure which remain in a fixed position relative to the structure.

D. Girder: The principal horizontal beam of the crane bridge. It is supported by the crane end trucks. Normally the crane trolley mounted hoist is suspended from the girder below the crane.

E. Live Load: A load which moves relative to the structure under consideration.

F. Rated Load: For the purpose of this specification the rated load is defined as the maximum working load suspended under the load hook.

G. Trolley Mounted Hoist: A combined unit consisting of a wheeled trolley that provides horizontal motion along the bridge girder, and a hoist suspended from the trolley, that provides lifting and lowering of a freely suspended load.

H. Top Running Crane: An overhead electric traveling crane that is supported by end trucks which run on top of supporting rails.

1.5 VERIFICATION OF DIMENSIONS

A. The Contractor is responsible for the coordination and proper relation of his work to the building structure and to the work of all trades. Verify all dimensions of the building that relate to fabrication of the crane and notify the Owners Representative of any discrepancy before finalizing the crane order.

1.6 SUBMITTALS

A. Action Submittals:

1. Shop Drawings

    a. Top Running Overhead Electric Crane system
    b. Coordination drawings

B. Product Data

1. Top Running Overhead Electric Crane system

    a. Submit data for all system components, including the following:

2. Bridge end trucks

3. Hoist trolley

4. Crane controllers

5. Couplings

6. Pendant push-button station

7. Crane Control Parameter Settings

    a. Crane electrification
    b. Motors
    c. Brakes
    d. Crane runway track system
    e. Overload Protection
    f. Hoist Limit Switches

C. Design Data

1. Load and sizing calculations
2. Crane bridge girder
3. Crane runway track system
4. Custom runway track suspension devices

D. Informational Submittals:

1. Test Reports

a. Hook and hook nut magnetic particle tests
b. Hook Proof Test
c. Hoisting rope breaking strength
d. Load Test
e. No-load Test
f. Post-erection inspection report
g. Operational test report

E. Certificates

1. Brake Setting Record
2. Overload Test Certificate
3. Loss of Power (Panic Test) Certificate
4. No Hazardous Material Certificate
5. Certificate of Compliance with Listed Standards

F. Operation and Maintenance Data

1. Top Running Overhead Electric Crane system ,including runway system

a. Submit data package in accordance with Submittal Procedure requirements including weekly, monthly, semi-annual, and annual required maintenance items.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualification:

1. Top Running Overhead Electric Crane system, including sub-system components manufactured by vendors, must be designed and manufactured by a company with a minimum of 10 years of specialized experience in designing and manufacturing the type of overhead crane required to meet requirements of the Contract Documents and conforming to ASME B30.16, ASME B30.17 and ASME B30.23.

B. Pre-Delivery Inspection

1. Contractor is responsible for performance of quality control inspections, testing and documentation of steel castings, hook assembly and trolley as follows.

C. Inspection of Steel Castings

1. Visually inspect and test load-carrying steel castings using ultrasonic testing. Reference allowable degree of discontinuities to ASTM E125, and relationship to service loads and stresses, critical configuration, location and type. All load bearing components, couplings, shafts, and gears, in the hoist drive train must be rolled or forged steel, except brake drums which may be ductile iron. Methods of repairing the discontinuities is subject to review by the Owners Representative.

D. Inspection of Hook Assembly

1. Inspect hook and nut and test ultrasonically prior to delivery. Furnish documentation of hook inspection (Hook Proof Test) to owner's representative prior to field operational testing. As part of the acceptance standard, linear indications greater than 1/16 inch are not allowed. Welding repairs of hook are not permitted. A hook showing linear indications, damage or deformation is not acceptable and must be replaced immediately.

E. Certifications

1. Submit a statement that the crane can be periodically load tested to 125 percent (plus 5 minus 0) of rated load.

2. Also provide the following certificates:

a. Overload Test Certificate
b. Loss of Power (Panic Test) Certificate
c. Certificate of Compliance with Listed Standards
d. No Hazardous Material Certificate, stating no asbestos, lead, cadmium, chromium, PCB's, elemental mercury, or any other hazardous materials.

3. Submit a loss of power (panic test) certificate stating that a test may be performed in which power is removed from the crane while the hoist, bridge and trolley are in operation to simulate a loss of power.

F. Drawings - Overhead Electric Crane System:

1. Submit shop drawings showing the general arrangement of all components in plan, elevation, and end views; hook approaches on all four sides, clearances and principal dimensions, assemblies of hoist, trolley and bridge drives, motor nameplate data, overcurrent protective device ratings, and electrical schematic drawings. Include weights of components and maximum bridge wheel loads and spacing.

2. Shop drawing quality must be equivalent to the contract drawings accompanying this solicitation. Drawings must be reviewed, signed and sealed by a licensed professional engineer.

3. Provide integral schedule of crane components on each drawing. Provide maximum wheel loads (without impact) and spacing imparted to the runway track beams. Indicate the crane speeds along the runway, the trolley speeds along the bridge girder, and the hoist lifting speeds; all speeds indicated are speeds with hoist loaded with rated crane capacity load.

4. Provide coordination drawings indicating crane components in relation to adjacent structure. Indicate other lifting mechanisms, critical dimensions, clearances and connection details.

G. Design Data: Load and Sizing Calculations

1. Submit calculations verifying the sizing of the bridge girder, end trucks and travel drives. Calculations must be must be reviewed, signed and sealed by a licensed professional engineer.

H. Welding Qualifications and Procedure

1. Welding must be in accordance with qualified procedures using AWS D14.1/D14.1M as modified. Written welding procedures must specify the Contractor's standard dimensional tolerances for deviation from camber and sweep and not exceed those specified in AWS D14.1/D14.1M and CMAA 74. Welders and welding operators must be qualified in accordance with AWS D1.1/D1.1M or AWS D14.1/D14.1M. Allowable stress values must comply with CMAA 74.

1.8 CRANE SAFETY

A. Comply with the mandatory and advisory safety requirements of ASME B30.11, ASME B30.16, ASME B30.23, ASME HST-4, NFPA 70, 29 CFR 1910(OSHA Standards), 29 CFR 1910.147, 29 CFR 1910.179, 29 CFR 1910.306 and GE Crane Safety Manual (Version 1.0).

B. Comply with all requirements of the GE Crane Safety Manual included in the safety requirements of these documents.

1.9 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, functions, and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damage, and missing parts; and abnormal deterioration of finish. Defects shall not include damage due to neglect, misuse, or situation resulting from non-performance of a manufacturer’s recommended preventive maintenance schedule.

PART 2 - PRODUCTS

2.1 TOP RUNNING CRANE SYSTEM

A. Provide top running bridge overhead electric traveling crane conforming to CMAA 74, Class C (Moderate Service) for outdoor service, ASME 30.2, with a vertical lift of approximately 240 feet and span approximately 47 feet as indicated on drawings. Crane must be controlled by a pendant on a separate festooned cable system from the trolley power supply.

B. All components of the crane system must comply with CMAA 74, Class C, except as modified and supplemented in this specification section.

C. The crane must operate in an outdoor environment having an ambient temperature range of -10 to 90 degrees Fahrenheit.

D. All components of the crane system shall comply with applicable provisions of the following specifications and documents:

1. AISC 325.
2. AISC 360.
3. RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."

E. Maximum crane wheel loads (without impact) due to dead and live loads, with the trolley in any position, must not cause a more severe loading condition in the runway support structure than that produced by the design wheel loads and spacing indicated on the design drawings.

F. Provide a foot walk on the drive girder side, and idler girder side with crossovers on the end trucks to allow access to all maintainable features of the crane.

G. Power Characteristics

1. Provide crane operating from a 480 volt AC, 60 Hz three phase power source.

H. Capacity

1. Provide a crane with a minimum rated capacity of 15 ton. Mark the rated capacity in both ton and pound units printed in different colors on each side of the crane bridge girders. Capacity marks must be clearly legible to the operator at ground level. Individual hoist units must have their rated capacity clearly marked on their bottom block, and additionally labeled on the hoist body. Rated capacity must include all accessories below the hook, such as load bars, magnets, grabs, etc. as part of the load to be handled.

I. Speeds & Crane Control Parameter Settings

1. Provide the crane with the maximum rated load speeds per recommendations from CMAA 74 and ASME.

2. Bridge Brake

a. Provide bridge drive with an electro-mechanical brake conforming to the requirements of CMAA 74, capable of stopping the motion of the bridge within a distance in feet equal to 10 percent of the full load speed in feet per minute when traveling at full speed with a full load. Provide brake with a minimum torque rating of 100 percent of the drive motor rated torque.

b. Provide brakes with an externally accessible means to manually defeat the brake. Select disc brake (if applicable) having housing which permits easy access for wear and setting inspection of the friction discs.

c. Bridge brake to conform to requirements of ASME B30.23.

3. Bumpers

a. Provide trolley and bridge bumpers conforming to CMAA 74 guidelines.

J. Hoist Trolley

1. Configure trolley such that the trolley frame contacts the trolley stops and prevents the trolley from dropping more than one inch in the event of an axle or wheel failure. Trolley must be mounted on straight and flat bridge beam. No hollow stamped steel wheels are permitted.

2. Trolley Drive

a. Provide motor-driven trolley.

3. Trolley Brake

a. Provide trolley brake or non-coasting worm drive capable of stopping the trolley within a distance in feet equal to 10 percent of the rated speed in feet per minute when traveling at rated speed with rated load. Provide brakes with an externally accessible means to manually defeat the brake.

b. Trolley brake to conform to requirements of ASME B30.23.

K. Hoist

1. ASME HST-4, Class H3, double reeved, except as modified and supplemented in this section. Equip hoist with a spring set, electro-mechanically released brake plus a mechanical load brake.

2. Load Block

a. Construct the load block entirely of steel. The design must preclude the wire rope from being cut, pinched, crushed, or chafed in case of two-blocking.

b. Construct the load block so that the hook and hook nut may be removed from the load block without disassembly of the block. Provide hook and hook nut forged from steel conforming to ASTM A668/A668M. Provide the hook with a safety latch per OSHA requirements. Provide the equalizer bar or sheave perpendicular to the running sheaves. Mark hoist capacity in pounds on both sides of the load blocks.

L. Crane Safety

1. Hook and Hook Nut

a. Provide hook conforming to ASME B30.10, except as modified and supplemented in this specification section. Do not coat, galvanize, or paint hook nut.

b. Provide hook and hook nut capable of complete disassembly that enables access to all surfaces of hook, including shank and hook nut for inspection purposes. Make provision for the hook nut, or other hook-to-block fastener, to be keyed to hook shank by means of a set screw or similar, easily removable, securing device. Provide bearing or bushing as necessary to ensure the hook rotates easily within the hook block when loaded at 131.25 percent of the rated hoist capacity. Hook should be provided with safety closure latch. Do not coat, galvanize, or paint hook.

c. Inspect each hook, including shank and hook nut, over the entire surface areas by magnetic particle inspection. If hook nut is not used, inspect any device that functions the same as the hook nut by magnetic particle inspection.

2. Hoisting Rope

a. Wire ropes must conform to ASTM A1023/A1023M and be tested as required by ASTM A931. Maximum hoisting rope fleet angles must be 4 degrees for drums and 4.75 degrees for sheaves. Hoisting rope end connections, other than drum connections, must be speltered sockets with forged steel terminals or swaged fittings installed in a fashion that provides 100 percent of the breaking strength of the wire rope. Provide proof of wire rope breaking strength. Wedge sockets or aluminum swages are not permitted on wire rope end connections.

b. Provide wire rope minimum safety factor of 5 to 1 based on the ratio of actual minimum wire rope breaking load to the calculated load on rope when hoist is assumed loaded to rated capacity. Certification from rope manufacturer verifying provided wire rope breaking strength, conforming to ASTM A931 must be approved by the owner’s representative. No paint or coatings are allowed on the wire rope. Minimum length of the wire rope must enable the load hook to operate through its full hook lift range and still have a minimum of two full wraps of wire rope around the rope drum.

3. Sheaves

   a. Provide steel sheaves. Minimum pitch diameters must be 18 times the rope diameter for running sheaves, and 12 times the rope diameter for equalizer sheaves. Sheave surfaces which contact wire rope are not to be painted.

4. Hoist Drum

   a. Provide drum of steel construction. Design drum so that not less than two dead wraps of hoisting rope remains on each anchorage when the hook is in its extreme low position. Provide right and left hand drum grooving beginning at the ends of the drum and grooving towards the center of the drum. Minimum drum groove depth, must be 0.375 times the rope diameter.

   b. Provide minimum drum groove pitch either 1.14 times the rope diameter, or the rope diameter plus 1/8 inch, whichever is smaller. Minimum drum pitch diameter must be 18 times the rope diameter. Do not paint, coat or galvanize the surface of the drum which comes in contact with wire rope.

5. Hoist Brake

   a. Provide both a mechanical load brake and an electro-mechanical brake (shoe or disc). The mechanical load brake and the electro-mechanical brake must each, independently, stop and hold 131.25 percent of rated capacity. The electro-mechanical brake must be adjustable to 50 percent of its rated capacity, and must have an externally accessible means of manual release.

   b. Hoist brake to conform to requirements of ASME B30.23.

6. Heaters

   a. Provide anti-condensation heaters at motor, control and brake locations as required to prevent crane operation from exceeding braking and safety requirements.

2.2 STRUCTURAL

A. Welding

1. Use AWS D14.1/D14.1M for welding design and procedures, including pre-weld and postweld heat treatments. However, the minimum classification of electrodes must be the E70 series.

B. Structural Bolted Connections

1. Structural bolted connections must be in accordance with CMAA 74, Section 3.8.

2.3 MECHANICAL

A. Threaded Fasteners

1. Fasten base-mounted and flange-mounted components and all mechanical connections subjected to calculable loads with ASTM A325 plain uncoated bolts (ASTM A307) with appropriate ASTM A194/A194M or ASTM A563plain nuts; and ASTM F436 plain, through hardened, flat, circular washers. Match bolt and nut threads. Oversize tapping is not permitted. Bolt and nut threads must conform to ASME B18.2.2 and ASME B1.1. Bolts and screws may be installed into tapped holes only in heat treated steel with a minimum hardness of 195 BHN.

B. Antifriction Bearings

1. Provide antifriction type bearings, except where bushings are specifically permitted or required. Provide grease lubricated bearings with means for relubrication through easily accessible lubrication fittings or provide permanently lubricated and sealed bearings.

C. Bushings

1. Provide manufacturer's standard bronze alloy bushings and thrust washers. Provide means for relubrication of grease lubricated bushings through easily accessible lubrication fittings or provide oil impregnated type bushings.

D. Gears

1. Gears must conform to the applicable requirements of ANSI/AGMA 2015-1, ANSI/AGMA 2001, AGMA ISO 10064-6, AGMA ISO 17485, ANSI/AGMA 2011, and ANSI/AGMA 6013.

2.4 ELECTRICAL

A. The design, selection, rating, and installation of the electrical portions of the crane and its accessories must conform to the requirements of NEMA ICS 4X, ASME HST-4, and NFPA 70, and other requirements specified herein.

B. The crane manufacturer must furnish and install all electrical equipment on the crane conforming to NEMA ICS 4X, including motors, conforming to NEMA MG 1, electrically released brakes, switches, crane controllers, panels, operating station, wiring system, cables, and bridge-to-trolley crane electrification, and the runway electrification.

C. Motors

1. Motors must meet all applicable requirements of NEMA MG 1 and UL 1004-1.

2. Provide motor overload protection utilizing a thermal sensitive device embedded in its windings. Motors must be sized sufficiently to provide continuous operation without overheating and causing a motor shut down at any point in a continuous bottom to top lift.

D. Pendant Pushbutton Station

1. Suspend the pendant push-button station from an independent festooned messenger track system, operating the length of the bridge. Locate the pendant pushbutton station 4 feet above the finished floor. Clearly mark all controls for identification of functions. Provide directional contactors with both mechanical and electrical interlocks.

2. Arrange pushbuttons in accordance with ASME B30.11 recommendations, except as supplemented or modified herein. On the pushbutton station, provide a pilot light to indicate that the pendant is energized. Provide a pilot light on the crane mounted electrical panel to indicate that power is available to the crane. Provide pendant station with an on and off button that removes power from the motors, brakes and control circuit. Provide directional contactors with both mechanical and electrical interlocks.

E. AC Controls

1. Provide static reversing, adjustable frequency controllers for the hoist, bridge and trolley electric drives. Provide dynamic braking for all electric drives. Speed control must be of the three step infinitely variable type for the hoist function and two step infinitely variable type for the bridge and trolley functions. The hoist, trolley and bridge brakes must set only after the associated controller decelerates the motor to a controlled stop.

2. All motors must run smoothly, without torque pulsations at the lowest speed and be energized at a frequency not exceeding 60 HZ at the highest speed. The hoist controller must enable the drive motor to develop full torque continuously at zero speed.

3. The use of definite purpose contactors is prohibited. All contactors must be NEMA rated. Feed control circuits from a single phase, air cooled, double wound transformer with a grounded metal screen between the primary and secondary windings of the transformer.

F. Protection

1. Protection must not be less than that required by NEMA ICS 4X, and NFPA 70. Provide enclosed type circuit breaker for crane disconnect. Provide an On/Off button that removes power from the motors, brakes and control circuit on the operator's control pendant station or radio controller. The control circuit must not operate unless the "On" button is depressed. Provide for lockout/tagout of all hazardous energy sources.

G. Resistors

1. Provide resistors rated for continuous duty operation based upon 125 percent of the motor nameplate amperes and fabricated of corrosion resistant metal; the use of "wire wound" type resistors is prohibited for segments of 8 ohms or less. Mount resistors in substantial, ventilated enclosures constructed entirely of non-combustible materials. Provide resistors with terminals fitted in the coolest position in the enclosure.

H. Limit Switches

1. Provide primary upper and lower geared limit switches. Geared limits must allow reversing direction to back out of the limit without resetting. Provide a backup mechanical hook block activated upper limit switch wired independent of the directional controllers and the primary upper limit switch that removes power from the hoist motor, hoist brake and hoist controls. The backup limit must require hoist resetting prior to operation of the hoist in any direction. Provide a three position keyed switch on the pendant control with positions for bypass of the primary upper limit (to allow testing of the backup upper limit) and bypass of the backup upper limit in the lower direction only.

2. Do not furnish clutch-to-stop devices with the hoist.

I. Overload Protection

1. Provide overload protection for bridge, runway, and hoist systems. Hoist overload protection must be adjustable between 80 and 150 percent of hoist capacity.

J. Reactors

1. Provide line reactors rated for continuous duty operation based upon the motor nameplate amperes. Select reactors for 60 Hz operation and having taps for field adjustment of inductance so as to permit achievement of the optimum acceleration characteristics for the drive. For a drive motor branch circuit that exceeds 100 feet in length, a reactor must also be connected in series with the controller load (output) terminals to provide standing wave protection.

K. Warning Devices

1. Provide a rotating beacon that is illuminated at all times during movement of the hoist, trolley, or bridge function.

L. Indicator Lights

1. Place indicator lights in an enclosure mounted on the bottom of the bridge with lights sized and positioned to be visible from the ground. The lights must be the dual-lamp type. Provide a white light to indicate that power is available on the load side of the crane disconnect and a blue light to indicate that the main contactor is energized. Voltage of the lights must be 115 VAC.

2. Provide nameplates that are legible from ground level. The nameplates must read, in their respective order. "POWER AVAILABLE" and "CRANE ENERGIZED". Energization of the "POWER AVAILABLE" light must be supplied by a separate, fused transformer.

M. Enclosures

1. Provide enclosures for control panels, controls, and brakes in accordance with NEMA 250 and NEMA ICS 4X, Classification Type 1 indoor, general purpose.
2. Provide electrical work for the crane system in accordance with NFPA 70.

2.5 CRANE PAINTING

A. Paint all portions of the crane and girders with 3 coats of primer and paint as noted below:

1. First Coat:

a. Benjamin Moore & Co.; M07 Universal Metal Primer at 1.5 to 2.5 mils DFT.
b. Sherwin-Williams Company (The); Zinc Clad II Plus.
c. Tnemec Inc.; Series 90-97 Tneme-Zinc at 2.5 to 3.5 mils DFT.

2. Second Coat:

a. Benjamin Moore & Co.; M45/M46 Epoxy Mastic Coating at 3.0 to 5.0 mils DFT.
b. Sherwin-Williams Company (The); Macropoxy HS High Solids Epoxy.
c. Tnemec Inc.; Series N69 Hi-Build Epoxoline II at 3.0 to 5.0 mils DFT.

3. Third Coat:

a. Benjamin Moore & Co.; M74/M75 Aliphatic Acrylic Urethane Gloss.
b. Sherwin-Williams Company (The); Hi Solids Polyurethane.
c. Tnemec Inc.; Series 1074 or 1075 Endura-Shield II at 2.0 to 5.0 mils DFT.

B. Paint exposed portions of the crane and girders in accordance with CMAA 74. Desired final color is brilliant yellow.

C. Coat faying surfaces of bolted connections per AISC 325, but do not apply finish paint.

D. Paint the load block brilliant yellow with black diagonal striping, one inch wide diagonal black stripes located on 2 inch centers.

E. Factory paint electrical and mechanical equipment in accordance with the manufacturer's best standard practice (for the specified environment), except that electrical equipment doors, which expose current-carrying electrical conductors when opened, must be orange.

2.6 IDENTIFICATION PLATES

A. Furnish and install identification plates. Provide non-corrosive metal identification plates with clearly legible permanent lettering giving the manufacturer's name, model number, serial number, capacity in both kilogram and pound units printed in different colors, and other essential information or identification.

B. Markings on Crane, Trolley and Hook

1. Markings include: bridge motion direction arrows on both sides of the bridge; and trolley motion direction arrows on both sides of trolley. Markings must be visible from push button station and from the loading point, corresponding to the push button labeling on the pendant pushbutton station. Mark the hook rated capacity on both sides of the hoist and hoist load block in tons and in pounds.

PART 3 - EXECUTION

3.1 POST-ERECTION INSPECTION

A. After erection, the Contractor, the activity crane certifying official, and the Owners Representative must jointly inspect the bridge crane and hoist systems and components to verify compliance with specifications and approved shop drawings and manufacturer's data. Notify the Owners Representative 7 days before the inspection.

B. Document the results of this inspection and submit the post-erection inspection report to the Owners Representative for approval.

3.2 OPERATIONAL TEST

A. After erection and inspection, test the hoist, bridge, and trolley as specified herein. All tests must be witnessed by a technical representative of the Owners Representative and the activity crane certifying official.

B. Perform the 125 percent rated load test with the bridge and trolley located to obtain maximum loads on the runway and bridge girders. Test the systems in service to determine that each component of the system operates as specified, is properly installed and adjusted, and is free from defects in material, manufacture, installation, and workmanship.

C. Rectify all deficiencies disclosed by testing and retest the system or component to prove the crane meets the specified requirements.

D. Provide all personnel and equipment required to meet the specified test requirements. This includes test loads, and rigging gear, crane operating personnel, instruments, and all other necessary apparatus.

E. Operational Test Report

1. Record crane test data on appropriate test record forms suitable for retention for the life of the crane. Include in the test records:

a. Test date
b. Crane identification number
c. Weather conditions (temperature, humidity, barometric pressure, dew point, and crane orientation)
d. Identification of each test performed
e. Results of each test performed
f. Data collected during testing
g. Remarks

2. Record operating and startup current and motor terminal voltage measurements for electrical equipment (motors) using appropriate instrumentation (e.g., clamp-on ammeters). Compare recorded values with design specifications or manufacturer's recommended values; abnormal differences (i.e., greater than 10 percent from manufacturer's or design values) must be justified or appropriate adjustments performed. In addition, note, investigate, and correct any high temperatures or abnormal operation of any equipment or machinery. Record hoist, trolley, and bridge speeds during each test cycle. Ensure that any energized drive motor initially rotates only in the direction selected by the operator by depressing the corresponding pushbutton; i.e., is not overhauled.

F. Hook

1. Measure hook for hook throat spread before and after load test. Establish a throat dimension base measurement by installing two tram points and measuring the distance between these tram points (plus or minus 1/64 inch). Record this base dimension. Measure the distance between tram points before and after load test. Any increase in throat opening from the base measurement is cause for rejection.

G. No-Load Test

1. Check entire clearance envelope to ensure there are no obstructions. Raise and lower the hook through the full range of normal travel at rated speed for three complete cycles. Then raise and lower the hook through the full range of normal travel in slow speed. Verify proper operation of hoist limit switches. Operate the bridge and trolley in each direction the full distance between end stops; bring bumpers into contact with bumper stops at each end of travel. Perform one complete cycle to check each speed point and verify proper brake operation.

H. Hoist Load Test

1. Perform the following tests, as specified, with test loads of 100 percent (plus 0 minus 10 percent) and 125 percent (plus 5 minus 0) of rated load.

a. Static Load Test (125 percent only): Check entire structure, holding brake and hoisting components as follows: With the trolley in the center of the bridge span, raise the test load approximately one foot. Hold the load for 10 minutes. Rotate load and hook a full 360 degrees to check bearing operation. Ensure there is no vertical movement of the load. Verify beam and girder deflections do not exceed CMAA 74 and MHI MH27.1 design limits.

b. Dynamic Load Test (100 percent only): Raise and lower the test load through the full lift height to test limit switches. Check speed points during raising and lowering. Lower the load to the floor, operate continuously for 5 minutes, then raise and lower the load through two more cycles, in order to demonstrate proper operation and repeatability of all functions without component overheating or malfunction. Completely stop the machinery at least once in each direction during each cycle to ensure proper brake operation.

c. Hoist Load Brake (125 percent only): Raise test load approximately 5 feet. With neither pushbutton depressed, release (by hand) the holding brake. The load brake must hold the test load. Again with the holding brake in the released position, start the test load down (first point) and then release the pushbutton as the test load lowers. The load brake must prevent the test load from accelerating. Submit 5 copies of the brake setting record.

d. Hoist Loss of Power (Panic Test) Certificate (125 percent only): Raise the test load to approximately 8 feet. While slowly lowering the test load, disconnect the crane's power source. Verify that the test load does not lower and that the brake is set.

I. Trolley/Hoist Load Test

1. Operate the trolley/hoist the full distance of the bridge rails in each direction with a test load of 125 percent of rated load on the hook (one cycle). Check proper functioning of all drive speed control points. Verify proper brake action.

J. Bridge Load Test

1. With a test load of 125 percent of rated load on the hook, operate the bridge for the full length of the runway in one direction with the trolley/hoist at the extreme end of the bridge, and in the opposite direction with the trolley at the opposite extreme end of the bridge (one cycle). Check proper functioning of all drive speed control points. Check for any binding of the bridge end trucks and verify proper brake action. Record deficiencies. Secure from testing if deficiencies are found.

K. Rated Travel Test

1. Repeat travel tests for trolley/hoist and bridge with a test load of 100 percent of rated load. Repeat the test for 2 cycles to demonstrate proper operation and repeatability of all functions without the overheating or malfunction of any components. Check speed points during each cycle. Completely stop the machinery at least once in each direction during each cycle to ensure proper brake action.

END OF SECTION 14630

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This specification covers furnishing and installing electrically operated jib crane utilized for personnel lifting and accessories, final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation, including wiring and switching between equipment and utilities.

1.3 REFERENCES

A. American Institute of Steel Construction (AISC)

1. AISC 325 (2011) Steel Construction Manual
2. AISC 360 (2010) Specification for Structural Steel Buildings

B. American Welding Society (AWS)

1. AWS D1.1/D1.1M (2010; Errata 2010) Structural Welding Code - Steel
2. AWS D14.1/D14.1M (2005) Specification for Welding Industrial and Mill Cranes and Other Material Handling Equipment

C. ASME International (ASME)

1. ASME B1.1 (2003; R 2008) Unified Inch Screw Threads (UN and UNR Thread Form)
2. ASME B18.2.2 (2010) Standard for Square and Hex Nuts
3. ASME B30.10 (2009) Hooks
4. ASME B30.11 (2010) Monorails and Underhung Cranes – Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings
5. ASME B30.16 (2007) Overhead Hoists (Underhung)
6. ASME B30.17 (2006) Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoists)
7. ASME B30.23 (2011) Personnel Lifting Systems – Safety standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks and Slings
8. ASME HST-4M (1999; R 2010) Performance Standard for Overhead Electric Wire Rope Hoists

D. ASTM International (ASTM)

1. ASTM A194/A194M (2011) Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
2. ASTM A275/A275M (2008) Standard Test Method for Magnetic Particle Examination of Steel Forgings

3. ASTM A307 (2010) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
4. ASTM A325 (2010) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
5. ASTM A563 (2007a) Standard Specification for Carbon and Alloy Steel Nuts
6. ASTM A668/A668M (2004; R 2009) Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
7. ASTM A931 (2008) Standard Test Method for Tension Testing of Wire Ropes and Strand
8. ASTM A1023/A1023M (2009) Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes
9. ASTM F436 (2011) Hardened Steel Washers
10. ASTM E125 (1963; R 2008) Photographs for Magnetic Particle Indications on Ferrous Castings
11. ASTM E543 (2009) Standard Practice for Agencies Performing Non-Destructive Testing

E. Crane Manufacturers Association of America (CMAA)

F. National Electrical Manufacturers Association (NEMA)

1. NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
2. NEMA ICS 3 (2005; R 2010) Medium-Voltage Controllers Rated 2001 to 7200 V AC
3. NEMA ICS 6 (1993; R 2011) Enclosures
4. NEMA ICS 8 (2011) Crane and Hoist Controllers
5. NEMA MG 1 (2011) Motors and Generators

G. National Fire Protection Association (NFPA)

1. NFPA 70 (2011; Errata 2 2012) National Electrical Code

H. U.S. National Archives And Records Administration (NARA)

1. 29 CFR 1910 Occupational Safety and Health Standards
2. 29 CFR 1910.147 Control of Hazardous Energy (Lock Out/Tag Out)
3. 29 CFR 1910.179 Overhead and Gantry Cranes
4. 29 CFR 1910.306 Specific Purpose Equipment and Installations

I. Underwriters Laboratories (UL)

1. UL 1004-1 (2008; Corrections 2008) Standard for Safety Rotating Electrical Machines
2. UL 1449 (2006; Reprint Feb 2011) Surge Protective Devices
3. UL 489 (2009; Reprint Jun 2011) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
4. UL 50 (2007; Reprint Apr 2012) Enclosures for Electrical Equipment, Non-environmental Considerations
5. UL 943 (2006; Reprint May 2010) Ground-Fault Circuit-Interrupters

1.4 DEFINITIONS

A. Mast: That part of an jib crane system consisting of structural steel pipe, seamless steel tube or a rolled section that supports the boom in level position when the rated load is suspended at the end of the boom.

B. Head Assembly: The head assembly shall support the boom beam atop the mast tube on a tapered roller bearing assembly which allows a minimum 180-degree (o) rotation. A self-aligning guide roller assembly shall support the radial load between the mast tube and lower portion of the head.

C. Boom: A cantilevered structural section supported by the mast and head assembly extending to the specified reach of the crane system. The boom is in level position and also supports the rated load suspended from the end.

D. Dead Loads: The loads on a structure which remain in a fixed position relative to the structure.

E. Live Load: A load which moves relative to the structure under consideration.

F. Rated Load: For the purpose of this specification the rated load is defined as the maximum working load suspended under the load hook.

1.5 PERFORMANCE REQUIREMENT

A. Design and Deflection Requirements:

1. Live Load: Rated capacity plus hoist/trolley weight
2. Dead Load: Component weights
3. Impact Factor: 25 percent
4. Deflection L/450

B. Jib Crane designs shall be in conformance with CMAA, ASME B30.16, and ASME B30.23.

1.6 SUBMITTALS

A. Action Submittals

1. Shop Drawings: For crane, include plans, elevations, sections, details, and attachments to other work. Shop drawings must be reviewed, signed and sealed by a licensed professional engineer.

    a. For installed products indicated to comply with design loads, showing all quantities, sizes, dimensions, components, fasteners, welds, connections, bearing, pivots, fitting, etc. for the fabrication and installation of the jib crane.
    b. Wiring Diagrams: Power, signal, and control wiring.

B. Coordination Drawings: Provide coordination drawings indicating crane components in relation to adjacent structure. Indicate other lifting mechanisms, critical dimensions, clearances and connection details.

C. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished accessories.

D. Design Data: Submit calculations verifying the sizing of the all crane components. Calculations must be must be reviewed, signed and sealed by a licensed professional engineer.

E. Informational Submittals:

1. Test Reports

a. Hook and hook nut magnetic particle tests
b. Hook Proof Test
c. Hoisting rope breaking strength
d. Load Test
e. No-load Test
f. Post-erection inspection report
g. Operational test report

F. Certificates

1. Brake Setting Record
2. Overload Test Certificate
3. Loss of Power (Panic Test) Certificate
4. No Hazardous Material Certificate
5. Certificate of Compliance with Listed Standards

G. Operation and Maintenance Data: For jib crane and accessories, submit data package in accordance with Submittal Procedure requirements including weekly, monthly, semi-annual, and annual required maintenance items.

1.7 QUALITY ASSURANCE

A. Experience: Equipment shall be produced by a manufacturer of established reputation with a minimum of five years of experience supplying specified equipment.

B. Training: Provide technical representative to provide training to Owner’s maintenance personal in operation and maintenance of specified equipment.

C. Quality standards shall meet or exceed ISO-9001.

D. Pre-Delivery Inspection

1. Contractor is responsible for performance of quality control inspections, testing and documentation of steel castings, hook assembly and trolley as follows.

E. Inspection of Steel Castings

1. Visually inspect and test load-carrying steel castings using ultrasonic testing. Reference allowable degree of discontinuities to ASTM E125, and relationship to service loads and stresses, critical configuration, location and type. All load bearing components, couplings, shafts, and gears, in the hoist drive train must be rolled or forged steel, except brake drums which may be ductile iron. Methods of repairing the discontinuities is subject to review by the Owners Representative.

F. Inspection of Hook Assembly

1. Inspect hook and nut and test ultrasonically prior to delivery. Furnish documentation of hook inspection (Hook Proof Test) to owner's representative prior to field operational testing. As part of the acceptance standard, linear indications greater than 1/16 inch are not allowed. Welding repairs of hook are not permitted. A hook showing linear indications, damage or deformation is not acceptable and must be replaced immediately.

G. Certifications

1. Submit a statement that the crane can be periodically load tested to 125 percent (plus 5 minus 0) of rated load.

2. Also provide the following certificates:

a. Overload Test Certificate
b. Loss of Power (Panic Test) Certificate
c. Certificate of Compliance with Listed Standards
d. No Hazardous Material Certificate, stating no asbestos, lead, cadmium, chromium, PCB's, elemental mercury, or any other hazardous materials.

3. Submit a loss of power (panic test) certificate stating that a test may be performed in which power is removed from the crane while the hoist, bridge and trolley are in operation to simulate a loss of power.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment.
B. Jib Crane and accessories shall be delivered to the site painted, except as otherwise specified.
C. At the site, Jib Crane and accessories shall be stored off the ground, in an enclosed area, and stored/handled in such a manner as to prevent soiling, corrosion and/or damage.

1.9 PROJECT CONDITIONS

A. Do not use equipment or equipment packaging as support during construction.

1.10 CRANE SAFETY

A. Comply with the mandatory and advisory safety requirements of ASME B30.10, ASME B30.16, ASME B30.23, ASME HST-4, NFPA 70, 29 CFR 1910(OSHA Standards), 29 CFR 1910.147, 29 CFR 1910.179, 29 CFR 1910.306 and GE Crane Safety Manual (Version 1.0).

1.11 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, functions, and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damage, and missing parts; and abnormal deterioration of finish. Defects shall not include damage due to neglect, misuse, or situation resulting from non-performance of a manufacturer's recommended preventive maintenance schedule.

PART 2 - PRODUCTS

2.1 JIB CRANE SYSTEM

A. Provide and install a free-standing, base-mounted, motorized jib crane and all accessories. Materials used shall be free from defects which would adversely affect the performance or maintainability of individual components or the overall assembly. Materials not specified herein shall be of the same quality used for the intended purpose in commercial practice. Unless otherwise specified herein, all equipment, material, and articles incorporated in the work covered by this specification are to be new and fabricated using materials produced from recovered materials to the maximum extent possible without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specified.

B. Ease of maintenance. The jib crane shall be so designed and constructed that normal adjustments, repair and overhaul can be readily accomplished by means of general purpose tools with a minimum removal or disturbance of other elements of the crane. Ease of maintenance provisions shall ensure operating clearances for facilitating maintenance and servicing. Lubrication fittings shall be accessible without the removal or adjustment of accessories or parts.

C. Safety. All rotating and reciprocating parts, and all parts subject to high operational temperatures, that are of such a nature or so located to be or become a hazard to the safety of the operating personnel shall be insulated, enclosed or guarded to the extent necessary to eliminate the hazard.

D. Design and construction. The jib crane shall conform to accepted engineering and manufacturing practices relative to design, capacity and quality of materials. The rated lifting capacity shall be based on full-rated live load at the hoist hook. Full allowance shall be made for the dead weight of the hoist and trolley and an impact load of 1/2 percent of rated load per foot per minute of hoisting speed but not less than 15 percent. The maximum allowable stress on mast, boom, tie rod assembly, and mounting brackets shall not exceed 20 percent of the minimum yield strength of the material. Hardware necessary for field erection of sections disassembled for shipment and parts required for installation of a trolley and hoist shall be provided. Conditions which can be hazardous to personnel or deleterious to equipment shall not be permitted. Crane and it's operation must meet requirements of crane safety per OSHA and ASME B30.23. A. The design, selection, rating, and installation of the electrical portions of the crane and its accessories must conform to the requirements of NEMA ICS 4X, ASME HST-4, and NFPA 70, and other requirements specified herein.

E. Capacity

1. 5 TON rated capacity with 180 degree minimum rotation.

F. Structural steel I-beam boom reach

1. Span = 20feet

G. Power Characteristics

1. Provide crane operating from a 480 volt AC, 60 Hz three phase power source.

H. Mast

1. The mast assembly shall consist of a structural steel pipe, seamless steel tube, or a rolled section as specified. The mast shall be heavily gusseted to a steel flange plate base, and fitted at the top with a center mounted bearing support. The mast shall be designed to support the boom in level position when the rated load is suspended at the end of the boom less the applicable deflection.

I. Head Assembly

1. The head assembly shall support the boom beam atop the mast tube on a tapered roller bearing assembly which allows a 180-degree (o) rotation. A self-aligning guide roller assembly shall support the radial load between the mast tube and lower portion of the head. Guide rollers shall be ball or roller bearing mounted and shall make full contact with the roller race. An adjustment means shall be provided for leveling of the boom. An electronic motor shall be provided for the rotation of the boom about the mast assembly.

J. Boom Section

1. The boom section dimensions and properties shall correspond to AISC structural steel "S" shapes or "W" shapes, as specified. The upper surface of the lower flange shall be free from bumps, depressions and irregularities. Trolley stops shall be provided to stop the trolley at both ends of the boom. The stops shall be mounted on both sides of the web of the boom and shall be in alignment. The span, from the mast centerline to the free end of the boom, shall be as specified. The maximum vertical deflection of the boom produced by the dead load, the weight of hoist, trolley, and the rated load shall not exceed L/300 of the span. Impact shall not be considered when determining deflection. The boom shall be motorized for rotation.

K. Bearings

1. All anti-friction bearings shall be of the commercially standard type as specified herein and shall have not less than a 5,000-hour fatigue life rating at 90 percent reliability. The ball and roller bearing ratings shall be in accordance with the manufacturer's standard practice, as applicable, and shall be determined for maximum thrust and radial loads developed at the rated capacity. Bushings, where permitted, shall be grooved to distribute the lubricant.

L. Hoist and Trolley

1. Motorized hoist with motorized operated trolley. Rated capacity 5 tons lbs. The electric motor powered hoist shall conform to ASME HST-4M and the trolley wheels shall be designed for use on the boom of the jib crane provided. Motors must be sized sufficiently to provide continuous operation without overheating and causing a motor shut down at any point in a continuous bottom to top lift. Rated load capacity of the hoist shall not exceed that of the jib crane. Hoist and power supply characteristics, and festooned conductor or trolley supported conductor system shall be as specified. Length of lift must be 250 feet.

    a. Brake Mechanism: Automatic in operation, having a factor of safety not less than 2 for the rated capacity and is to comply with requirements of ASME B30.23.

    b. Pendant: Suspend the pendant push-button station from an independent festooned messenger track system, operating the length of the boom. Locate the pendant pushbutton station 4 feet above the finished floor. Clearly mark all controls for identification of functions. Provide directional contactors with both mechanical and electrical interlocks.

    c. Hoist speed – Provide the crane with the maximum rated load speeds per recommendations from CMAA and ASME.

2. Hoist Trolley

    a. Configure trolley such that the trolley frame contacts the trolley stops and prevents the trolley from dropping more than one inch in the event of an axle or wheel failure. Trolley must be mounted on straight and flat bridge beam. No hollow stamped steel wheels are permitted.

b. Trolley Drive - Provide motor-driven trolley.

c. Trolley Brake - Provide trolley brake or non-coasting worm drive capable of stopping the trolley within a distance in feet equal to 10 percent of the rated speed in feet per minute when traveling at rated speed with rated load. Provide brakes with an externally accessible means to manually defeat the brake.

d. Trolley brake to conform to requirements of ASME B30.23.

3. Hoist Drum

a. Provide drum of steel construction. Design drum so that not less than two dead wraps of hoisting rope remains on each anchorage when the hook is in its extreme low position. Provide right and left hand drum grooving beginning at the ends of the drum and grooving towards the center of the drum. Minimum drum groove depth, must be 0.375 times the rope diameter.

b. Provide minimum drum groove pitch either 1.14 times the rope diameter, or the rope diameter plus 1/8 inch, whichever is smaller. Minimum drum pitch diameter must be 18 times the rope diameter. Do not paint, coat or galvanize the surface of the drum which comes in contact with wire rope.

4. Hoist Brake

a. Provide both a mechanical load brake and an electro-mechanical brake (shoe or disc). The mechanical load brake and the electro-mechanical brake must each, independently, stop and hold 131.25 percent of rated capacity. The electro-mechanical brake must be adjustable to 50 percent of its rated capacity, and must have an externally accessible means of manual release.

b. Hoist brake to conform to requirements of ASME B30.23.

5. Hoisting Rope

a. Wire ropes must conform to ASTM A1023/A1023M and be tested as required by ASTM A931. Maximum hoisting rope fleet angles must be 4 degrees for drums and 4.75 degrees for sheaves. Hoisting rope end connections, other than drum connections, must be speltered sockets with forged steel terminals or swaged fittings installed in a fashion that provides 100 percent of the breaking strength of the wire rope. Provide proof of wire rope breaking strength. Wedge sockets or aluminum swages are not permitted on wire rope end connections.

b. Provide wire rope minimum safety factor of 5 to 1 based on the ratio of actual minimum wire rope breaking load to the calculated load on rope when hoist is assumed loaded to rated capacity. Certification from rope manufacturer verifying provided wire rope breaking strength, conforming to ASTM A931 must be approved by the owner’s representative. No paint or coatings are allowed on the wire rope. Minimum length of the wire rope must enable the load hook to operate through its full hook lift range and still have a minimum of two full wraps of wire rope around the rope drum.

6. Hook and Hook Nut

   a. Provide hook conforming to ASME B30.10, except as modified and supplemented in this specification section. Do not coat, galvanize, or paint hook nut.

   b. Provide hook and hook nut capable of complete disassembly that enables access to all surfaces of hook, including shank and hook nut for inspection purposes. Make provision for the hook nut, or other hook-to-block fastener, to be keyed to hook shank by means of a set screw or similar, easily removable, securing device. Provide bearing or bushing as necessary to ensure the hook rotates easily within the hook block when loaded at 131.25 percent of the rated hoist capacity. Hook should be provided with safety closure latch. Do not coat, galvanize, or paint hook.

   c. Inspect each hook, including shank and hook nut, over the entire surface areas by magnetic particle inspection. If hook nut is not used, inspect any device that functions the same as the hook nut by magnetic particle inspection.

M. Finishes

1. Paint all portions of the crane with 3 coats of primer and paint as noted below:

2. First Coat:

   a. Benjamin Moore & Co.; M07 Universal Metal Primer at 1.5 to 2.5 mils DFT.
   b. Sherwin-Williams Company (The); Zinc Clad II Plus.
   c. Tnemec Inc.; Series 90-97 Tneme-Zinc at 2.5 to 3.5 mils DFT.

3. Second Coat:

   a. Benjamin Moore & Co.; M45/M46 Epoxy Mastic Coating at 3.0 to 5.0 mils DFT.
   b. Sherwin-Williams Company (The); Macropoxy HS High Solids Epoxy.
   c. Tnemec Inc.; Series N69 Hi-Build Epoxoline II at 3.0 to 5.0 mils DFT.

4. Third Coat:

   a. Benjamin Moore & Co.; M74/M75 Aliphatic Acrylic Urethane Gloss.
   b. Sherwin-Williams Company (The); Hi Solids Polyurethane.
   c. Tnemec Inc.; Series 1074 or 1075 Endura-Shield II at 2.0 to 5.0 mils DFT.

5. Jib crane, except bushings, bearing, pivot pins and grease fittings shall be painted.

N. Marking

1. Booms shall have signs noting the rated load capacity on both sides.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, concrete bases, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of jib crane.
B. Examine and verify actual locations of utility connections before jib crane installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASE

A. Install concrete base of dimensions indicated for jib crane.

B. Install steel anchor bolts in the concrete base. These bolts shall be of proper number, size and type as per jib crane manufacturer’s recommendations and as shown in drawings.

1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Cast-in-place concrete materials and placement requirements are specified in Division 3.

3.3 INSTALLATION

A. Install and align jib crane and accessories to meet all OSHA design and clearance guidelines.

B. Install equipment in accordance with plans, shop drawings and manufacturer’s instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements general level, plumb and at right angles to adjacent work.

a. Tolerances: Boom level: L/450

C. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.

D. Anchorage: Attach equipment as directed by manufacturer. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.

E. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

F. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Post-erection Inspection

1. After erection, the Contractor, the activity crane certifying official, and the Owners Representative must jointly inspect the bridge crane and hoist systems and components to verify compliance with specifications and approved shop drawings and manufacturer's data. Notify the Owners Representative 7 days before the inspection.

2. Document the results of this inspection and submit the post-erection inspection report to the Owners Representative for approval.

C. Operational Test

1. After erection and inspection, test the hoist, bridge, and trolley as specified herein. All tests must be witnessed by a technical representative of the Owners Representative and the activity crane certifying official.

2. Perform the 125 percent rated load test with the bridge and trolley located to obtain maximum loads on the runway and bridge girders. Test the systems in service to determine that each component of the system operates as specified, is properly installed and adjusted, and is free from defects in material, manufacture, installation, and workmanship.

3. Rectify all deficiencies disclosed by testing and retest the system or component to prove the crane meets the specified requirements.

4. Provide all personnel and equipment required to meet the specified test requirements. This includes test loads, and rigging gear, crane operating personnel, instruments, and all other necessary apparatus. Operational Test Report - Record crane test data on appropriate test record forms suitable for retention for the life of the crane. Include in the test records:

   a. Test date
   b. Crane identification number
   c. Weather conditions (temperature, humidity, barometric pressure, dew point, and crane orientation)
   d. Identification of each test performed
   e. Results of each test performed
   f. Data collected during testing
   g. Remarks

5. Record operating and startup current and motor terminal voltage measurements for electrical equipment (motors) using appropriate instrumentation (e.g., clamp-on ammeters). Compare recorded values with design specifications or manufacturer's recommended values; abnormal differences (i.e., greater than 10 percent from manufacturer's or design values) must be justified or appropriate adjustments performed. In addition, note, investigate, and correct any high temperatures or abnormal operation of any equipment or machinery. Record hoist, trolley, and bridge speeds during each test cycle. Ensure that any energized drive motor initially rotates only in the direction selected by the operator by depressing the corresponding pushbutton; i.e., is not overhauled.

D. Hook

1. Measure hook for hook throat spread before and after load test. Establish a throat dimension base measurement by installing two tram points and measuring the distance between these tram points (plus or minus 1/64 inch). Record this base dimension. Measure the distance between tram points before and after load test. Any increase in throat opening from the base measurement is cause for rejection.

E. No-Load Test

1. Check entire clearance envelope to ensure there are no obstructions. Raise and lower the hook through the full range of normal travel at rated speed for three complete cycles. Then raise and lower the hook through the full range of normal travel in slow speed. Verify proper operation of hoist limit switches. Operate the bridge and trolley in each direction the full distance between end stops; bring bumpers into contact with bumper stops at each end of travel. Perform one complete cycle to check each speed point and verify proper brake operation.

F. Hoist Load Test

1. Perform the following tests, as specified, with test loads of 100 percent (plus 0 minus 10 percent) and 125 percent (plus 5 minus 0) of rated load.

a. Static Load Test (125 percent only): Check entire structure, holding brake and hoisting components as follows: With the trolley in the center of the bridge span, raise the test load approximately one foot. Hold the load for 10 minutes. Rotate load and hook a full 360 degrees to check bearing operation. Ensure there is no vertical movement of the load. Verify beam and girder deflections do not exceed CMAA 74 and MHI MH27.1 design limits.

b. Dynamic Load Test (100 percent only): Raise and lower the test load through the full lift height to test limit switches. Check speed points during raising and lowering. Lower the load to the floor, operate continuously for 5 minutes, then raise and lower the load through two more cycles, in order to demonstrate proper operation and repeatability of all functions without component overheating or malfunction. Completely stop the machinery at least once in each direction during each cycle to ensure proper brake operation.

c. Hoist Load Brake (125 percent only): Raise test load approximately 5 feet. With neither pushbutton depressed, release (by hand) the holding brake. The load brake must hold the test load. Again with the holding brake in the released position, start the test load down (first point) and then release the pushbutton as the test load lowers. The load brake must prevent the test load from accelerating. Submit 5 copies of the brake setting record.

d. Hoist Loss of Power (Panic Test) Certificate (125 percent only): Raise the test load to approximately 8 feet. While slowly lowering the test load, disconnect the crane's power source. Verify that the test load does not lower and that the brake is set.

G. Trolley/Hoist Load Test

1. Operate the trolley/hoist the full distance of the bridge rails in each direction with a test load of 125 percent of rated load on the hook (one cycle). Check proper functioning of all drive speed control points. Verify proper brake action.

H. Bridge Load Test

1. With a test load of 125 percent of rated load on the hook, operate the bridge for the full length of the runway in one direction with the trolley/hoist at the extreme end of the bridge, and in the opposite direction with the trolley at the opposite extreme end of the bridge (one cycle). Check proper functioning of all drive speed control points. Check for any binding of the bridge end trucks and verify proper brake action. Record deficiencies. Secure from testing if deficiencies are found.

I. Rated Travel Test

1. Repeat travel tests for trolley/hoist and bridge with a test load of 100 percent of rated load. Repeat the test for 2 cycles to demonstrate proper operation and repeatability of all functions without the overheating or malfunction of any components. Check speed points during each cycle. Completely stop the machinery at least once in each direction during each cycle to ensure proper brake action.

3.5 ADJUSTING

A. After installation, the Contractor shall adjust all components and fittings as required for proper functioning.
B. After installation, the Contractor shall check and adjust all lubrication as required for proper functioning.

3.6 REPAIR AND CLEANING

A. Abraded and scarred areas on painted surfaces, including bolt heads and nuts, shall be repaired with all repairs equal to the original finish and not visible.
B. At time of final cleanup, all exposed surfaces shall be cleaned.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain jib crane, including review of operating and maintenance manuals.

END OF SECTION 14680

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Requirements and procedures applicable to DIVISION 15 - Heating Work in addition to applicable requirements in DIVISION 1 - General Requirements, including (but not limited to):

   a. References, abbreviations, and definitions.
   b. General regulatory requirements.
   c. General requirements regarding site/field conditions including existing conditions and field measurements.
   d. Definition of design equipment and procedures for consideration of equivalents or substitutions.
   e. Minimum material requirements and equipment verification.
   f. General requirements for demonstration of completed systems.

B. Related Sections

1. Bidding and Contract Documents - Including (but not limited to):

   a. Instructions to Bidders, including (but not limited to) requirements relating to equivalents and substitutions during bidding.
   b. Bid Forms
   c. General and Supplementary Conditions, including (but not limited to) requirements for Contractor’s liability insurance.
   d. Prevailing Wage Rates
   e. Miscellaneous Requirements

2. DIVISION 1 - General Requirements - Including (but not limited to):

   a. Project schedule requirements
   b. Alternates, unit prices, and allowances (if any)
   c. Construction facilities and temporary controls
   d. Procedural and administrative requirements
   e. Material and equipment requirements, including (but not limited to) requirements for substitutions after Contract Award.
   f. Alteration project procedures, including (but not limited to) cutting and patching requirements and replacement and restoration requirements.
   g. Owner’s instruction manuals

1.2 DEFINITIONS AND ABBREVIATIONS

A. Abbreviations: Reference to technical society, organization, body or section made in Division 15 in accordance with the following abbreviations:

1. AIA ..... American Institute of Architects
2. ADA..... Americans with Disabilities Act.
3. AMCA ..... Air Moving and Conditioning Association, Inc.
4. ANSI..... American National Standards Institute
5. ASHRAE ..... American Society of Heating, Refrigerating and Air Conditioning Engineers
6. ASME ..... American Society of Mechanical Engineers
7. ASTM ..... American Society of Testing Materials
8. AWSC..... American Welding Society Code
9. IEEE..... Institute of Electric and Electronics Engineers
10. NEC ..... National Electric Code
11. NEMA..... National Electrical Manufacturer's Association
12. NFPA ..... National Fire Protection Association
13. SMACNA ..... Sheet Metal and Air Conditioning Contractors National Association
14. UL ..... Underwriters' Laboratories, Inc.

B. Definitions: Refer to SECTION 01060 - References and Regulatory Requirements for additional definitions applicable to DIVISION 15.

1. “Design Equipment”: Equipment, specified in Technical Specification Section or on Contract Drawings using applicable manufacturer’s designation, that forms the basis for performance requirements, physical dimensions, configuration, and similar aspects used in the design of this Project including (but not limited to) physical configuration of surrounding construction and location of connections to other components.

2. “Specified Equivalents”: Products identified in Technical Specification Section that provide performance complying with specified requirements but do not have the same arrangement, configuration, size, construction, or other aspects as the specified Design Equipment. Refer to Instructions To Bidders and SECTION 01600 - Materials and Equipment for additional information and requirements regarding equivalents and substitutions.

1.3 SYSTEM DESCRIPTION

A. Provide complete systems, properly tested, balanced, fully adjusted, and ready for operation, including all necessary and required controls, details and accessories, including (but not limited to):

1. Air distribution and related equipment
2. Miscellaneous items required for equipment and system installation.
3. Demolition and removals required for equipment and system installation.
4. Electrical control wiring to equipment furnished in this contract

1.4 SUBMITTALS

A. Comply with requirements of SECTION 01300 - Submittals and as modified below.

B. Product Data: Submit product data for items listed in individual technical section. Clearly identify manufacturer, pertinent design, function, materials, construction, and performance data specifically addressing specification description of item. Strike out products that are not applicable to item being submitted, where more than one product is indicated on manufacturer product literature.

1. Cover Sheet: Follow procedures identified in SECTION 01330, to product data of each item submitted. Provide cover sheet for only one type of item with related accessories, equipment with related components. Do not combine unrelated items under same cover sheet.

2. Specified Equivalent Product Data: Submit manufacturer's product information including product literature, technical specifications and descriptions, performance data, and similar items to demonstrate compatibility with Design Equipment as specified in "Manufacturers" in Part 2 - Products below.

C. Shop Drawings

1. Coordination Drawings: Prepare coordination drawings in timely manner to comply with overall construction schedule.

a. Areas Requiring Coordination Drawings:

1) For all areas containing ductwork

b. Do not proceed with installation of Heating Work in each area until agreement is reached with all Prime Contractors on exact arrangements for each room or area, unless otherwise directed by Architect. If Heating Work Prime Contractor proceeds prior to resolving conflicts, Heating Work Prime Contractor shall modify installed Heating Work construction as required to permit other Prime Contractors to proceed with a coordinated installation.

1) Provide additional details and sections, as required for clarity, at places of conflict with work of other Prime Contractors.

c. Specified Equivalent Drawings: Submit detailed drawings of proposed Specified Equivalents, indicating proposed installation of equipment and showing maintenance clearances, required service removal space, and other pertinent revisions to arrangement and configuration shown in Contract Documents.

D. Contract Closeout Submittals: Comply with requirements of SECTION 01770, including submission of operating and maintenance instructions as item in "General Construction Instructions" manual described in that section.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements

1. Comply with applicable requirements of all Federal, State, and Local Building, Health, Plumbing and Electrical Codes, Laws, Ordinances and Regulations, including (but not limited to):

a. Mechanical Code of New York State
b. Fire Code of New York State
c. Energy Conservation Construction Code of New York State
d. In event of a conflict between the Codes identified above and Contract Documents, comply with more stringent requirement.

B. Certifications: Obtain and pay for all necessary inspections and certificates from all applicable agencies. Perform all required tests in accordance with regulation of agency having jurisdiction. Submit certificates of approval prior to Final Completion as defined in Section 01770 – Project Closeout. Submit certificates of approval prior to request for final acceptance of Contract.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Ship materials in manufacturer's containers, fully identified with manufacturer's name, trade name, type, class, style, model, grade, size and color.

B. Storage and Protection

1. Store materials, equipment, fixtures, pipe, fittings, attachments, under cover, off ground in original containers as applicable, and protect from physical and weather damage while in storage and during construction.

2. Replace or repair damaged, rusted, corroded or otherwise unusable materials physically damaged or weather damaged equipment as determined by Architect, at no change in Contract Sum.

1.7 PROJECT/SITE CONDITIONS

A. Field Measurements

1. DO NOT SCALE DRAWINGS; Heating Work drawings are diagrammatic. Refer to Architectural and Structural drawings for dimensions and details, and verify measurements in field before proceeding.

a. Provide all required fittings, offsets, elevation changes, and similar items not indicated on Drawings. Do not infer that Drawings show level of detail indicating every offset, elbow, union, fitting, elevation changes, or other aspect required for complete installation.

b. Install all items with proper provision for removal and access to coil bundles, boiler tubes, belts, valves, traps, and similar components.

2. Layout of equipment, piping, and similar components in Drawings is diagrammatic. Review Drawings to identify interference with other construction and verify dimensions at Site prior to beginning installation.

   a. Obtain exact location of all items and openings and confirm all existing conditions in field. Review Shop Drawings of all Contracts.

   b. Coordinate all Heating Work that interferes with other construction with other responsible Contractor.

   c. Obtain exact location and roughing requirements for all equipment furnished by others, but installed by this Contractor before roughing. Owner reserves right to make reasonable changes prior to "roughing-in" without increase in Contract Sum.

3. Report any conflicts to Architect in writing before beginning installation.

1.8 SEQUENCING AND SCHEDULING

A. Perform all Heating Work in cooperation with Owner, Architect, and all Prime Contractors on this Project, and other separate Contractors at the Site.

   1. Coordinate all Heating Work with construction schedule requirements in SECTION 01320 - Project Schedule and with requirements and schedules contained in Construction Schedules described in SECTION 01330 - Submittals.

   2. Immediately report any delays in receipt of materials required for Heating Work including circumstances causing delays.

B. New Construction:

   1. Furnish necessary information, such as locations and sizes of heating construction, fixtures and equipment, to all Prime Contractors in ample time for installation of openings, chases, recesses, lintels and bucks required for admission of plumbing construction, fixtures and equipment.

   2. Furnish and install sleeves, inserts, panels, raceways, boxes, and similar components, ahead of General Work and provide Heating Work representative during installation of General Work responsible for maintaining items in position.

C. Supports for Heating Work: Furnish and install anchor bolts required supporting or securing Heating Work. Locate settings and check locations as construction progresses. Provide templates or holding fixtures as required to maintain proper accuracy.

D. Cutting and Patching: Bear expense of cutting, patching, repairing or replacing of work of all Prime Contracts required due to fault, error or damage by contractor responsible for Heating Work, unless otherwise specified in Contract Documents. Employ and pay Prime Contractor involved.

E. Refer to DIVISION 1 for cooperation between Prime Contractors. Prior to start of construction:

1. Obtain from Contract Drawings or Architect, exact location of items and openings in construction. Conform to existing conditions in field.

2. Review shop drawings of all Prime Contracts.

3. If conflict occurs between Contract Drawings, advise Architect in writing before beginning installation and comply with Architect's directions.

4. Obtain exact location and roughing requirements for equipment furnished by other Prime Contractor or by Owner, but installed by contractor responsible for Heating Work before beginning roughing.

F. Coordination

1. Coordinate Heating Work with plumbing systems, lighting fixtures, ceiling mounted devices, ceiling heights, materials, structural work, maintenance clearances, electric code clearance, and building systems. Verify that Work of all Prime Contractors can be installed without interference with Heating Work.

2. Notify Architect in case of unresolved interferences prior to installation of Heating Work.

3. Adjust exact size, location and offsets of pipes to achieve reasonable appearance objectives in open areas without ceilings without increase in Contract Sum.

4. Provide Coordination Drawings in timely manner to comply with overall construction schedule.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Minimum Material Requirements:

1. Construct potable water systems and equipment according to AWWA standards.

2. Provide electrical equipment and systems meeting UL standards and requirements of NEC.

3. Provide UL label on all equipment and material with listing service.

4. Material Flammability:

a. Flame spread rating of 25 or less.
b. Smoke developed rating of 50 or less.

B. Equipment Verification: Carefully check manufacturer's drawings and specifications as they affect their particular equipment; follow factory instructions for roughing, installation, connection, filling, lubrication, testing, balancing, adjusting, alignment, wiring, and start-up operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine conditions under which Heating Work is to be installed and notify affected Prime Contractors and Architect in writing of any conditions detrimental to proper and timely installation. Do not proceed with installation until unsatisfactory conditions have been corrected in an acceptable manner.

1. When conditions are confirmed to be acceptable to ensure proper and timely installation and to ensure requirements for applicable warranty or guarantee can be satisfied, submit to Architect written confirmation. Failure to submit written confirmation and subsequent installation will be assumed to indicate conditions are acceptable.

3.2 CLEANING

A. Prior to Final Completion, thoroughly demonstrate and instruct Owner’s designated representatives in care and operation of all heating and ventilating systems and equipment provided in Heating Work.

3.3 ALTERATIONS

A. Provide protection of existing facilities, demolition and removals, replacement and restoration, including patch-to-match requirements, and hazardous materials procedures to install Heating Work in conformance with DIVISION 1 requirements.

END OF SECTION 15010

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Hangers and supports for (but not limited to) following components:

    a. Duct hangers and supports

2. Miscellaneous components and accessories including (but not limited to):

    a. Anchors
    b. Threaded rods
    c. Bolts, nuts, washers, hardware, and assembly components
    d. Structural steel connectors
    e. Concrete connectors

B. Related Sections

1. Section 05500 – Metal Fabrications

1.2 SUBMITTALS

A. Comply with requirements of SECTION 01300 - Submittals and as modified below.

B. Product Data: Submit manufacturer’s product literature, technical specifications, and other data required to demonstrate compliance with specified requirements for following components:

1. Hangers
2. Threaded Rods

1.3 SYSTEM DESCRIPTION

A. Applicable Standards

1. Design, Products, and Installation: Comply with applicable requirements of following standards for all pipe hangers and supports:

    a. Manufacturers Standardization Society (MSS) MSS-SP-58 and MSS-SP-69
    b. ANSI Code for Pressure Piping B 31.1
    c. UL 203 Standard for Pipe Hanger Equipment and Fire Protection Service
    d. Metal Framing Association MFMA-2

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. For convenience, details, specification and catalog numbers shown have been based on products by the following manufacturers:

1. Hilti, Inc.; Tulsa, Oklahoma
2. Ramset/Red Head; Michigan City, Indiana
3. Rawlplug Co. Inc.; New Rochelle, New York
4. Red Hed; Lincoln, Rhode Island.
5. ERICO/Michigan Hanger Co.; Solon, Ohio
6. Grinnell Corporation; Pipe Support Division, Cranston, Rhode Island
7. Miro Industries, Inc., Murray, Utah.
8. Standard International, Columbus, Georgia.
9. ICA Inc.; Lehighton, Pennsylvania
10. The Pate Company; Broadview, Illinois

2.2 HANGERS AND SUPPORTS

A. Duct Hangers and Supports: Per SMACNA Manual Standards for size, height, and location of ductwork. Materials and corrosion resistance as listed above.

2.3 MISCELLANEOUS COMPONENTS AND ACCESSORIES

A. Anchors

1. Precast Masonry/Concrete Anchor Bolt and Sleeves, and Bolt Anchor Expansion Shields Assemblies

a. General Use Outdoors, Mechanical Rooms, Boiler Rooms, Equipment Rooms

1) Hot-Dip Galvanized: GSA Specification FF-S-325, Group II, Type 4, Class 1, UL Listed, FM approved, ASTM A-153 Class C hot dipped zinc coating with one-piece, concrete dual-interlocking wedges; similar to “Rawl-Stud” by Rawlplug.

2. Precast Masonry and Concrete Rod Hanger Anchors: UL Listed, FM approved, steel, one-piece, concrete dual-interlocking wedges, similar to “Rod Hanger Wedge Anchor” by Rawlplug.

B. Threaded Rods:

1. General Use Outdoors: ASTM A-36, A307, or A325 rolled carbon steel rod with ASTM B 633 zinc plating.

C. Bolts, Nuts, Washers, Hardware, And Assembly Components:

1. General Use Outdoors, Mechanical Rooms, Boiler Rooms, Equipment Rooms:

a. ASTM A 307, Grade A, mechanically deposited zinc according to ASTM B695
b. ASTM A 307, Grade A, hot dipped zinc coating according to ASTM B153

D. Concrete Connectors

1. New Concrete: Carbon steel or malleable iron concrete insert, similar to “Fig. 285”, “Fig. 281” and “Fig. 282” by Grinnell.

a. Insert 10-inch x 1/2-inch reinforcing rod through top of insert in pipes 6 inches and larger.
b. Slotted inserts may be used in lieu of multiple single inserts.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Examine conditions under which hangers and supports are to be installed in coordination with Installer of materials and components specified in this Section and notify affected Prime Contractors and Architect in writing of any conditions detrimental to proper and timely installation. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

1. When Installer confirms conditions as acceptable to ensure proper and timely installation and to ensure requirements for applicable warranty or guarantee can be satisfied, submit to Architect written confirmation from applicable Installer. Failure to submit written confirmation and subsequent installation will be assumed to indicate conditions are acceptable to Installer.

2. Identify any discrepancies between specifications and field conditions or changes required due to specific equipment selection, prior to installation. Corrective work required by discrepancies after installation at responsible Contractor's expense.

3.2 INSTALLATION

A. Provide hangers and supports for piping systems and equipment, including, threaded rods, bolts, hardware, and similar components for assembly of hangers and supports systems.

1. Do not use chain, perforated hanger strapping or band, or wire hangers.
2. Decrease distance between hangers spacing where necessary to not exceed manufacturer's listed maximum recommended load for hangers or accessories.
3. Provide rods of sufficient length for ample swing.

B. Provide miscellaneous metal, beams, angles pipe bars, structural steel shapes, bases, braces, etc. accessories required to attach hangers and supports to walls, floors, structural members, etc. in conformance with Section 05500 – Metal Fabrications

C. Fasteners: Provide screws, bolts, anchors, to secure piping, supports, panels, equipment, fixture mountings, wiring devices, and accessories (clips, inserts, etc.) to structure. Nailing not permitted. Use stainless steel hardware for mounting stainless steel and corrosion resistant equipment, panels, fixtures, hangers, etc.

1. Do not use explosive driven inserts in precast concrete.

D. Install hangers, supporting devices and inserts in accordance with applicable sections of this specification, in accordance with the manufacturer's recommended installation instructions, and as detailed on the Drawings.

E. Special Hangers and Supports: Install as required by special circumstances encountered, in accordance with applicable details and layouts shown on Drawings, and as approved by Architect.

1. Provide vibration isolation, seismic restraint, and thermal movement capability for hangers and supports.

END OF SECTION 15060

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This Section includes above grade piping and related components for domestic water systems, sanitary waste and vent systems, compressed air systems and natural gas located inside the building to 5-feet outside the building.

B. The Contractor shall furnish, install complete, and test all aboveground piping, including valves, fittings, supports, couplings, piping insulation, and related appurtenances as shown on the drawings and as specified herein.

C. Related Sections include the following:

1. Refer to Section 15223 for various underground piping systems.
2. Refer to Section 15400 for various plumbing equipment and testing requirements.

1.3 DEFINITIONS

A. CIP: Cast Iron Pipe.
B. CISPI: Cast Iron Soil Pipe Institute.
C. PVC: Polyvinyl chloride.

1.4 SUBMITTAL

A. The Contractor shall submit the product data sheet, dimensional drawings and manufacturer's literature for all piping systems, valves, fittings, supports, and miscellaneous items specified herein.

B. Submittals shall be as per Section 01330.

1.5 QUALITY ASSURANCE

A. Material and equipment shall be as specified below and as shown and shall be suitable for the service intended. Materials and equipment shall be new and unused. Where two or more pieces of equipment performing the same function are required, they shall be duplicate products of the same manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site to insure uninterrupted progress of the Work. Contractor shall be responsible for unloading of all materials supplied by the Contractor and its subcontractors.

B. Handle all pipe, fittings and accessories carefully with approved handling devices. Do not drop or roll pipe off trucks. Do not otherwise drop roll or skid pipe. Materials cracked, gouged, chipped, dented or otherwise damaged shall be removed from the site immediately.

C. Store pipes and fittings on heavy wood blocking or platforms so they are not in contact with the ground.

D. Unload pipe, fittings and specials opposite to or as close to the place where they are to be installed as is practical to avoid unnecessary handling. Keep pipe interiors completely free from dirt and foreign matter.

1.7 TESTING

A. Testing shall be the responsibility of the Contractor. Testing shall be performed by an approved independent testing laboratory or by the Contractor subject to approval. The tests shall be performed in the presence of the Owner. The Owner shall be notified at least 7 days in advance of tests. Refer to Section 15400 – Plumbing Systems for additional testing requirements.

PART 2 - PRODUCTS

2.1 COPPER TUBING AND FITTINGS

A. For potable and non-potable water service (2" and below), use copper tubing with wrought copper solder joints fittings installed with 95/5 solder per ASTM B32 as follows:

1. Above Ground: Type "L" hard.
2. Refrigerant: ACR Type "L" hard.

B. Standards: ASTM B-88, ASTM B820 (ACR).

C. Fittings: Wrought copper, ANSI B16.22; dielectric fittings between copper and steel pipe as manufactured by EPCO or equal.

D. Joint material: Alloy Grade 95-5 (95% tin - 5% antimony) in wire or rod conforming to ASTM B-32 with flux as recommended by manufacturer applied to fitting and pipe; silver- solder shall be used underground and on all refrigerant piping. See service schedule for type required on each pipe service.

2.2 STEEL PIPING AND FITTINGS

A. Galvanized steel, 4-inch diameter and less, where specified, shall be Schedule 40, hot-dipped, galvanized steel pipe to conform to ASTM A53. Threaded galvanized steel pipe shall be joined with galvanized malleable iron, threaded fittings, ASA B16.3. Screwed, malleable iron, ground joint, brass seat, 150 psi unions shall be used to connect ferrous piping to valves and equipment to facilitate their removal and replacement.

B. Where specified, galvanized steel, greater than 3-inch diameter, shall be Schedule 40, hot-dipped, galvanized steel pipe to conform to ASTM A53. Galvanized steel pipe shall be joined with galvanized welding fittings, ASA B16.9. Elbows, whenever possible, shall be long radius.

C. Galvanized steel piping system shall be as manufactured by Grinnell, Crane, Taylor, Forge or approved equal.

2.3 STEEL PIPING FOR COMPRESSED AIR SERVICE

A. Schedule 40, Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, black or hot-dip zinc coated with ends threaded according to ASME B1.20.1.

1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.

2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.

3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.

4. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel, threaded.

5. Wrought-Steel Butt-Welding Fittings: ASME B16.9, Schedule 40.

6. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.

7. Grooved-End Fittings and Couplings:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Anvil International, Inc.; Star Pipe Products; Star Fittings Div. or Victaulic Company.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose. Automatic shut-off type, straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.

1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
2. Plug End: Straight-through type with barbed outlet for attaching hose.

D. Provide mounting brackets for all air stations as per the drawings.

2.4 FLOOR DRAINAGE

A. Floor drainage 3" and larger shall be heavy cast iron soil pipe with bells and spigots. Cast iron soil pipe shall conform to all applicable standards of the Cast Iron Soil Pipe Institute Standards HS-67 for extra heavy cast iron soil pipe. All extra heavy cast iron soil pipe shall be fitted with rubber gaskets in accordance with ASTM C564 latest revision. Floor drainage below grade shall be extra heavy cast iron soil pipe with bells, spigots, and rubber gasketed joints.

B. Threaded joints shall be made up with approved compounds suitable for the particular service, applied to the male threads only. Caulked lead joints shall be made up with oakum and virgin pig lead, using 12 ounces of lead for each inch of pipe diameter. Rubber joints shall be made by inserting pre-formed rubber gaskets within the bell end of each pipe and forcing the cast iron spigot into the gasket zone until properly seated.

2.5 VALVES AND SPECIALTIES

A. General. The Contractor shall furnish and install all valves and specialties as specified. In addition, valve-operating units and other accessories shall be furnished and installed by the Contractor where specified for various system packages. All valves shall be new and of current manufacture. All valves, specialties, etc. shall be installed with sufficient unions and/or flange joints to permit replacement without the need to cut the pipes.

B. Check Valves. Check valves smaller than 3 inches shall be all bronze swing check valves with screwed ends. Check valves for liquid services shall be as manufactured by Darling Valves and Manufacturing Company, Clow Corporation, or approve equal.

C. Ball Valves on Domestic Water Systems. 2" and smaller, ASTM B584, all bronze, two piece body with screwed or solder ends as required, chrome plated ball, TFE seats and seals. Nibco T-585-70 type for threaded and Type S-585-70 for Solder ends.

2.6 PIPE AND VALVE HANGERS, SUPPORTS AND GUIDES

A. All supports and parts thereof shall conform to the latest requirements of the ANSI Code for Pressure Piping B31.1 and MSS Standard Practice SP-58, except as supplemented or modified by the requirements of these Specifications.

B. Designs generally accepted as exemplifying good engineering practice, using stock or production parts, shall be utilized wherever possible.

C. Pipe hangers shall be capable of supporting the pipe in all conditions of operation. They shall allow free expansion and contraction of the piping, and prevent excessive stress on equipment.

2.7 MISCELLANEOUS METAL FABRICATIONS

A. Steel and iron items such as galvanized steel plate, equipment supports, grating, pipes, bars, etc., shall be furnished as required to complete the proper installation of all piping, valves and related appurtenances.

PART 3 - EXECUTION

3.1 GENERAL

A. Install piping as shown, specified and in complete accordance with manufacturer's instructions. Request instructions from Owner's Representative before proceeding if there is a conflict between the manufacturer's recommendations and the Drawings and Specifications. Pipe and fittings and accessories that are cracked, damage, or with damaged linings will be rejected.

B. Where necessary to joint piping of different materials, Contractor shall provide the necessary adapters as recommended by the pipe manufacturer.

C. For connection to valves, fittings or equipment with screwed ends, Contractor shall use unions with appropriate end conditions as recommended by the manufacturer.

D. Where necessary to connect to valves, fittings or equipment with flanged ends, Contractor shall use Uni-flange Series 900-S adaptor flange, or equal. Flanges shall comply with ANSI B16.1, Class 125. Gaskets shall be neoprene and bolts shall be Type 304 stainless steel.

E. Marking. Pipe and fittings shall be marked in accordance with and spaced at the recommended distances in each piece of pipe, as per the referenced ASTM and/or AWWA specifications.

F. Install safety relief valves on hot water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Pipe discharge to floor without valves. Comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.

G. Install pressure-reducing valves on hot water generators and elsewhere as required to regulate system pressure.

3.2 ABOVEGROUND PIPING

A. Install straight runs true to line and elevation.

B. Install vertical pipe truly plumb in all directions.

C. Pitch condensate piping uniformly to drain.

D. Conceal piping in finished areas in wall, ceilings, floors, chases, etc.

E. Final equipment connections for HVAC systems as indicated on Drawings are diagrammatic. Contractor shall be responsible for actual routing of piping in compliance with diagrammatic details and physical space requirements.

F. Piping shall be installed 3'-0" min. away from electric equipment.

G. Install refrigerant piping per manufacturer's recommendations.

H. Install drains at low points and vents at high points of all piping.

I. Install sleeves for pipes passing through concrete and masonry walls, gypsum board partitions and concrete floor and roof slabs.

J. Install piping parallel or perpendicular to building walls. Pipe at angles and 45 degree runs across corners will not be accepted unless specifically shown or approved.

K. Install small diameter piping generally as shown when specific locations and elevations are not indicated. Locate such piping as required to avoid ducts, equipment, beams, etc.

L. Install piping so as to leave all corridors, walkways, work areas, and like spaces unobstructed. Unless otherwise approved, provide a minimum headroom clearance under all piping of 7 feet 6 inches.

M. Provide temporary caps or plugs over all pipe openings at the end of each day's work, and when otherwise required or directed by Owner’s Representative.

N. Cutting: Cut pipe from measurements taken at site, not from Drawings.

O. Install dielectric unions wherever dissimilar metals are connected except for bronze or brass valves in ferrous piping.

P. Provide a union downstream of each valve with screwed connections.

Q. Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.

R. Support all valves independently of the piping system. Utilize wide band supports as recommended by manufacturer and approved by Owner’s Representative to minimize localized stresses. Provide piping passing through walls with a sleeve of wearing material to prevent abrasion damage to piping.

S. When anchors are required at locations other than equipment or tanks, they shall be placed at elbows, valve locations and at bends in pipe line. Spacing of supports shall be in accordance with the manufacturer's published values at the maximum design operating temperature of the pipe. Use "U" clamps with wide band circumferential contact. Avoid all pressure contact with piping.

T. Use guides on long runs of piping to maintain alignment and reduce chance of elastic failure of pipe. Space guides as recommended by manufacturer.

3.3 JOINTS

A. General. Make joints in accordance with the pipe manufacturer's recommendations and the requirements herein. Cut piping accurately and squarely and install without forcing or springing. Ream out all pipes and tubing to full inside diameter after cutting. Remove all sharp edges on end cuts. Remove all cuttings and foreign matter from the inside of pipes and tubing before installation. Thoroughly clean all pipe, fittings, valves, specials and accessories before installing.

B. Flanged Joints. Use hexagon head nuts and bolts (Type 304 SS) on all flanged joints. Bolts shall project not more than 1/4 inch from nor fall short of the end of the nut. Clean and lubricate bolt threads and gasket faces. Place and adjust gasket between flanges. Slide flanges together to compress gasket. Alternately tighten bolts 180 degrees opposite to each other to compress the gasket evenly.

C. Joints for copper tubing shall be made with soldered or brazed fittings. Tube shall be cut square with burrs removed. Outside surface of the tube where engaged in the fitting, and inside surface of the fitting in contact with the tube, shall be cleaned with an abrasive material before soldering. Care shall be taken to prevent annealing of tube and fittings when making connections. Solder joints shall be made with flux and wire form or paste-type solder. The flux for 95/5 solder shall be mildly corrosive liquid or petroleum-based past containing chlorides of zinc and ammonium. Core solder shall not be used. Excess solder shall be wiped from joint before solder hardens.

3.4 INSTALLING VALVES AND ACCESSORIES

A. Provide supports for large valves, flow meters and other heavy items as shown or required.

B. Install floor stands as shown and as recommended by the manufacturer.

C. Provide lateral restraints for extension bonnets and extension stems as shown as recommended by the manufacturer.

D. Position valve operators as shown in the drawings. When the position is not shown, install the valve so that it can be conveniently operated and as approved by Owner's Representative. Avoid placing operators at angles to the floors or walls.

E. Position flow measuring devices in pipe lines so that they have the amount of straight upstream and downstream runs recommended by the manufacturer, unless specific location dimensions are shown.

3.5 UNIONS

A. Install dielectric unions wherever dissimilar metals are connected except for bronze or brass valves in ferrous piping. Provide a union downstream of each valve with screwed connections. Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.

B. Eccentric Reducers. Use eccentric reducers where shown and where air or water pockets would otherwise occur in mains because of a reduction in pipe size.

C. Transitions from one type of pipe to another. Provide all necessary adapters, specials and connection pieces required when connecting different types and sizes of piping or connecting pipe made by different manufacturers.

3.6 PIPE SUPPORT

A. All aboveground piping shall be supported adequately either from floor, concrete wall or ceiling joist as shown in the drawings. Where possible, horizontal piping shall be secured with pipe clamps. Do not support piping from other piping.

B. All rigid hangers shall provide a means of vertical adjustment after erection.

C. Hanger rods shall be subject to tensile loading only. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement.

D. Where horizontal pipe movement is greater than ½ inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from the cold to the hot position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position. Use roller chairs and stands fastened to trapeze channels where provision for expansion and contraction in piping is required.

E. Supports for insulated pipe shall have galvanized steel insulation protection shields to fit the outside diameter of the insulation. Shields shall be provided by the pipe support manufacturer and selected based on support and pipe size and insulation thickness.

F. Provide dielectric hanger connector for copper pipe equal to EPCO Model No. 385.

G. Free-standing pipe connections to equipment shall be firmly attached to fabricated steel frames made of angles, channels, or I-beams anchored to the structure.

H. Hangers shall be designed so that they cannot become disengaged by movements of the supported pipe.

I. Hangers shall be spaced accordingly to adequately support the pipe.

J. Where practical, risers shall be supported with riser lugs independent of the connected horizontal piping.

K. Supports, guides, and anchors shall be so designed that excessive heat will not be transmitted to the structure.

L. All submerged hangers, brackets, bolts, and supports shall be of stainless steel.

M. Various metal components, including such items as galvanized plates, grating, pipes, bars, etc., shall be furnished and installed as necessary.

N. Hangers for carbon steel or copper pipe shall be in accordance with the following schedule:

1. Pipe size: Up to 1-1/2" = 3/8" rod at 8'-0"*
2. Pipe size: 1-1/2" to 2" = 3/8" rod at 10'-0"
3. Pipe size: 2-1/2" to 3" = 1/2" rod at 10'-0"

4. Pipe size: 4" to 5" = 5/8" rod at 12'-0"
5. Pipe size: 6" = 3/4" rod at 12';-0"

* Copper pipe 5'-0"

O. The pipe supports shall provide adequate, non-point, bearing surfaces. The pipe supports shall provide for normal axial movement of the pipe from thermal expansion and contraction, and shall not interfere with expansion joints.

P. The contractor shall prepare and submit detailed pipe support layout drawings, showing the proposed location and type of supports to be furnished, for review and approval by Owner's Representative.

3.7 FLOOR DRAINAGE

A. The floor drainage system shall include all labor, materials and testing incidental to the completion of such a system. Materials shall include piping, jointing materials, pipe hangers, floor drainage devices, and cleanouts as shown on the drawings or specified hereinafter.

B. The Contractor shall test floor drainage systems in the presence of Owner's Representative.

C. All defects noted by testing procedures shall be immediately corrected.

D. All pipes and fittings shall conform to the applicable ASA and ASTM Standards, the State Plumbing Code and Local Plumbing Code.

3.8 SPECIAL REQUIREMENTS FOR AIR PIPING

A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.
B. Install air-main pressure regulators in compressed-air piping at or near air compressors.
C. Install air-line pressure regulators in branch piping to equipment/tools.
D. Install automatic drain valves on after coolers, receivers, and dryers. Discharge condensate onto nearest floor drain.
E. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters.
F. Install mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filters.
G. Install air-line lubricators in branch piping to machine tools. Mount on wall at locations indicated.
H. Install quick couplings at piping terminals for hose connections.
I. Install hose assemblies at hose connections.

3.9 IDENTIFICATION

A. Identify each valve in all systems with black, numbered and stamped 1-1/2" brass or aluminum tags fastened to valve by brass chain and "S" - hook.

B. Piping Identification: Identify piping with Seton "Setmark", or equal, semi-rigid plastic, wraparound pipe markers with flow arrows and conforming to ANSI A13.1. Locate marker at each valve, changes in direction, where pipes pass thru barriers and every 25' of horizontal runs. Lettering and background colors shall be in accordance with the following:

Service	Band Color	Legend
Potable water	Dark blue for Cold and Yellow for Hot	Potable Water
Non-potable water / wastewater	Dark gray	Non-potable Water
Compressed Air	Dark blue	Compressed Air
Natural Gas	Safety Yellow	Natural Gas

3.10 CLEANING

A. Thoroughly clean all piping and flush prior to placing in service in a manner approved by the Owner's Representative. Contractor shall take preventing measures during construction to protect and keep clean water pipe interiors, fittings, and valves.

B. All potable water piping system shall be disinfected per AWWA C601 prior to placing into operation.

END OF SECTION 15222

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This Section includes buried piping and related components for domestic water, sanitary waste and vent systems and compressed air piping systems located inside the building to 5-feet outside the building.

B. The Contractor shall furnish, install complete, test and place in operation all underground piping systems including fittings, valves and related accessories as shown on the drawings and as specified herein.

C. Related Sections include the following:

1. Section 02300, Earthmoving.
2. Section 15222, For aboveground piping, fitting, and related accessories.
3. Section 15400, Plumbing systems for testing requirements.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

A. American Society For Testing And Materials (ASTM) Publications

1.	D1248-81a	Polyethylene Plastics Molding and Extrusion Materials
2.	D1785-82	Specification for Polyvinyl Chloride (PVC) Plastic Pipe
3.	D2564-84	Solvent Cement for PVC Pipe and Fittings
4.	D2774-72	Underground Installation of Thermoplastic Pressure Piping
5.	D3034-81	Specification for Type PSM PVC Sewer Pipe and Fittings
6.	D3212-81	Specification for Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals

1.4 DEFINITIONS

A. AWS: American Welding Society.
B. PVC: Polyvinyl chloride.

1.5 SUBMITTAL

A. The Contractor shall submit product data, dimensional drawings, and literature for all piping systems, valves, fittings and miscellaneous items specified under this Section.
B. Submittals shall be as per Section 01330.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
B. Comply with relevant ASTM standard listed in Subsection 1.3 (References) of this section for piping components, testing and installation.
C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

1.7 DELIVERY AND STORAGE

A. All materials delivered and stored shall be handled and stored in such a manner that pipe, fittings and accessories, and pipe coatings are not damaged.
B. Store pipes, fittings, and valves on heavy wood blocking or platforms so they are not in contact with the ground.
C. Keep pipe interiors completely free from dirt and foreign matters.

1.8 TESTING

A. Testing shall be the responsibility of the Contractor. Testing shall be performed by an approved independent testing laboratory or by the Contractor subject to approval. The tests shall be performed in the presence of the Owner. The Owner shall be notified at least 7 days in advance of tests. Refer to Section 15400 – Plumbing Systems for additional testing requirements.

PART 2 - MATERIALS

2.1 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: Centrifugally cast gray cast iron pipe and static cast fittings conforming to requirements of ASTM Standard A 74, service weight (SV) and extra heavy weight (XH) type with coating on interior and exterior in accordance with ANSI/AWWA C104/A21.4. Pipe and fittings marked with the collective trademark of the Cast Iron Soil Institute and listed by NSF® International.

1. Gaskets: ASTM C 564, rubber.
2. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

B. Manufacturers: Cast iron pipe shall be as manufactured by U. S. Pipe and Foundry, Clow Corporation or approved equal.

2.2 COPPER TUBE AND FITTINGS

A. For underground domestic water and compressed air systems 2-inch and smaller, use ASTM B 88, Type K annealed temper copper tube and brazed joints.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cerro Flow Products, Inc.
2. Ford Meter Box Company, Inc.
3. Mueller Industries, Inc.

2.3 GATE VALVES AND BOXES

A. Gate Valve: Complying with AWWA Standard C509, UL listed, FM approved, and provided with corrosion resistant coating on internal cast iron parts, mechanical joint, body, resilient seat.

1. Waterway: Full size and unobstructed at least equal to internal diameter of connecting piping.

2. Cast Iron Disc: Encapsulated with bonded, synthetic elastomer material that seals against valve body to provide bubble tight shutoff at full differential of 200 PSI meeting ASTM D 429.

3. Valve Disc: Operated by cast iron hub nut connected to bronze stem with synthetic polymer thrust washers and synthetic rubber O-ring seals, open left valve operation.

4. Valve Body: Cast iron, factory tested to 400 PSI to eliminate leaks at valve joints or connections.

5. Similar to "Ken-Seal Fig. 4571" by Kennedy

B. Curb Box: Cast iron, two piece, adjustable screw type curb box, sized for gate valve and bury depth with sewer marker on cover and direction of opening valve and stationary rod; similar to products by Kennedy.

C. Furnish one tee wrench under this Contract suitable for operation for buried gate valves. Lengths to be determined by the Contractor after valves have been set underground and valve boxes set in place.

2.4 CURB VALVES AND BOXES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ford Meter Box Company, Inc. (The); Pipe Products Div.
2. Jones, James Company.
3. Mueller Co.; Water Products Div.

B. Curb Valves: Comply with AWWA C800. Include bronze body, ball valve type, and wide tee head, with inlet and outlet matching service piping material.

C. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches in diameter.

D. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve. Provide 1 rod for every service box installed.

E. Furnish one tee wrench under this Contract suitable for operation for buried gate valves. Lengths to be determined by the Contractor after valves have been set underground and valve boxes set in place.

2.5 MISCELLANEOUS MATERIALS

A. Miscellaneous materials shall comply with the following requirements:

1. Joint Lubricants: Joint lubricants shall be as recommended by the pipe manufacturer.
2. Bolts, Nuts and Glands: ANSI A21.11.
3. Bedding material: A.A.S.H.T.O. No. 57 stone.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. All pipe, pipe fittings, and appurtenances shall be installed at the locations indicated.

1. The Contractor shall verify the location and inverts of certain existing utilities and/or crossing that are not previously verified during design phase prior to starting any work. Any discrepancies in location or invert shall be brought to Owner’s attention in order that the design may be adjusted accordingly. Damages suffered or additional costs incurred by the Contractor as a result of his failure to confirm these requirements shall be the sole responsibility of the Contractor.

2. Utility Separation: Wastewater/process water pipe and potable water pipe shall be separated at least 10 feet horizontally. If conditions prevent 10 feet, a minimum of 5 feet horizontal distance shall be provided along with a minimum vertical separation of 12 inches from the bottom of the potable water pipe to the top of the wastewater/process water pipe. Where wastewater/process water pipe must cross potable water pipe, wastewater/process water pipe shall always cross beneath potable water pipe. A vertical distance of 12 inches between the bottom of potable water pipe and the top of wastewater/process water pipe shall be maintained and the wastewater pipe shall have a concrete encasement (a minimum of 6" around diameter) 10 feet on either side of the crossing. The wastewater/process water force main joints shall not be closer than 3 feet horizontally to the point of crossing.

3. Cutting: Pipe shall be cut in a neat manner with mechanical cutters. Wheel cutters shall be used where practical. Sharp and rough edges shall be ground smooth and loose material removed from the pipe before laying except as otherwise specified.

4. Proper and suitable tools and equipment for the safe and convenient handling and laying of the pipe and fittings shall be used in accordance with the manufacturer's standards. Pipe and fittings shall be carefully handled and lowered into the trench.

5. Whenever a pipe requires cutting to fit in the line or to bring it to the required location, the work shall be done without extra compensation, in a satisfactory manner so as to leave a smooth cut perpendicular to the axis of the pipe.

6. Before any joints are actually made in the trench, the Contractor shall demonstrate to Owner's Representative by making a sample joint that the methods which he will employ conform to the specifications and will secure a watertight joint and that the workers whom he intends to use in this work are familiar with the requirements.

7. All laying, jointing and testing for defects and for leakage shall be performed in the presence of Owner's Representative. All defects in workmanship rejected by Owner's Representative shall be promptly corrected by the Contractor and defective materials removed from the project.

8. All lumber, rubbish, and large rocks shall be removed from the trenches. The bottom of the trenches shall be padded with six inches of pea gravel before laying pipe. Pipe shall have a firm, uniform bearing for the entire length of each pipe to prevent uneven settlement. Wedging or blocking of pipe will not be permitted.

9. The excavation in which pipe is being laid shall be kept free from water, and no joint shall be made underwater. Care shall be used to secure water tightness and to prevent damage to, or the disturbing of, the joints during the backfilling process or at any other time. After pipes have been laid and the joints have been made, there shall be no walking on or working over them except as may be necessary in tamping until there is a covering at least two feet in depth over their tops. After joint materials, which require it, have received their set and testing is completed, backfilling of the trench may proceed in the manner specified elsewhere in these specifications.

10. Before joints are made, each pipe shall be well bedded in minimum of 6" of AASHTO No. 57 stone and no pipe shall be brought into position until the preceding length has been thoroughly embedded and secured in place. No pipe shall be laid in wet trench conditions that preclude proper bedding or on a frozen trench bottom or when, in the opinion of the Owner's Representative, the trench or weather conditions are unsuitable for proper installation. Any defects due to settlement shall be corrected by the Contractor at his own expense. Bellholes or coupling holes shall be dug sufficiently large to insure the making of proper joints. Special precautions shall be exercised to prevent any pipe from resting on rock. In no case will pipe be closer than four inches from bedrock.

11. In laying pipe, special care shall be taken to insure that each length shall abut against the next in such manner that there shall be no shoulder or unevenness of any kind along the inside of the pipeline.

12. No wedging or blocking will be permitted in laying any pipe.

13. Pipes and fittings shall be thoroughly cleaned before they are laid and shall be kept clean until the acceptance of the completed work. The open end shall be kept closed with a stopper until the next length is laid. At the close of each workday, the end of the pipeline shall be tightly closed with an expansion stopper so that no dirt or other foreign substances may enter the line, and this stopper shall be kept in place until pipe laying is again resumed.

14. Buttresses and anchors shall be installed on the pressured piping system at all bends, tees, and reducers or other fittings where changes in direction or pipe size occur. Buttresses shall be a minimum 2' x 2' x 2'.

3.2 SPECIAL CONDITIONS FOR BURIED COPPER TUBING

A. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

3.3 SPECIAL REQUIREMENT FOR NATURAL GAS SYSTEM

A. Install underground, natural-gas piping buried at least 36 inches below finished grade.

3.4 VALVES

A. Prior to installation, valves shall be cleaned of all foreign matter and inspected for damage. Valves shall be fully opened and be installed with the stem in the vertical position.

3.5 VALVE BOX

A. Valve boxes shall be installed over each outside valve, unless otherwise indicated. Valve boxes shall be centered over the distance of 4 feet on all sides or to undisturbed trench face, if less than 4 feet.

3.6 CLEANING

A. Thoroughly clean all piping and flush prior to placing in service in a manner approved by the Owner’s Representative. Contractor shall take preventing measures during construction to protect and keep clean water pipe interiors, fittings, and valves.

B. All potable water piping system shall be disinfected per AWWA C601 prior to placing into operation.

END OF SECTION 15223

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. Description of System(s): Perform all work necessary and/or required and furnish all materials for a complete installation of the system(s) indicated and specified. Such work shall include, but not be limited to, the following:

1. Domestic cold water piping systems.
2. Sanitary and vent system piping.
4. All miscellaneous devices and accessories for the domestic and sanitary systems.

B. Related Sections:

1. Section 15010: General Provisions
2. Section 15222: Aboveground Piping, Fittings and Related Accessories
3. Section 15223: Underground Piping, Fittings and Related Accessories

1.3 QUALITY ASSURANCE

A. Qualifications:

1. Unless otherwise specified or indicated, all materials and equipment shall be the products of a manufacturer regularly engaged in the production of plumbing materials and equipment.

2. All design, fabrication and erection shall be performed in full compliance with all applicable laws, ordinances, rules, regulations and the latest edition of the following codes and standards:

a. IBC
b. International Plumbing Code
c. NFPA
d. UL
e. OSHA

B. Requirements of Regulatory Agencies:

1. Contractor shall comply with all applicable code and regulatory requirements of Federal, State and Local Authorities. These shall include, but not be limited to, the following:

a. State Health Department

b. Local Department of Licenses and Inspections

2. Contractor shall comply with all requirements regarding the testing and inspections of domestic water and sanitary piping systems.

1.4 SUBMITTALS

A. General: Submit shop drawings and descriptive data in accordance with Section 01330.

B. Shop Drawings: Furnish shop drawings and descriptive data, complete with project designation, for the following:

1. Hydrants.
2. Cleanouts.

1.5 PRODUCT DELIVERY, HANDLING & STORAGE

A. Delivery: Deliver equipment and materials to project site in manufacturer's unopened original packaging.

B. Handling: During loading, transporting and unloading exercise care to prevent damage to equipment and materials.

C. Storage: Store material in area protected from weather, moisture and mechanical damage. Materials that have been exposed to weather or moisture and exhibit excessive scale, rust or water damage will not be permitted.

PART 2 - PRODUCTS

2.1 HYDRANTS

A. Non-freeze, Draining-Type Post Hydrants:

1. Basis-of-Design Product: Subject to compliance with requirements, Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.: Model No. 5909 or comparable product by one of the following:

a. MIFAB, Inc.
b. Prier Products, Inc.
c. Watts Drainage Products.
d. Woodford Manufacturing Company; a division of WCM Industries, Inc.
e. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

2. Standard: ASME A112.21.3M.

3. Type: Non-freeze, exposed-outlet post hydrant.

4. Operation: Loose key.

5. Casing and Operating Rod: Of at least length required for burial of valve below frost line.

6. Casing: Galvanized steel with casing guard.

7. Inlet: NPS 3/4.

8. Outlet: Garden-hose thread complying with ASME B1.20.7.

9. Drain: Designed with hole to drain into ground when shut off.

10. Vacuum Breaker:

    a. Garden-hose thread complying with ASME B1.20.7 on outlet.

2.2 CLEANOUTS

A. Floor Cleanouts (CODP): Cast iron clean-out with round adjustable scoriated nickel bronze cover. Include secured cover vandal - proof screws. J.R.Smith series 4100, Josam, Ancon.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Water Piping Installation:

1. Water Piping:

    a. Layout: Connect and install as indicated to water heaters, wall supplies, plumbing fixtures, equipment, etc.

2. Water piping accessories:

    a. Install ball valves in all branches leading from mains to groups of fixtures and as indicated.

3. Branch supplies: Install branch lines of sizes indicated.

4. Install draining-type post hydrants with 1 cu. yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. of concrete block at grade.

B. Building Sanitary Sewer and Vent Lines:

1. Layout:

    a. Install piping as indicated to receive discharge of all stacks, branch mains and runouts.

b. Install mains with elevations and grades as indicated or directed.
c. All horizontal piping 3" and smaller shall be pitched not less than 1/4" per foot; 4" and larger at 1/8" per foot unless specifically noted otherwise.

2. Sizes: Install sanitary lines of sizes indicated on drawings.

3. Placement:

a. Make changes in direction and connection of drain, soil and waste lines with proper fittings and necessary offsets.

1) All pipes and fittings shall be kept clean, with the exposed ends of incomplete or unconnected work to be plugged. Cleanouts shall be placed at all changes in direction or as shown on the drawings.

2) Install cleanouts in soil and waste lines at change in direction; install cleanouts as plugged tee. Cleanouts to be same size as pipe it serves up to 4" in pipe size. For larger pipes, cleanouts to be 4" in size. Install wall cleanouts whenever possible.

2) Provide "Y" branches to fixtures and connections in soil and waste line; short "TY" branches permitted in vertical lines only.

3) Install floor connections for water closets and other fixtures with brass or iron flange, caulked or screwed into pipe; bolt with gasket or approved setting compound between fixture base and connections.

4) Make all other final connections as required.

a) Install branches to all outlets for connections to plumbing fixtures, equipment, floor drains, etc.

b) Traps:

1) All fixtures shall be trapped except as noted.
2) Trap fixtures at distance not more than 2' from fixture.
3) Trap fixtures so that discharge from any fixture does not pass through more than one trap before reaching house drain.
4) Provide traps with seal of 2-1/2" minimum and 4" maximum.
5) Provide traps on all floor drains.
6) Properly vent all traps to prevent siphoning.

c) Vent lines:

1) Vent piping shall not be trapped and shall be graded to drip back to a waste or soil line.

2) Changes in direction of piping shall be made with long radius fittings.

3) Install offsets in main vent not less than 45 degree to horizontal.

4) Connect vent line at bottom with soil and waste line in such a manner that foreign debris will be washed by water flow from fixtures.

5) Install branch vents above tops of fixture to which connected.

6) Extend vent through roof minimum of 24" and flash with proper roof flashing boot.

7) Install increaser to 3" before passing through roof and vent lines which are less than 3" diameter.

3.2 FLUSHING AND STERILIZING WATER SYSTEM

A. Flushing:

1. After water system has been tested and connected, open outlet nearest to new water service connection and let run until water is clear.
2. Repeat this process with each outlet working toward the furthermost outlet from new water system connection.

B. Sterilization:

1. Introduce chlorine or solution of calcium or sodium hypochlorite, filling lines slowly and applying sterilizing agent at a rate of 50 ppm of chlorine as determined by residual chlorine tests at end of lines.

2. After sterilizing agent has been applied for 24 hours, test for residual chlorine at ends of lines; if less than 5 ppm, repeat process.

3. When test shows at least 5 ppm of residual chlorine, flush out system until all traces of chemicals used are removed.

4. If system is found bacteriologically unsafe at any time prior to final acceptance, re-chlorinate as specified above.

3.3 TESTING, BALANCING AND ADJUSTING

A. Test procedures outlined here are a minimum requirement. If requirements of governing or utility companies are more stringent, perform testing procedures as directed thereby. Remove or valve any appurtenances that are not capable of withstanding test pressure.

B. Provide all testing apparatus including pumps, hoses, gauges, and fittings required to adequately test each piping system.

C. Pipelines that fail to hold specified test pressures or exceed the allowable leakage rate shall be repaired and retested.

D. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

E. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

F. Conduct all tests in the presence of the Representative. Repeat tests in the presence of local authorities having jurisdiction, if required.

G. Submit to the Engineer/Architect all data required for conformance to the requirements of this Article.

H. Potable Water System Testing:

1. Initial Test:

a. Do not connect fixtures, equipment and solenoid valves into system during this test.

b. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

c. Cap and subject piping to static water pressure of 150 psig, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

d. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

e. Prepare reports for tests and for corrective action required.

2. Test After Fixtures are Connected:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test system again for 2 hours at 75 psig or prevailing water pressure, whichever is higher.
c. Repair leaks and defects at fixture and equipment connections or at solenoid valves, and retest piping or portion thereof until satisfactory results are obtained.
d. Prepare reports for tests and for corrective action required.

I. Sanitary Waste and Vent System Testing:

1. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

2. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wc. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

4. Prepare reports for tests and required corrective action.

J. Compressed Air Piping System Testing:

1. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.

2. Repair leaks and retest until no leaks exist.

3. Inspect filters and pressure regulators for proper operation.

END OF SECTION 15400

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. CONTRACTOR shall procure and install one (1) DNAPL single-wall aboveground DNAPL/Water Separator as manufactured by Hydrasep, Inc. Model HS-4000-RCTH/DNAPL or equal. The separator shall be 23-ft long, 6-ft wide and 6-ft high and have a volume of 3,770 gallons. The separator shall be rated for a continuous flow rate of 125 gpm for an intermittent flow rate of 300 gpm and gravity fed flow.

B. The DNAPL/Water Separator shall be designed in accordance with the American Petroleum Institute Manual on Disposal of Refinery Wastes, Volume on Liquid Wastes, Oil Water Separator Process Design and A.P.I. Bulletin No. 1630 First Edition, Waste Water handling and Treatment Manual for Petroleum Marketing Facilities.

C. The separator shall have a separate inlet chamber partitioned from the separating chamber and of sufficient size to provide a liquid residence time of at least one (1) minute at the rated flow. The inlet chamber shall be a sludge retention chamber designed to prevent sludge migration into the separating chamber and shall be designed to enhance the settling of solids and direct the liquid into the separating chamber. This chamber shall be equipped with a 4” side drain.

D. The separating chamber shall be designed to enhance the separation process utilizing non-clogging vertical laminar flow control plates that maximize retention time, enhance flow dynamics and minimize turbulence. The separating chamber shall consist of a set of compound series and parallel channels that control and maintain the laminar characteristics of the flow, maximize retention time and useful cross-section, and minimize short-circuiting. The series flow shall be five (5) or seven (7) times the length of the separating chamber. The liquid shall enter the separating chamber through the first series channel at the diagonally furthermost location from the pipe connecting the separating and clean water chambers. The three (3) or five (5) intermediate series pathways shall be equipped with equally spaced vertical parallel plates subdividing the series channels into a set of parallel sub-channels to provide laminar flow control and minimize turbulence. The flow velocity shall be at all times parallel to the DNAPL/water interface to prevent re-mixing. This chamber shall be equipped with a 2” side drain.

E. The separator shall have a separate chamber for the removal of DNAPL contaminate. This section shall be located between the separating and final effluent chambers and equipped with a 2” DNAPL draw-off outlet located near the rated DNAPL storage capacity level and configured to remove the separated DNAPL without entraining water. This chamber shall be equipped with a 2” side drain.

F. The effluent chamber shall be sealed from all other chambers of the separator and equipped with a flow control pipe that connects the effluent chamber to the separating chamber. The interconnecting pipe shall be specifically sized, designed and located to convey the treated water to the effluent chamber while precluding sudden accelerations in the flow and inadvertent mixing of the separated liquid (DNAPL) with the treated water by causing the upstream chambers to act as surge dampers. This chamber shall be equipped with a 2" side drain.

G. The separator shall not have any coalescing meshes, replaceable media, inclined plates or vertical tubes. The separator shall have no moving parts or pumps to effect separation within and shall not require any type of electrical connection to effect separation.

H. The inlet and outlet shall be 8-inch flanged connections.

I. The separator shall have a nominal DNAPL storage capacity of 1,200 gallons.

J. The separation chamber shall be equipped with a 2" DNAPL draw-off pipe and a 2" interface float connection coupling.

K. The effluent chamber shall be equipped with a 2" side vent located above the static liquid level.

L. The effluent chamber shall be equipped with a 2" side vent located above the static liquid level.

M. The vessel shall be equipped with a cover providing a positive vapor seal.

N. The DNAPL/water separator shall be fabricated, inspected and tested for leakage by the manufacturer before shipment from the factory as a completely assembled vessel ready for installation.

O. The separator shall be designed for gravity separation of free DNAPL and settleable solids from water. The source of the influent to the separator shall be gravity or pump-fed flow from groundwater remediation wells, process water, spill or cleaning operations.

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330 Submittal Procedures:

A. Shop Drawings: Detail drawings shall contain complete schematic diagrams and any other details required to demonstrate how the pumps will function following installation.

B. Product Data: Manufacturer's descriptive data and technical literature, performance charts, catalog cuts, and installation instructions.

1.3 QUALITY ASSURANCE

A. Manufacturers' Field Services: Provide the services of a manufacturer's representative experienced in the installation, adjustment, and operation of the separator specified. The representative shall supervise installation, adjustment, and testing of the separator.

B. Provide a signed statement certifying that the installation is satisfactory and in accordance with the contract drawings and specifications and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect all equipment from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS

A. The separator shall be fabricated of new and unused carbon steel of ASTM A36 grade or equal.

B. The separator plates shall be fabricated of polypropylene.

C. All welded fittings shall have 2000# rating.

D. All flanged piping connections shall be ANSI 150#

2.2 COATING(S)

A. External surfaces shall be prepared and coated in accordance with the paint manufacturer’s specifications. External surfaces shall be primed with Farrell-Calhoun Tuff-Boy 1022 Rust-Stop White Primer and coated with Farrell-Calhoun Tuff-Boy 800 Line Interior Exterior Industrial Gloss Enamel.

B. Internal carbon steel surfaces shall be prepared and coated in accordance with the paint manufacturer’s specifications. Internal coating shall be Duraplate 235 Epoxy.

PART 3 - EXECUTION

3.1 INFLUENT CHARACTERISTICS

Provide a DNAPL/Water Separator designed for intermittent or continuous and variable flows of water, DNAPL, or any combination of non-emulsified DNAPL water mixtures ranging from zero up to the maximum applicable flow rate. The separator shall be designed to operate as a flow through device capable of handling intermittent flows with DNAPL concentrations up to 100% and continuous concentrations up to 50%. Specific gravities of the DNAPLs at operating temperature range shall be greater than 1.00. Operating temperatures shall range from 40° F to 180° F.

3.2 EFFLUENT CHARACTERISTICS

The free DNAPL concentrations in the effluent shall not exceed 10mg/l.

END OF SECTION 15445

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Contractor shall procure and install five (5) DNAPL pumping systems at the following four well locations:

1. RW-100

2. RW-103

3. RW-104

4. RW-105

5. RW-110

B. The CONTRACTOR shall procure and install new pneumatic pump, pump controller, and accessories at each of these well locations.

C. The CONTRACTOR shall re-use the existing DNAPL interface probe system at each well location.

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330 Submittal Procedures:

A. Shop Drawings: Detail drawings shall contain complete schematic diagrams and any other details required to demonstrate how the pumps will function following installation.

B. Product Data: Manufacturer's descriptive data and technical literature, performance charts, catalog cuts, and installation instructions.

1.3 QUALITY ASSURANCE

A. Manufacturers' Field Services: Provide the services of a manufacturer's representative experienced in the installation, adjustment, and operation of the pumps specified. The representative shall supervise installation, adjustment, and testing of the pumps.

B. Provide a signed statement certifying that the installation is satisfactory and in accordance with the contract drawings and specifications and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect all equipment from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

The contractor shall provide the following pneumatic pumps and control systems:

DNAPL Pumps For All Well Locations	
Pump Type:	Pneumatic
Inlet:	Bottom
Outside Diameter:	1.66 inch
Material of Construction:	Stainless Steel, PTFE
Fittings: Type / Material:	Compression / SS
Liquid Discharge:	1/2 in
Air Supply:	3/8 in
Pump Stroke:	0.09 gal
Operating Pressure:	40-100 psi
Maximum Depth:	230 ft
Maximum Flow Rate:	2 gpm
Minimum Submergence:	< 1 ft.
Liquid to be pumped:	PCBs (DNAPL)
Pump Model:	QED LP1301 or equal
Accessories:	Inlet Screen QED S1301
Pump Controller For All Well Locations	
Controller Type:	Electronic/Pneumatic
Enclosure Type:	FRP, NEMA 4X
Power:	Solar or 110VAC
Display:	LCD
Pneumatic Control:	100 psi max

Controller Model:	QED C100M or equal
Included Accessories:	3/8” Filter/Regulator
Exhaust Valve:	In well type QED L355

PART 3 - EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field and advise Engineer of any discrepancy before performing the work.

3.2 INSTALLATION

The installation elevation of each of the DNAPL pumps shall be field verified and adjusted based on input from the Owner’s representative. Following are the estimated well depths which have to be field verified prior to installation of the DNAPL pumps.

1. RW-100 – Depth 196 feet
2. RW-103 – Depth 159 feet
3. RW-104 – Depth 106 feet
4. RW-105 – Depth 126 feet
5. RW-110 – Depth 141 feet

3.3 OPERATION

The operation of each DNAPL pumping system is completely manual in order to fill a 5 gallon bucket. The pumping system and pneumatic controller shall be operated using clean, dry air from a portable air compressor supplied by the owner. The air supply hose on the inlet side of the filter/regulator shall be fitted with quick-type couplings for connecting to the air compressor. Once air supply is connected, the pump is operated from the push-button pneumatic controller until a sufficient amount of DNAPL fills the bucket.

3.4 MANUFACTURER'S FIELD SERVICES

The contractor shall utilize the services of a manufacturer’s representative during installation and testing of each of these systems.

3.5 FIELD TESTS

A. Factory Pump Test not required.

B. Field Equipment Test

1. After installation of the pumping units and appurtenances is complete, operating tests shall be carried out to assure that the pumping installation operates properly. Make arrangements to have the manufacturer's representatives present when field equipment tests are made. Each pumping unit shall be given a running field test in the presence of the Engineer. Each pumping unit shall be operated at its rated capacity. Provide an accurate and acceptable method of measuring the discharge flow.

a. Correct Installation of Appurtenances

Tests shall assure that the units and appurtenances have been installed correctly, that there is no objectionable vibration, or noise from any parts, and that all manual and automatic controls function properly.

b. Deficiencies

If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be re-conducted.

END OF SECTION 15446

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This project will re-use pumps that are located on the site. The contractor shall install re-used pumps at the following locations:

Pump	Pump Type	New Pump Description
P-1030A	Self-Priming	North Basin Transfer Pump
P-1030B	Self-Priming	North Basin Transfer Pump
P-1040	Self-Priming	Railcar Pit Pump
P-1020A	Centrifugal	Influent Transfer Pump
P-1020B	Centrifugal	Influent Transfer Pump

B. Relocation of pumps shall include testing the pumps to ensure they are in good working condition and can be reused, disconnecting the pump from the existing location, and installing the pump at the new location per drawings and manufacturer's instructions. Relocation shall include baseplate, pump, electric motor drive, and accessories. The Contractor shall utilize new fasteners, and anchor bolts during the reinstallation of pumps.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASME INTERNATIONAL (ASME)

ASME B1.1 (2003; R 2008) Unified Inch Screw Threads (UN and UNR Thread Form)

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.2 (2000) Centrifugal Pump Nomenclature

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2007; Errata 2008) Standard for Motors and Generators

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330 Submittal Procedures:

A. Shop Drawings: Provide a complete list of equipment and materials required to disassemble, relocate, and re-install the existing pumps. Detail drawings shall contain complete wiring and schematic diagrams and any other details required to demonstrate that the pumps will function following re-installation. Show proposed layout and anchorage.

B. Product Data: Manufacturer's descriptive data and technical literature for the new 7.5 HP motor for pump P-1030B.

1.4 QUALITY ASSURANCE

A. Manufacturers' Field Services: Provide the services of a manufacturer's representative experienced in the relocation, installation, adjustment, and operation of the pumps specified. The representative shall supervise disconnecting the pump and the relocation, installation, adjustment, and testing of the pumps.

B. Provide a signed statement certifying that the installation is satisfactory and in accordance with the contract drawings and specifications and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect all equipment from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

The CONTRACTOR shall un-install and re-install the following pumps:

Pump	Pump Type	New Pump Description	Existing Pump Located At	Manufacturer and Model	Pump Capacity	Horsepower
P-1030A	Self-Priming	North Basin Transfer Pump	Pre-treatment Building (P-3A Not in use)	Gorman-Rupp T3A-B	225 gpm and 60-ft TDH	7.5 HP; 460/3/60
P-1030B	Self-Priming	North Basin Transfer Pump	Pre-treatment Building (Pump P-1 connected to T-100)	Gorman-Rupp T3A-B	225 gpm and 60-ft TDH	**Change motor from 5 to 7.5 HP; 460/3/60**
P-1040	Self-Priming	Railcar Pit Pump	Pre-treatment Building (Pump P-2 connected to T-200)	Gorman-Rupp T3A-B	150 gpm and 45-ft TDH	5HP; 460/3/60

P-1020A	Centrifugal	Influent Transfer Pump	Utility tunnel	Goulds 3196	250 gpm and 29-ft TDH	3 HP; 460/3/60
P-1020B	Centrifugal	Influent Transfer Pump	Utility tunnel	Goulds 3196	250 gpm and 29-ft TDH	3 HP; 460/3/60

2.2 ELECTRICAL WORK

Pump P-1030B shall get a new 7.5 HP motor similar to existing pump P-3A. The pump drive motor shall be non-overloading of NEMA standard design, JM-frame suitable for horizontal mounting, and belt drive to the pump unit. The motor rating shall be:

A. 7.5 HP, 1750 RPM, 460 volts, 3 phase, 60 Hz

B. Totally enclosed fan cooled (TEFC)

C. 1.15 Service Factor

D. High Efficiency for VFD service

2.3 EQUIPMENT APPURTENANCES

A. Attachments

All new anchor bolts, nuts, washers, bolt sleeves, and other types of attachments for the installation of the equipment shall be procured and used during the installation. Anchor bolts, nuts, and washers shall be stainless steel Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field and advise Engineer of any discrepancy before performing the work.

3.2 INSTALLATION

Install each pump in accordance with the written instructions of the manufacturer and under the direct supervision of the manufacturer's representative. Concrete for equipment foundations shall be as specified in Section 03310 Cast-in-Place Concrete. Concrete foundations shall be integral with and of the same class as that of the building floor unless otherwise indicated. Concrete having a compressive strength of at least 2,500 psi shall be used in foundations that are entirely separated from the surrounding floor. Any templates necessary and all dimensions for setting the anchor bolts shall be furnished at the proper time.

3.3 MANUFACTURER'S FIELD SERVICES

Obtain the services of a manufacturer's representative experienced in the dismantling, relocation, and installation, adjustment, and operation of the equipment specified. The representative shall supervise the dismantling, relocation, installation, adjusting, and testing of the equipment.

3.4 FIELD TESTS

A. Factory Pump Test not required.

B. Field Equipment Test

1. After installation of the pumping units and appurtenances is complete, operating tests shall be carried out to assure that the pumping installation operates properly. Make arrangements to have the manufacturer's representatives present when field equipment tests are made. Each pumping unit shall be given a running field test in the presence of the Engineer for a minimum of 2 hours. Each pumping unit shall be operated at its rated capacity or such other point on its head-capacity curve selected by the Engineer. Provide an accurate and acceptable method of measuring the discharge flow and gauge pressure.

a. Correct Installation of Appurtenances

Tests shall assure that the units and appurtenances have been installed correctly, that there is no objectionable heating, vibration, or noise from any parts, and that all manual and automatic controls function properly.

b. Deficiencies

If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be re-conducted.

3.5 FIELD PAINTING

Do not paint stainless steel, galvanized steel, and nonferrous surfaces.

A. Touch-Up Painting

Items requiring touching up in the field shall be thoroughly cleaned of all foreign material and shall be primed and top coated with the manufacturer's standard factory finish.

END OF SECTION 15447

PART 1 - GENERAL

1.1 SCOPE OF WORK

Furnish all labor, materials, equipment and incidentals required to install the Feed Tank (T-1020).

1.2 RELATED SECTIONS

01330 Submittal Procedures

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publication shall be the latest edition and is referred to within the text by the basic designation only.

Underwriters Laboratories (UL)

UL-142 Underwriters Laboratories Construction of Vertical Storage Tanks

1.4 QUALIFICATIONS AND QUALITY CONTROL

A. Manufacturer Qualification

The tank furnished under this section shall be supplied by reputable Manufacturers having at least five (5) years experience in the design and fabrication of such tank for the treatment of groundwater, water, and wastewater. The tank shall be engineered, designed, constructed, and delivered in accordance with these specifications and the best industry practices and methods, and it shall operate satisfactorily when installed as shown on the Contract Drawings and as recommended by the Manufacturer.

B. Quality Control

The Manufacturer shall submit and follow quality control procedures adequate to ensure that all fabrication complies with the Technical Specifications. Quality control shall include a final inspection by the Manufacturer and the submittal of a written record of this final inspection.

1.5 SUBMITTALS

Submit the following in accordance with Section 01330 Submittal Procedures.

A. Manufacturer's Product Data: Submit product data describing tank features, materials of construction, general dimensions, and operational parameters. Include detail specifications, available test data and instructions for installation and maintenance.

B. Shop Drawings: Submit shop drawings for approval. Indicate nozzle (size and orientation), connection, and man-way types, sizes, locations, tank wall thickness, installation details, and other construction details.

C. Reports: Submit a report describing the findings of the field inspection of the installed tank and the results of the hydrostatic testing.

1.6 SEISMIC LOADS

As required for seismic zone 2A (importance factor of 1.0).

1.7 DELIVERY AND STORAGE

Handle and store storage tank system, components, and parts to prevent distortions and other damage that could affect their structural or mechanical integrity. Replace damaged items that cannot be restored to their original condition. Store items subject to deterioration by exposure to elements, in a well-drained location, protected from weather, and accessible for inspection and handling.

1.8 EQUAL PRODUCTS

The Contract Drawings and Technical Specifications are based on a conceptual arrangement of tank and piping. Should the Contractor propose to furnish equal tank of a different configuration, the Contractor shall be responsible for all revisions necessary to incorporate the proposed tank into the design, and submit the necessary revised Contract Drawings and Technical Specifications for review and approval.

PART 2 - PRODUCTS

2.1 TANK

Following are the tank requirements:

A. Tank Volume: 2,000 gallons

B. Tank dimensions: 84” diameter x 84” high.

C. The purpose of the feed tank is to provide the required storage volume to hold the effluent from the DNAPL separator prior to being pumped to the influent tanks. The fluid composition will be:

1.	Temperature,	°F	50 to 60
2.	Average Influent pH,	SU	7
3.	Specific Gravity	SU	1

D. The tank shall be constructed in accordance with UL-142 and shall be complete with flat bottom, flat top, side manway, and nozzles.

E. The nozzles sizes and positions shall be as shown on the Contract Drawings. The nozzle sizes and locations are as follows:

1. Top

a. Vent: 4-inch flanged
b. Spare: One 4-inch flanged and one 2" threaded
c. Instrument Connection: 2-inch threaded
d. Instrument Connection: 4-inch flanged
e. Access manhole: 24" diameter
f. Recycle Line: 4-inch flanged

2. Side

a. Access manhole: 24-inch diameter
b. Fill: 8-inch flanged
c. Overflow: 6-inch flanged
d. Discharge: 8-inch flanged
e. Spare/Drain: 4-inch flanged

2.2 MATERIALS OF FABRICATION

The tank, nozzles, and hatch shall be carbon steel compatible with the expected concentration of chemicals in the tank.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Tank shall be installed in accordance with Manufacturer's Instruction and as shown on the Contract Drawings.

B. The installed tank shall be visually inspected for plumb and nozzle alignment, smoothness, and evenness of the steel shall also be visually checked.

C. Tank shall be installed on top of ½-inch thick geo-net matting to detect any leaks.

3.2 FIELD INSPECTION AND TESTING

A. Field tests shall not be conducted until such time that the entire installation is complete and ready for testing.

B. The tank shall be hydrostatically tested for leaks by filling them with water. The tank shall be checked for leaks after it has been full for at least one hour.

C. If the installation inspection reveals deficiencies, corrective measures shall be taken until the tank meets the specified requirements.

END OF SECTION 15448

PART 1 - GENERAL

1.1 SCOPE OF WORK

Procure and install above-grade process piping, pipe supports, valves, fittings, connections, and other accessories per project drawings. Piping includes:

A. Ductile-iron piping (in TDCS).

B. PVC process piping (in GWTP) – Schedule 80.

C. PVC vent piping (in GWTP) – Schedule 40

D. Double Containment PVC piping – Schedule 80 (from the wells to the treatment building). Leak detection as required or as noted on drawings

E. Carbon steel piping (Air line From Building-4A to RW-105).

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2008) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2008) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2005) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C150/A21.50	(2002; Errata 2003) Thickness Design of Ductile-Iron Pipe
AWWA C151/A21.51	(2002; Errata 2002) Ductile-Iron Pipe, Centrifugally Cast, for Water

ASME INTERNATIONAL (ASME)

ASME B16.42	(1998; R 2006) Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300
ASME B16.5	(2009) Standard for Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24
ASME B18.2.1	(1996; Addenda A 1999; Errata 2003; R 2005) Square and Hex Bolts and Screws (Inch Series)

ASME B18.2.2	(1987; R 2005) Standard for Square and Hex Nuts
ASME B31.3	(2008) Process Piping

ASTM INTERNATIONAL (ASTM)

ASTM A 105/A 105M	(2010) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A 181/A 181M	(2006) Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
ASTM D 1784	(2008) Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(2006) Standard Specification for Poly (Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(2005) Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	(2006) Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2467	(2006) Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	(2004e1) Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2855	(1996; R 2002) Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(2008) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application
MSS SP-89	(2003) Pipe Hangers and Supports - Fabrication and Installation Practices

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330 Submittal Procedures:

A. Shop Drawings: Equipment shop drawings and support system detail drawings showing piping systems and appurtenances, such as mechanical joints, valves, local indicators and hangers, including a complete list of equipment and materials.

B. Product Data: Manufacturer's descriptive and technical literature for each piping system, including design recommendations; pressure and temperature ratings; dimensions, type, grade and strength of pipe and fittings; thermal characteristics (coefficient of expansion and thermal conductivity); and chemical resistance.

C. Material safety data sheet in conformance with 29 CFR 1910 Section 1200(g) for each chemical (solvents, solvent cements, and glues) delivered for use in pipe installation.

D. Pipe Schedule: Provide a list of piping systems, pressure ratings and source of supply for each piping system broken out by material, size and application as indicated on the contract drawings. A list of any special tools necessary for each piping system and appurtenances furnished for adjustment, operation, maintenance and disassembly of the system.

E. Valve and Valve Operator Schedule: Provide a list of valve materials, pressure ratings, and valve operator materials and reference identification as indicated in the contract drawings. A list of any special tools necessary for each valve type and appurtenances furnished for adjustment, operation, maintenance and disassembly.

F. Test Reports: Pipe Leakage Tests, Hydrostatic Tests, Valve Testing. Copies of all field test reports including Pipe Leakage Tests and Hydrostatic Tests. Manufacturer's engineering end load calculations for anchors in double containment piping systems.

G. As-built drawings: Show pipe anchors and guides, and layout of piping systems relative to other parts of the work including clearances for maintenance and operation. As-built piping and instrumentation diagrams (P&IDs) identifying and labeling equipment, instrumentation, valves, vents, drains, and all other inline devices. The P&IDs found in the contract drawings shall be revised to reflect the constructed process system, as directed by GE’s site representative.

H. Instructions Manuals: Detail in the Operation Manuals the step-by-step procedures required for startup, operation and shutdown of piping systems, and include the manufacturer's name, model number, parts list and brief description of piping equipment such as valves and other appurtenances and their basic operating features. List in the Maintenance Manuals routine maintenance procedures and troubleshooting guides for the equipment, and include piping layout and valve locations.

1.4 DELIVERY, STORAGE, AND HANDLING

Materials delivered and placed in storage shall be stored with protection from the weather, excessive humidity variation, excessive temperature variation, dirt, dust and/or other contaminants. Proper protection and care of material before, during and after installation is the Contractor's responsibility. Any material found to be damaged shall be replaced at the Contractor's expense. During installation, piping shall be capped to keep out dirt and other foreign matter. A material safety data sheet in conformance with 29 CFR 1910 Section 1200(g) shall accompany each chemical delivered for use in pipe installation. At a minimum, this includes all solvents, solvent cements, glues and other materials that may contain hazardous compounds. Handling shall be in accordance with ASTM F 402. Storage facilities shall be classified and marked in accordance with NFPA 704. Materials shall be stored with protection from puncture, dirt, grease, moisture, mechanical abrasions, excessive heat, ultraviolet (UV) radiation damage, or other damage. Pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendation. Plastic pipe shall be packed, packaged and marked in accordance with ASTM D 3892.

1.5 SEQUENCING AND SCHEDULING

A. For slab, floor, wall, and roof penetrations, keep on site pertinent wall pipes and sleeves before they are required for placement in concrete forms. Verify and coordinate the size and location of building and structure pipe penetrations before forming and placing concrete.

B. The CONTRACTOR shall utilize the services of a pipe manufacturing representative knowledgeable in the handling and installation of double containment piping. The double containment piping system manufacturer shall have at least 10 years of installation experience with leak detection/location sensor cable technology.

1.6 MAINTENANCE

A. Service

Services for automatic valve systems shall be provided by a manufacturer's representative who is experienced in the installation, adjustment and operation of the equipment specified. The representative shall inspect the installation, and supervise the adjustment and testing of the equipment.

B. Extra Materials

Concurrent with delivery and installation of the specified piping systems and appurtenances, spare parts for each different item of material and equipment specified that is recommended by the manufacturer to be replaced any time up to 3 years of service shall be furnished.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT, in general

A. Provide piping materials and appurtenances as specified and as shown on the drawings, and suitable for the service intended. Piping materials, appurtenances, and equipment supplied as part of this contract shall be of equal material and ratings as the connecting pipe, new and unused except for testing equipment. Components that serve the same function and are the same size shall be identical products of the same manufacturer. The general materials to be used for the piping systems shall be in accordance with the contract drawings. Pipe fittings shall be compatible with the applicable pipe materials.

B. The pressure ratings and materials specified represent minimum acceptable standards for piping systems. The piping systems shall be suitable for the services specified and intended. Each piping system shall be coordinated to function as a unit. Flanges, valves, fittings and appurtenances shall have a pressure rating no less than that required for the system in which they are installed.

C. Piping systems shall be suitable for design conditions, considering the piping both with and without internal pressure, and installation factors such as insulation, support spans, and ambient temperatures. Consideration shall be given to all operating and service conditions both internal and external to the piping systems.

D. Standard Products

Provide material and equipment which are the standard products of a manufacturer regularly engaged in the manufacturing of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Nominal sizes for standardized products shall be used. Pipe, valves, fittings and appurtenances shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

E. Identification and Tagging

Each piece of pipe shall bear the ASTM designation and all other markings required for that designation. The service, valve identification number shown on the contract drawings, the manufacturer's name, and the valve model number shall be displayed.

2.2 DUCTILE IRON PIPING (DIP) AND FITTINGS

A. DIP where specified on the Drawings shall mean ductile iron pipe with flanged joints for interior and other non-buried piping. Flanged DIP shall be Class 51, centrifugally cast and shall conform to AWWA C151 and ANSI 21.51.

B. All exposed DIP fittings shall have flanged fittings in accordance with AWWA C110 and ANSI 21.10.

C. The exterior surface of the exposed ductile iron pipe and fittings shall be painted in accordance with the paint schedule and specifications specified in Section 09900.

D. Ductile iron pipe shall be as manufactured by U. S. Pipe and Foundry, Clow Corporation or approved equal.

2.3 PLASTIC PIPING SYSTEM AND FITTINGS FOR PROCESS WASTE

A. Plastic piping shall be Schedule 80 PVC pipe, seamless, unplasticized polyvinyl chloride normal impact type, conforming to ASTM D-1784 and D-1785, for Type I, Grade 1. PVC pipe system shall be as manufactured by Certainteed Corp. or approved equal.

B. All pipe and fittings shall be as per ASTM D2467 and joints shall be solvent socket welded (except flanges shall be used at valves and greater than three-inch diameter). Flanges shall be the socket type complete with gaskets, bolts, and nuts.

C. Joints shall be assembled using an approved solvent cement in accordance with the manufacturer's recommendations and ASTM D2855, Standard Recommended Practice for Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings. No cementing shall be done in the rain or when the temperature is below 40°F or above 90°F.

D. Pipe shall be provided with supports spaced not farther than the manufacturer's recommended spacing for 100°F service. Provide pipe unions of the same material at all changes in piping direction. Piping shall be pitched to drain as shown on the drawings.

E. The Contractor shall provide slip-type PVC expansion joints with joint material as recommended by the manufacturer for the type of service. Joints shall be installed near all fittings and not more than 100 feet apart on all runs of pipe.

F. The Contractor is cautioned to exercise care in handling, loading, unloading, and storing plastic pipe and fittings. All plastic pipe and fittings shall be stored under cover before using and shall be transported in a vehicle with a bed long enough to allow the length of pipe to lay flat so as not to be subject to undue bending or concentrated external load at any point. Any section of pipe that has been dented or damaged will be discarded until said section of pipe is cut out and rejoined with a coupling.

G. All PVC piping, fitting, and valving will not be painted.

2.4 PLASTIC PIPING AND FITTINGS FOR VENT PIPING

A. Material: Schedule 40, DWV or SDR class as indicated, white virgin material, Type 1, Grade 1, as indicated.

B. Standards: ASTM D 1785 for Schedule 40 PVC; ASTM D 2665 and NSF approved for DWV; ASTM D 3034 for SDR.

C. Fittings: PVC material, solvent weld, Type 1, ASTM D 2466 for Schedule 40, and ASTM 2665 for DWV; ASTM D 3212 for SDR.

D. Joint material: Use solvent cement in accordance with industry standards and manufacturer's recommendations.

2.5 DOUBLE CONTAINMENT PIPING

A. Double containment piping systems shall conform to the requirements of ASME B31.3.

B. The primary, or carrier, pipe of the double containment piping and the secondary, or containment, pipe of the double containment piping system shall be Schedule 80 PVC. The piping shall be free of flanges and other joints that are not compatible with the secondary piping installation. The piping shall be equipped with expansion loops, offsets, or direction changes as necessary to counter thermal expansion and contraction, which shall be coordinated with the secondary piping. The secondary piping shall be drainable and shall be continuous and equipped with drains at all low points and vents at all high points. The piping shall be designed to allow pulling of the leak detection cable into the containment pipe both during and after piping installation.

C. All fittings shall be factory manufactured of material compatible with the process fluids (groundwater with PCBs) and associated piping. Anchors shall be of sufficient thickness to withstand the maximum possible end loads that will be generated by the carrier pipe during the life of the system. Elbows must be anchored on both ends. Tees must be anchored on both the run and the branch.

D. Pressure rating of connections and fittings shall be greater than or equal to the design pressure of the system with a minimum safety factor of five. End seals and other subassemblies shall be designed and factory prefabricated to prevent the ingress of moisture into the system. Subassemblies shall be designed to allow for complete draining of the secondary containment.

E. Leak Detection

1. Where specified, the leak detection system shall be a cable detection and visual detection system. If any of these conditions should occur at any point along the cable, an alarm shall sound. The sensor cable, connectors, and jumpers shall be supplied by the manufacturer of the monitoring unit. The cable sensing principle shall provide for continuous monitoring while short lengths of the cable are in contact with liquids, without altering the system's sensitivity and/or accuracy. The cable system shall be a conductance type.

2. All low points of the secondary piping system shall be equipped with sample valves.

F. Supports

Supports shall be designed and supplied for the conveyance and containment piping to prevent distortion of the pipes and strain on joints and fittings. Supports shall be designed by the double containment piping system manufacturer. No field fabricated supports will be allowed. Double supports shall be required throughout the system to minimize stresses due to point loading.

2.6 STEEL PIPING FOR AIR SERVICE

A. Schedule 40, Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, black or hot-dip zinc coated with ends threaded according to ASME B1.20.1.

1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.

2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.

3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.

4. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel, threaded.

5. Wrought-Steel Butt-Welding Fittings: ASME B16.9, Schedule 40.

6. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.

7. Grooved-End Fittings and Couplings:

   a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Anvil International, Inc.; Star Pipe Products; Star Fittings Div. or Victaulic Company.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250-psig (1725-kPa) inlet pressure, unless otherwise indicated.

D. Air-Line Pressure Regulators: Diaphragm operated, aluminum alloy or plastic body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for [200-psig (1380-kPa)] minimum inlet pressure, unless otherwise indicated.

E. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig (1380-kPa) minimum working pressure, capable of automatic discharge of collected condensate.

F. Air-Line Lubricators: With drip chamber and sight dome for observing oil drop entering air stream; with oil-feed adjustment screw and quick-release collar for easy bowl removal.

G. Hose Assemblies: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig (2070-kPa) minimum working pressure, unless otherwise indicated.

H. Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose. Automatic shut-off type, straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.

1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.

2. Plug End: Straight-through type with barbed outlet for attaching hose.

Provide mounting brackets for all air stations as per the drawings.

2.7 VALVES AND SPECIALTIES (TDCS SHAFT AND VAULT)

A. General. The Contractor shall furnish and install all valves and specialties as specified. In addition, valve-operating units and other accessories shall be furnished and installed by the Contractor where specified for various system packages. All valves shall be new and of current manufacture. All valves, specialties, etc. shall be installed with sufficient unions and/or flange joints to permit replacement without the need to cut the pipes.

B. Gate Valves (To Be Determined). Gate valves 3 inches and larger shall be flanged iron body, fully bronze-mounted, solid wedge or double disc type with renewable seat rings, suitable for a working pressure of 150 psi and shop tested at 300 psi. Gate valves shall conform with all applicable provisions of AWWA C500. Threaded gate valves 2 inches and less shall be bronze construction, union bonnet type with rising stem, solid wedge pattern. Floor stand model shall be non-rising stem type with bronze indicator. Gate valves shall be as manufactured by Darling, Clow Corporation or approved equal.

C. Check Valves. Check valves 3 inches and larger for liquid service shall be iron body, fully bronze-mounted, horizontal single disc swing type with full sized removable flanged cover and extended hinge, lever and weight. Renewable bronze seat rings shall be provided. Check valves shall have 125-pound American Standard flanged ends and shall be suitable for 150 psi working pressure, shop tested to 300 psi. Check valves smaller than 3 inches shall be all bronze swing check valves with screwed ends. Check valves for liquid services shall be as manufactured by Darling Valves and Manufacturing Company, Clow Corporation, or approved equal. Weights shall be adjustable.

D. Ball Valves (General Purpose). Ball valves, 2 inch and smaller, shall be end entry type with bronze bodies and threaded, in accordance with ASME B1.20.1, regular ports. Valves shall have polytetrafluoroethylene (PTFE) seats and packing, brass balls hand lever operators. Valves shall be rated for 150 psig service at 150 degrees F. A union shall be installed adjacent to the valves to provide access to the seat.

E. Butterfly Valves (To Be Determined). Butterfly valves, 2 inch and larger, shall have carbon steel bodies, lugged styled with ASME B16.1 flanged. Valves shall conform to AWWA C504 Class 125. Discs shall be contoured ASTM A 436 Type 1 Ni-resist cast iron with maximum lead content of 0.003 percent. The valve shafts shall be stainless steel with self-lubricating, corrosion-resistant sleeve type bearings. Valve seats for 24 inch and smaller valves shall be attached to either the valve body or the disc and shall be constructed of chloroprene. Valves shall have hand wheel or chain wheel operators.

F. Factory Finishing

Valves shall have an epoxy lining and coating in accordance with AWWA C550 unless otherwise specified. The epoxy shall be either a two-part liquid material or a heat-activated (fusion) material except that only a heat-activated material shall apply if a valve coating is specified as "fusion" or "fusion bonded" epoxy. The epoxy lining and coating shall have minimum 7.0 mils dry film thickness except where it is limited by valve operating tolerances. Exposed valves shall be finished in accordance with Section 09900 “Paints and Coatings”.

2.8 VALVES AND SPECIALTIES (ALL OTHER PROCESS SERVICE)

A. General. The Contractor shall furnish and install all valves and specialties as specified. In addition, valve-operating units and other accessories shall be furnished and installed by the Contractor where specified for various system packages. All valves shall be new and of current manufacture. All valves, specialties, etc. shall be installed with sufficient unions and/or flange joints to permit replacement without the need to cut the pipes.

B. Check Valves. Check valves 4 inches and larger for liquid service shall be Schedule 80 PVC Wafer-type with spring-loaded flapper similar to existing check valves. Check valves 3 inches and smaller for liquid services shall be Schedule 80 double-union ball check as manufactured by Nibco, Hayward, or approved equal.

C. Ball Valves (General Purpose). Ball valves, 3 inch and smaller, shall be Schedule 80 PVC double-union ball valve with handle as manufactured by Nibco, Hayward, or approved equal.

D. Butterfly Valves. Butterfly valves, 4 inch and larger, shall be Schedule 80 PVC with lugs for flanged service. Butterfly Valves shall have hand wheel or chain wheel operators. Butterfly valves shall be as manufactured by Nibco, Hayward, or approved equal.

E. Pressure Gauge. Pressure gauges shall be all welded construction of stainless steel (316 SS) with 3½" case size, ¼" NPT bottom connection with a shutoff valve, overload and underload stops, field liquid fillable, 1% full scale accuracy with 0-100 psi pressure range. Pressure gauges shall be factory filled with glycerine and as manufactured by Ashcroft, Model #35-1009SW-02L or an approved equal.

2.9 DRAINS

Valved drains may not be shown on the detailed drawings for individual pipelines; their absence will not relieve the Contractor of the responsibility for providing and installing them as indicated in the piping and instrumentation diagrams to complete the piping system for the use intended.

A. Locations

All pipeline low points shall be drained.

B. Sizes

For pipelines 2.5 inch and larger, drains shall be 0.75 inch and equipped with ball valves. For pipelines 2 inch and smaller, drains shall be 1/2 inch and equipped with ball valves.

2.10 SAMPLE PORTS

Sample ports, shown on the flow diagrams and piping and instrument diagrams of the contract drawings, may not be shown on the detailed drawings of the individual pipelines; their absence shall not relieve the Contractor of the responsibility for providing them. Sample ports shall be provided as indicated in the piping and instrument diagrams to complete the piping systems for the use intended. The sample ports shall be located in easily accessible locations, and shall avoid potential stagnant points and/or areas where material could collect.

2.11 MISCELLANEOUS PIPING COMPONENTS

A. Air Release

Air release vents shall be located, and vented, such that a hazardous atmosphere will not be created upon operation.

1. Locations

Air release shall be located as indicated on the contract drawings and at all high points.

B. Indicating Devices

Instrumentation and Indicating Devices such as pressure gauges are located in Section Instrumentation and Process Control.

C. Expansion Joints

Provide all structural work and equipment required to control expansion and contraction of piping. Verify that the anchors, guides, and expansion joints provided, adequately protect the piping systems. Provide expansion joints for ductile iron piping at connections to equipment as shown on the drawings.

2.12 PIPE SUPPORTS AND PENETRATIONS

Provide auxiliary steel where the support of piping systems and equipment is required between building structural elements. Light gauge and structural steel shapes shall conform to the requirements of ASTM A 36/A 36M. The Contractor has the option to use pre-engineered support systems of electrogalvanized steel products. However, a mixture of support system manufacturer's products is not permitted. Where auxiliary steel is indicated as stainless steel, provide TP304 stainless steel conforming to ASTM A 167, No. 1 Finish.

A. Pipe Supports

Pipe supports shall conform to the requirements of MSS SP-58, MSS SP-69, and MSS SP-89. Where pipe supports contact bare piping or in-line devices, provide supports of compatible material so that neither shall have a deteriorating action on the other. The absence of pipe supports and details on the Contract Drawings does not relieve the Contractor of responsibility for sizing and providing supports throughout the facility.

1. Beam Clamps

For upper attachments on structural steel, provide beam clamps of ASTM A 36/A 36M carbon steel and MSS SP-58 Types 19 through 23, 25 or 27 through 30. Holes drilled in structural steel for hanger support rods will not be permitted. Clamps shall be provided with hardened steel cup-point set screws and lock-nuts for anchoring in place. Clamp size selection shall only be based on the support of the required load.

2. Riser Clamps

Vertical runs of piping shall be supported at each floor, or closer where required, with ASTM A 36/A 36M carbon steel clamps bolted around pipes and attached to the building construction. Two bolt-type clamps designed for installation under insulation shall be used on insulated pipe runs.

3. Brackets

Where piping is run adjacent to walls or steel columns, provide welded ASTM A 36/A 36M steel brackets, pre-punched with a minimum of two fastener holes.

4. Offset Pipe Clamp

Where pipes are indicated as offset from wall surfaces, supply a double-leg design two-piece pipe clamp.

5. Racks

Multiple pipe racks or trapeze hangers shall be fabricated from ASTM A 36/A 36M steel, and designed to suit the conditions at the points of installation. Pipes shall be kept in their relative positions to each other by the use of clamps or clips. Pipelines subject to thermal expansion must be free to slide or roll.

6. Hangers

Hangers shall be fabricated of ASTM A 36/A 36M carbon steel. All hangers shall be of a uniform type and material for a given pipe run and application. Coated or plated hangers shall be used to isolate steel hangers from dissimilar metal tube or pipe. Hangers for pipe sizes 2.5 inch or larger shall incorporate a means of vertical adjustment after erection while supporting the load. For piping systems with liquid temperatures up to 122 degrees F the following shall be used: MSS SP-58 Types 1, 3 through 12, Types 24 and 26 with overhead support, or Types 35 through 38 with support from below.

7. Hanger Rods

Hanger rods shall be carbon steel conforming to ASTM A 576. The diameter of the rods for piping system support shall conform to ASME B31.1.

B. Wall Penetrations

1. Above Grade Wall Penetrations

Plastic pipe penetrations shall be fitted with galvanized steel collars that have intumescent inlays.

2. Below-Grade Wall Penetrations

Below-grade wall penetrations shall be provided with hydrostatic seals designed to seal opening between pipe or conduit and a through-structure opening. The

seals shall be polysiloxane (also known as silicone) based, non-slumping, vibration and water resistant sealant with intumescent properties.

3. Galvanizing

Galvanizing shall be hot-dip applied and meet the requirements of ASTM A 153/A 153M. Stainless steel components may be substituted where galvanizing is specified.

PART 3 - EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise GE's representative of any discrepancy before performing the work.

3.2 PREPARATION

Pipe and equipment openings shall be closed with caps or plugs during installation. Equipment shall be protected from dirt, water, and chemical or mechanical damage. Pipe and fittings shall be inspected before exposed piping is installed. Clean the ends of pipes thoroughly, remove foreign matter and dirt from inside of pipes, and keep piping clean during and after laying.

3.3 EXPOSED PIPING INSTALLATION

Exposed piping shall be run as straight as practical along the alignment shown on the contract drawings and with a minimum of joints. Piping and appurtenances shall be installed in conformance with reviewed shop drawings, manufacturer's instructions and ASME B31.3. Piping shall be installed without springing or forcing the pipe.

A. Piping Flexibility Provisions

Thrust protection shall be provided as required. Flexible couplings and expansion joints shall be installed at connections to equipment, and where shown on the contract drawings. Additional pipe anchors and flexible couplings beyond those shown on the contract drawings shall be provided to facilitate piping installation, in accordance with reviewed shop drawings.

B. Couplings, Adapters and Service Saddles

Pipes shall be thoroughly cleaned of oil, scale, rust, and dirt in order to provide a clean seat for gaskets. Gaskets shall be wiped clean prior to installation. Flexible couplings and flanged coupling adapter gaskets shall be lubricated with the manufacturer's standard lubricant before installation on the pipe ends. Couplings, service saddles, and anchor studs shall be installed in accordance with manufacturer's instructions. Bolts shall be tightened progressively, drawing up bolts on opposite sides a little at a time until all bolts have a uniform tightness. Torque-limiting wrenches shall be used to tighten bolts.

C. Piping Equipment/Component Installation

1. Piping components and indicators shall be installed in accordance with manufacturer's instructions. Required upstream and downstream clearances,

isolation valves, and miscellaneous devices shall be provided for an operable installation. The upstream and downstream lengths of undisturbed piping shall be in accordance with flow indicator manufacturer's recommendations.

2. Local Indicators: All direct-reading indicator devices and pressure gauges shall be installed so that they can be easily read from floor level, and are readily accessible for maintenance and service. Pressure gauges and shall be installed where indicated in the contract drawings. Differential pressure gauges shall be installed across the process equipment indicated in the contract drawings, in accordance with the manufacturer's recommendations, and arranged for easy observation.

D. Pipe Flanges

Pipe flanges shall be set level, plumb, and aligned. Flanged fittings shall be installed true and perpendicular to the axis of the pipe. The bolt holes shall be concentric to the centerline of the pipe and shall straddle the vertical centerline of the pipe.

E. Valve Locations

Valves shall be located in accordance with the contract drawings where actuators are shown. Where actuators are not shown, valves shall be located and oriented to permit easy access to the valve operator, and to avoid interferences.

F. PVC Pipe Installation

All PVC pipe shall be cut, made up, and installed in accordance with the pipe manufacturer's recommendations. Solvent-cemented joints shall be constructed in accordance with ASTM D 2855. Pipe shall not be laid when the temperature is below 40.1 degrees F or above 90 degrees F when exposed to direct sunlight. Any pipe installed above grade and outdoors shall be ultraviolet (UV) resistant. The pipe ends that are to be joined shall be shielded from direct sunlight prior to and during installation. Adequate ventilation shall be provided when working with pipe joint solvent cement and the handling of solvent cement. Provide and install supports and hangers in accordance with the manufacturer's recommendations. All lines shall be hydrostatically tested at the maximum operating pressures.

3.4 DOUBLE WALL PIPING INSTALLATION

A. All underground and exposed double wall pipe shall be installed as shown on the drawings and as per manufacturer’s recommended procedure.

3.5 CONNECTING DISSIMILAR PIPE

Flexible transition couplings, dielectric fittings and isolation joints shall be installed in accordance with the manufacturer's instructions.

3.6 FLEXIBLE JOINTS AT CONCRETE STRUCTURES

Flexible joints shall be provided at the face of all structures, whether or not shown on the contract drawings. Rubber ring joints, mechanical joints, flexible couplings, and proprietary restrained ductile iron pipe joints shall be considered flexible joints; welded pipe joints shall not. Joints

may be flush with the structure face or may be located up to 1 pipe diameter away from face, but not further than 17.7 inches away from face. For pipelines larger than 18 inch in diameter the first joint shall be within 1 pipe diameter.

3.7 PENETRATIONS

Steel pipe sleeves shall be hot-dipped galvanized after fabrication for above grade applications in non-submerged areas. For below grade, or in submerged and damp environments, steel pipe sleeves shall be lined and coated. Wall pipes shall be securely supported by form work to prevent contact with reinforcing steel and tie-wires. Joints shall be caulked with rubber sealant or sealed with a wall penetration seal. For existing concrete walls, rotary drilled holes may be provided in lieu of sleeves.

3.8 VALVE INSTALLATION

Flanged valve bolt holes shall be installed so as to straddle the vertical centerline of pipe. Flanged faces shall be cleaned prior to inserting the gasket and bolts, and then the nuts shall be tightened progressively and uniformly. Threaded ends shall have the threads cleaned by wire brushing or swabbing prior to installation.

A. Valve Orientation

The operating stem of a manual valve shall be installed in a vertical position when the valve is installed in horizontal runs of pipe having centerline elevations 4.5 feet or less above finished floor, unless otherwise shown on contract drawings. The operating stem of a manual valve shall be installed in a horizontal position in horizontal runs of pipe having centerline elevations between 4.5 feet and 6.75 feet above finish floor, unless otherwise shown on contract drawings. Automatic valves shall be installed in accordance with the manufacturer's instructions.

3.9 AIR RELEASE, DRAINS AND SAMPLE PORTS

Sample ports shall be provided where indicated on the contract drawings. Install specified vents at piping high points for entrapped air release and install drains in the low points of pipelines regardless of whether shown on contract drawings.

3.10 PIPING SUPPORT SYSTEMS INSTALLATION

The absence of pipe supports and details on the contract drawings shall not relieve the Contractor of responsibility for sizing and providing supports throughout plant.

A. General Support Requirements

Large or heavy valves, fittings, and/or equipment shall be supported independently of associated piping. Pipes shall not be supported off other pipes. Supports shall be provided at piping changes in direction or in elevation, adjacent to flexible joints and couplings, and where otherwise shown on the contract drawings. Pipe supports and hangers shall not be installed in equipment access areas. Hanging pipes shall be braced against horizontal movement by both longitudinal and lateral sway bracing. Existing support systems may be used to support additional new piping only if the Contractor can demonstrate that the existing support systems are adequate for the additional loads, or if the existing systems are strengthened to support the additional loads. Pedestal type pipe

supports shall be provided under base flanges adjacent to rotating equipment and where required to isolate vibration.

B. Support Methods

Piping support and spacing shall be provided as specified and as shown in the contract drawings, in addition to supplemental support as needed in the field. Single horizontal suspended piping shall be supported by adjustable swivel-ring hangers. Multiple horizontal suspended piping shall be supported by trapeze hangers with channel type supports. Horizontal pedestal mounted piping shall have saddle type supports. Horizontal wall mounted piping shall have wall brackets. Vertical piping shall be supported by wall brackets, base elbows, or riser clamps on floor penetrations.

3.11 FIELD QUALITY CONTROL

A. Exposed Piping

1. Hydrostatic testing shall be conducted in accordance with ASME B31.3. Piping systems shall be tested under normal service conditions (as indicated in the Pipe Schedule in the contract drawings) to demonstrate compliance. The test pressure shall not be less than 1.5 times the design pressure. Water shall be used as the hydrostatic test fluid. Provide clean test water of such quality to prevent corrosion of the piping system materials. Air release vents shall be opened at all high points of the piping system in order to purge air pockets while the piping system is filling.

2. Tests for above ground pressure piping shall be conducted after the piping has been completely installed, including all supports, hangers, and anchors, and inspected for proper installation but prior to installation of insulation.

B. Pipe Leakage Tests

1. Leakage testing shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the piping shall be subjected to not less than 200 psig pressure. Leakage is defined as the quantity of the test liquid, water that is supplied to the piping system, or any valved or approved section thereof, in order to maintain pressure within 5 psi of the specified leakage test pressure after the piping has been filled with the test liquid and all air is expelled. No piping installation will be accepted if leakage exceeds the allowable leakage determined by the following formula:

   a. L = Cf x N x D x P0.5
   b. Cf = conversion factor = 0.0001351
   c. L = allowable leakage, gallons per hour
   d. N = number of joints in the length of piping tested
   e. D = nominal pipe diameter, inches
   f. P = average test pressure during the test, psig.

2. Should any test disclose leakage greater than that allowed, the leaks shall be located and repaired until the leakage is within the specified allowance, without additional cost.

C. Leak Testing Air Lines

Following installation of the carbon steel piping, the piping shall be checked for leaks at joints. An air pressure of 1.5 times the system pressure shall be applied within the pipe and soap water shall be applied to pipe joints. Any bubbling of the soap water will indicate pipe leaks. All leaks shall be fixed by the CONTRACTOR.

D. Testing New to Existing Connections

New piping connected to existing pipe, existing equipment, existing treatment systems, or tanks and treatment systems furnished under other Sections shall be tested. Isolate the new piping with pipe caps, spectacle blinds, or blind flanges. The joint between new piping and existing piping shall be tested by methods that do not place the entire existing system under the test load. Proceed then, with the testing of new piping systems as specified herein.

E. Valve Testing

Valves may either be tested while testing pipelines. It shall be demonstrated that valves open and close smoothly with operating pressure.

3.12 FINAL CLEANING

Following assembly and testing, and prior to final acceptance, piping systems shall be flushed with water to remove accumulated construction debris and other foreign matter. The piping shall be flushed until all foreign matter is removed from the pipeline. Provide all hoses, temporary pipes, ditches, and other items as required to properly dispose of flushing water without damage to adjacent properties. The minimum flushing velocity shall be 2.5 fps. Accumulated debris shall be removed through drains, or by removing spools or valves.

3.13 WASTE WATER DISPOSAL

All wastewater shall be disposed of at the treatment plant.

3.14 MANUFACTURERS' FIELD SERVICES

Obtain manufacturer's technical assistance for installation dual containment piping and ductile iron piping.

END OF SECTION 15449

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This Section includes items related to the Electrical and Instrumentation Sections required to perform the work indicated and specified in those Sections.

1.3 PERMITS AND INSPECTIONS

A. Contractor shall arrange and pay for all inspections specified herein or required by all agencies having jurisdiction and furnish required certificates of inspection to Owner, including electrical certificate from State-licensed agency.

1.4 CODES AND STANDARDS

A. The installations shall conform to all applicable codes and standards. The construction of the systems indicated and called for in these specifications shall be performed in accordance with standard practices, except as otherwise indicated or specified. The Contractor shall be responsible for obtaining the necessary information to comply with these requirements. Any modification of the drawings or specifications that may be necessary to meet these requirements must be approved by the Engineer/Architect or authorized representative before they are made.

B. The Contractor shall give all notices and comply with all laws, ordinances, codes, rules and regulations bearing on the conduct of the work as drawn and specified. If the Contractor observes that the drawings and/or specifications are at variance therewith, he shall promptly notify the Engineer/Architect in writing of any necessary changes of work. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, codes, rules and regulations and without such notice to the Engineer/Architect, he shall bear all costs arising there from.

C. Requirements of the following organizations shall be considered minimum:

1. National Electrical Code
2. National Electrical Safety Code
3. Local Utility Company
4. OSHA
5. Local City and County Codes

1.5 ELECTRICAL ABBREVIATIONS, REFERENCES AND DEFINITIONS

A. Abbreviations and symbols herein and on Drawings are in accordance with ANSI Standard Y1.

B. References to technical societies, trade organizations and governmental agencies in the Electrical Division are in accordance with the following:

1. ANSI - American National Standards Institute
2. ASTM - American Society for Testing Materials
3. IEEE - Institute of Electrical and Electronics Engineers, Inc.
4. NEC - National Electrical Code
5. NEMA - National Electrical Manufacturers Association
6. NFPA - National Fire Protection Association
7. OSHA - Occupational Safety and Health Administration
8. UL - Underwriters' Laboratories, Inc.

1.6 TESTS

A. Arrange and pay for all tests. Notify Engineer/Architect three (3) working days before tests are made. Conduct tests in presence of Engineer/Architect or authorized representative. Repeat tests after defects are corrected.

B. Prior to tests, provide feeders and branch circuits continuous from main distribution panel to outlets, fixtures and equipment.

C. Demonstrate system is free from short circuits and properly grounded.

D. Check all motors for correct rotation.

E. Test load balance as specified herein.

1.7 SYSTEM OPERATION INSTRUCTIONS

A. Field Instruction

1. After all tests and adjustments, Contractor shall instruct attendant or Owner's representative in all details of operation of distribution.

2. Supply attendants to operate the systems until Engineer/Architect is satisfied that the systems have been installed in accordance with these Drawings and Specifications and are functioning properly.

3. Provide services and equipment manufacturer's engineer to instruct representative of Owner in operation and maintenance of Electrical equipment.

B. Written Instruction

1. Provide printed instructions and diagrams covering operation and maintenance of each item of equipment required under this project as per Division requirements.
2. Instructions furnished in bound covers and posted at locations designated by Engineer/Architect or authorized representative.

1.8 DRAWINGS AND SPECIFICATIONS

A. The drawing and specifications shall be considered mutually complementary to the completion of the electrical installation. Items shown on the drawings and not detailed in the specifications or detailed in the specifications and not shown on the drawings shall be considered as both shown and specified.

1. Sufficient detail has been made in the preparation of the construction documents to allow electrical contractor and equipment vendors to prepare proposals on an acceptable electrical installation. No attempt has been made to detail items of installation that are self-evident, necessary as per code requirements or in other manner would compromise the electrical and instrument system operation and reliability.

2. The routing of conduits and locations of equipment are shown in locations desired and for final location. Such routings and locations are subject to final modifications as required to suit structural conditions and obstructions. Such proposed routing modifications shall be submitted to the Engineer/Architect before such changes are made.

3. The Contractor shall observe all necessary safety procedures as they apply to working on 600 Volt class equipment, conductors and terminations of energized and de-energized services, circuits and equipment on the project. The Contractor shall follow all recognized electrical safety standards and rules concerning working in close proximity to any energized lines.

B. Coordinate the installation of wiring, raceways, outlet boxes, sleeves, switches, etc., with other trades to eliminate conflicts and to provide proper clearances and access to equipment.

C. Record Documents of actual “as-built” layouts shall be submitted.

1.9 SHOP DRAWINGS

A. The Contractor shall secure descriptive drawings or catalog cuts of equipment to be furnished under his contract. He shall review these Shop Drawings for conformance to contract documents prior to submission to Engineer/Architect. No equipment shall be ordered until they have been reviewed by the Engineer/Architect and found to be in conformance with the Contract Documents.

B. Shop Drawings shall be in accordance with Section 01330.

1.10 MATERIALS AND EQUIPMENT REQUIREMENTS

A. Provide materials and equipment conforming to those specified herein. Manufacturers' names and catalog numbers are given to describe type, quality and design of material and equipment required.

B. All material and equipment shall conform to capacity, efficiency, design and material specified and shall meet dimension and space requirements. Sizes of materials and equipment indicated or specified are minimum requirements. The Contractor may use larger sizes to expedite the work provided that such change meets space requirements and does not result in additional installation, maintenance or operating cost to the Owner. Equipment or materials of the same type or classification, used for the same purpose, shall be the products of the same manufacturer.

C. All materials shall be new, of the best of their respective kind and shall conform with accepted standards of the trade in every case where such a standard has been established for the particular type of material in question. Equipment and accessories not specifically described or identified by manufacturer's catalog numbers shall be designed in conformity with applicable technical standards and specification of societies, organizations and/or agencies listed herein, suitable for maximum working pressure and shall have neat and finished appearance.

D. Materials and appliances of types for which there are UL standard requirements, listings or labels shall have such listing of UL, be so labeled, and shall conform to their requirements.

E. In all cases where a device or part of the equipment is herein referred to in the singular number, it is intended that such reference shall apply to as many such items as are required to complete the installation.

F. Contractor shall, without charge, replace any work or material that develop defects, except ordinary wear and tear, or fail to perform satisfactorily, within one (l) year from the date of final acceptance.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

Not Applicable

END OF SECTION 16010

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. Furnish the following electrical items as specified herein after:

1. Conductors/cables and wiring devices
2. Disconnect switches
3. Enclosures and junction boxes
4. Tape, tags, and stands
5. Specialty devices

PART 2 - PRODUCTS

2.1 CONDUCTORS/CABLES

A. Single Conductor

1. Lighting and receptacle conductors shall be 600 volt, 75 deg centigrade, THWN/THHN in aboveground conduits and XHHW-2 in underground conduits.

2. Lighting and receptacle circuits shall be No. 12 AWG minimum. Neutral conductors for lighting and receptacle branch circuits shall be white in color, ground conductors shall be green, hot conductors; black, red or blue unless indicated otherwise on drawing.

3. 600 volt single conductor wire for feeders, power and control wiring shall be type THHN/THWN in aboveground installations and type XHHW-2 wire in underground installations.

4. 600 volt multiconductor cable shall satisfy the requirements of NEC Article 340 and UL 1277 - Type TC power and control tray cables.

5. All branch circuit and feeder wiring in tunnel area shall be 600 volt, copper conductor, 90 deg C, moisture and sunlight resistant, Type TC cable.

6. Manufacturers: Cablec, ITT-Royal, Southwire or Okonite.

B. Instrumentation/Signal Cable

1. 600 volt, 90° C, Type TC, individual shielded pairs or triads, multiple pairs or triads individually and overall shielded, PVC jacketed construction.

2. 18 AWG, soft annealed stranded copper conductors, PVC insulation with nylon overcoat.
3. NEC Type TC listed. UL Subject 1277.
4. Shield type: 100% coverage, aluminum polyester foil or tape with drain wire.
5. Manufacturer: Belden, Coleman, Okonite, or Dekoron

2.2 CONDUITS

A. Galvanized Rigid Steel Conduit

1. Material: Hot dipped galvanized rigid steel.
2. Fittings: Cast metal, threaded fittings; 1-1/2" and larger, mogul type. (Zinc coupling or nonferrous metal fittings are not acceptable).
3. Standards: ANSI C80.1, ANSI C80.4.
4. Manufacturers: Spang, Triangle, Wheatland or Allied.

B. Electric Metallic Tubing

1. Material: Hot dipped galvanized steel.
2. Fittings: Connectors and couplings shall be rain-tight compression type made of steel; cast fittings and set screw type are unacceptable.
3. Standards: ANSI C80.3.
4. Manufacturers: Spang, Triangle, Wheatland or Allied

C. Polyvinyl Chloride Conduit

1. Material: Schedule 40 (PVC) and 80 (XPVC), polyvinyl chloride rigid conduit listed for 90ºC conductors or cable and use in direct sunlight.
2. Fittings: Coupling type.
3. Joints: Connections shall be made by solvent welding.
4. Standards: NEMA, UL, NEC, ASTM D1784.
5. Manufacturers: Carlon EPC-40 or 80 PVC, Triangle and Robroy.

D. Liquid-Tight Flexible Metallic Conduit

1. Flexible galvanized steel core with continuous copper ground in the convolutions covered with extruded polyvinyl chloride.
2. Connectors: Nylon insulated screw in ground core type connectors constructed of malleable iron Thomas & Betts Liquid-tight fittings or equal.
3. Manufacturers: Triangle, Electri-Flex or Robroy.

2.3 OUTLET BOXES & FITTINGS

A. Sheet Metal Boxes (Use Limited to EMT Raceway System)

1. Non-gangable 14 gauge galvanized steel knockout type. Minimum size shall be 4" x 2" deep unless otherwise specified. Boxes shall be 4-11/16" deep when served with one-inch conduit.

2. Manufacturers: Allied Metal, Steel City, RACO, Appleton or equal.

B. Non-Metallic Outlet Boxes, Fittings & Junction Boxes

1. Boxes shall be constructed of either high temperature PVC or polyester with reinforcing fiberglass.
2. Enclosures shall be NEMA 4 or 4X.
3. Screw covered boxes shall use stainless steel screws and brass threaded inserts in box.
4. Hinge covered boxes shall use either non-metallic or stainless steel hinges and latches.
5. Manufacturers: Carlon, Stahlin Bros., Hoffman, or Crouse Hinds.

C. Cast Boxes, Fittings and Conduit Bodies (Use For Rigid Steel and Rigid Aluminum Raceway System)

1. Standard general purpose cast aluminum type with threaded conduit entry, gaskets and covers.
2. Choice of body types shall be made to conform to installation requirements.
3. Aluminum metallic finish.
4. Manufacturers: Crouse Hinds, Appleton or Killark.

2.4 JUNCTION AND PULL BOXES

A. Smaller than 150 cubic inches: Standard outlet boxes with cover.

B. 150 cubic inches and larger: Construct same as cabinets and conforming to UL "Standards for Cabinets and Boxes".

C. Junction and pull boxes shall be:

1. NEMA Type 4X enclosure.
2. Type 316L stainless steel enclosure and exterior hardware.
3. Stainless steel hinged door clamps, hasp and suitable for padlocking, and neoprene gaskets.
4. External mounting brackets.
5. Manufacturers: Hoffman, Bulletin A4S or equal.

2.5 CONNECTORS AND INSULATING TAPE

A. Connectors

1. Conductors No. 8 and larger terminated and spliced with Burndy or T&B mechanical pressure connectors.
2. Conductors No. 10 and smaller terminated and spliced with insulated expandable live spring type twist-on compression type connector.
3. Connect conductors to apparatus by means of approved lugs or connectors as manufactured by Thomas & Betts or equal.

B. Insulating Tape

1. Vinyl plastic insulating tape, 0. 7 mil thick, Scotch 33+ or equal.
2. Apply at all joints and splices.

2.6 TAGS AND NAMEPLATES

A. Identify electrical conductors in boxes and cabinets with letters and numerals as manufactured by W.H. Brady, Cat. No. B-500 vinyl or equal with prior approval. Letters and numerals shall be black printing on a white vinyl background, 0.006 inches thick. Identification includes circuit number and panel designation.

B. Provide laminated plastic nameplates, black background, with 1/4" engraved white lettering with 2 each 3/16" holes for attachment with 1/4" No. 6 self-tapping sheet metal screws.

1. Panelboard nameplate shall be 4" x 1-5/8" x 1/16".
2. Motor controls and equipment: 2-1/2" x 3/4" x 1/16".

C. Panelboard nameplate shall include voltage and phase identification.

2.7 WIRING DEVICES

A. Wall switches: 20 ampere 120/277 volt, quiet type, brown bakelite housing, back and side wiring, single pole, two pole, three way or four way as indicated. GE Cat. Nos. 5951-1G, GE-5952-1G, GE-5953-1G, GE5954-1G.

B. Convenience outlets: 2 pole, 3 wire, 20 ampere, 125 volt, NEMA 5-20R. General purpose duplex grounding type, Hubbell Cat. No. HBL5362. Ground fault circuit interrupter (GFCI) duplex receptacle, Hubbell Cat. No. GF 5362A.

C. Wall plates: Standard duplex receptacles, smooth finish brown nylon plates, Hubbell Cat. No. P8X. Weatherproof type receptacle covers; Hubbell Cat. No. HBL5206WO for duplex and Hubbell Cat. No. WPFS26 for GFCI type. Standard wall switch covers, smooth finish brown nylon plates, Hubbell Cat. No. P1X. Weatherproof type wall switch, Hubbell Cat. No. HBL1795.

2.8 EQUIPMENT SUPPORTS AND STANDS

A. Design and construct supporting structures of strength to safely withstand stresses to which subjected and to distribute properly the load and impact over building.

2.9 DISCONNECT SWITCHES

A. Construction

1. Type: NEMA heavy duty Type HD, non-fused, except as indicated otherwise.
2. Terminal lugs: UL listed for copper cables and front removable.
3. Switch blades: Blades shall have quick make and quick break operating handle with dual cover interlock to prevent door opening in ON position.

4. Enclosure: NEMA 4X Exterior; NEMA 1 Interior.
5. Electrical interlock: One normally open contact on all switches on equipment served by power and control wiring.

B. Manufacturers: GE

2.10 EQUIPMENT ENCLOSURE

A. Freestanding vertical cabinet shall NEMA 12 construction and be labeled by Underwriters' Laboratories. The cabinet shall be constructed of 10-gauge thick sheet steel suitably braced internally for structural rigidity and strength. All exposed welds, seams or edges shall be ground smooth.

B. Cabinet shall be provided with full-length gasketed access doors with removable and fixed center posts. Doors shall be mounted with strong, continuous, piano type hinges and doors shall be provided with stainless steel pad lockable door handles, three point latches and hold open hardware. Provide louver plate kits (6 louver type) with filter assembly where indicated on the drawings. Provide electric heaters of the quantity and type as noted on the drawings.

C. Interior flat panels shall be provided for mounting of electrical equipment indicated on the drawings.

D. Cabinet construction shall comply with industrial standards UL 508, NEMA/EEMAC Type 12 ANSI E.I.A RS-310-D.

E. Interior finish shall be white, and outside finish shall have polyester urethane powder coating. Color to be selected by Engineer/Architect.

F. Manufacturer: Hoffman Bulletin A28 or equal.

PART 3 - EXECUTION

3.1 CONDUIT CLASSIFICATION

A. XPVC conduit shall be used for wiring installed underground, in or under floors slabs and in tunnel except as indicated otherwise.

B. Rigid galvanized steel conduit shall be used for wiring installed exposed above grade.

C. EMT conduit shall be used for interior wiring.

D. Liquid-Tight metal conduit shall be used as follows:

1. For final connections to motors or other equipment subject to motion or vibration (length: 2 ft. max.).
2. For final connections to unit heaters and exhaust fans.

E. PVC conduit shall be used for underground primary services. Such conduits shall be encased in a concrete envelope as specified herein in paragraph titled: “CONCRETE ENCASED CONDUITS”. PVC conduit shall be converted to PVC coated rigid galvanized conduit 1 foot from exiting the encasement.

3.2 CONDUIT INSTALLATION

A. Install conduit in accordance with the following:

1. Generally conduits are to be installed:

a. Exposed inside the shaft and tunnels.

2. Minimum size conduit shall be 3/4". Other sizes shall be as indicated or required by the NEC for number and size of conductors installed.

3. All conduit joints shall be cut square, threaded, reamed smooth, and drawn up tight. Bends or offsets shall be made with an approved bender or hickey, or hub type conduit fitting. Number of bends per run shall conform to NEC limitations. All exposed field and factory installed threads are to have two coats of Zinc-Riche's ZR or Zinc-X applied after threads are cleaned of oil and grindings.

4. Concealed and exposed conduits shall be run with long sweep bends and offsets (parallel to and at right angles to building lines).

5. Conduits shall be continuous from outlet to outlet and from outlets to cabinets, pull or junction boxes, and shall be secured to all boxes with locknuts and bushings in such a manner that each system shall be electrically continuous throughout. Conduit ends shall be capped to prevent entrance of foreign materials during construction.

6. Conduit terminals at cabinets and boxes shall be rigidly secured with locknuts and bushings as required by the NEC. On all conduit 1-1/4" trade size and larger, bushings shall be of the installed or insulating with double locknut type as manufactured by Thomas & Betts or approved equal.

7. Conduit side entries into service cabinet shall be made with flanged unions for continuous raceway passage through cabinet wall.

8. All underground conduits entering service cabinet shall be effectively sealed to prevent water or moisture or any other foreign matter from entering.

9. Underground conduit system shall consist of wide sweep elbows and bends and shall be completely watertight. Unless noted otherwise, conduits shall be not less than 30" below finish grade for cables 600-volts and not less than 36" below finish grade for cables above 600-volts.

10. Routing of all underground conduits to be identified by placing a continuous plastic tape in the trench backfill six to eight inches below finished grade. The tape is to be non-biodegradable type plastic at least 4" wide, yellow in color, and imprinted with the legend "Caution - Buried Electric Line Below".

3.3 SUPPORTS AND HANGERS

A. Rigid metal conduit shall be supported in accordance with the National Electrical Code.

B. Conduits shall be supported by Robroy Industries fiberglass strut support system, or equal, consisting of threaded rod, strut, clamps, straps, fasteners, etc., for a complete non-corrosive system.

C. Where exposed conduit is installed on masonry or concrete walls, provide stand-off brackets to maintain a minimum ¼ inch air space between the conduit and mounting surfaces.

D. No electrical equipment (i.e., cabinets, enclosures, panelboards, etc.) shall be fastened directly to masonry surfaces or steel beams or columns. Lengths of nonmetallic strut support shall first be fastened to the structure, and then the electrical equipment fastened to the channel with metal fasteners designed for the purpose.

E. Where supporting channels are fastened to masonry walls, non-corrosive toggle bolts, expansion shields or through bolts shall be used.

F. Provide "supports" or "hangers" where required to fasten or support electrical equipment to the building as shown on the plans.

G. The required strength of the supporting equipment, and the size and type of anchors, shall be based on the combined weight of conduit, hanger and cables.

3.4 JUNCTION PULL AND OUTLET BOX INSTALLATION

A. Install boxes approximately where indicated:

1. Set boxes true and rigidly secure in position.

B. Provide boxes of sizes and types to accommodate the following:

1. Structural conditions
2. Size and number of conductors or cables entering
3. Device or fixture for which required.

3.5 CONDUCTOR INSTALLATION

A. Install conductors of size and number indicated or required in accordance with requirements of NEC.

1. Do not draw conductors into conduit until conduit is free from moisture and foreign debris.
2. Leave sufficient slack to permit connection of fixtures, switches and equipment without additional splices; 8" minimum.
3. Minimum wire size shall be 12 AWG for power and lighting circuits.
4. Minimum wire size shall be 14 AWG for control circuits.
5. 10 AWG conductors for 20 ampere, 120-volt branch circuits longer than 100 feet.

6. 10 AWG conductors for 20 ampere, 277-volt branch circuits longer than 200 feet.
7. A separate neutral conductor shall be installed for each 120 and 277 VAC circuit. Use of common neutral is not permitted.

B. Make taps and splices in wire as follows:

1. Conductors shall be square cut with a hacksaw or cable cutter without deforming the strands. Insulation shall be removed with a penciling cut to avoid nicking the strands, and surface oxides shall be removed by brushing exposed strands with a wire brush or card file. Where conductor bends are less than 8 times cable diameter, foregoing operations shall be done after bending.

2. Compression connectors shall be selected to fit the conductor.

3. Splice only in accessible pull, junction or outlet boxes.

4. Use mechanical wire splices and joints for #8 wire and smaller and AL/CU pressure connectors for #6 wire or larger.

5. Insulate joint at least 100% in excess of wire insulation.

C. Wire Color

1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:

   a. Black and red for single phase circuits at 120/240 volts.
   b. Black, red and blue for circuits at 120/208 volts single or three phase.
   c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.

2. For wires sizes 8 AWG and larger, use colored tape to identify wires at terminals, splices and boxes.

3. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.

4. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color-coded.

5. Feeder Circuit Conductors: Uniquely color code each phase.

6. Ground Conductors:

   a. For 6 AWG and smaller: Green.
   a. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.6 GROUNDING

A. Ground neutral of service and noncurrent carrying metallic parts of electrical system to the service grounding system.

1. Service to be grounded to ground rod and water service main.
2. Metallic parts to be grounded shall include cabinets, panelboards, conduit, outlet boxes, motor frames, control panels, transformers, and generators.
3. Bond with suitable ground clamps.
4. Provide all wiring, grounding conductors and grounding devices required to comply with NEC.
5. An electrician is responsible for the connectivity to the Telecommunication grounding bus system as per the NEC and J-STD-607-A.

B. Provide maximum resistance of 5 ohms.

3.7 CUTTING AND PATCHING

A. All cutting of concrete or other material for the passage of conduit shall be performed by the Contractor where necessary to install his work. Contractor will close all such openings around conduit with material equivalent to that removed. All exposed surfaces shall be left in suitable condition for refinishing without further work.

B. Where conduit passes through fire rated walls and floors, seal opening with fire resistant elastic adhesive compound.

C. No structural member shall be altered or cut without the special permission of the Engineer/Architect.

3.8 WIRING DEVICES

A. Where devices are indicated, install device complete with metallic outlet box. Ground connections between device and outlet box are required on both standard and self-grounding devices equipped with a ground terminal.

3.9 EXCAVATION AND BACKFILLING

A. Contractor shall perform all necessary excavation and backfilling required for the installation of their work.

B. Excavate bottom of trenches to exact depth, refill excavation below required grade of cable or raceway with firmly compacted sand. Deposit excavated materials on side of trench; do not leave material where it will interfere with traffic. Protect trenches and openings with signs, barricades, enclosures or flashing light.

C. Trenches shall not be backfilled until all required tests are performed and until the utilities systems, as installed, conform to the requirements for the installation of the various utilities. Trenches improperly backfilled shall be reopened to the depth required for proper compaction, then refilled and compacted as specified, or the condition shall be otherwise corrected as permitted by the Owner.

1. Lower Portion of Trench:

   a. Backfill material shall be deposited in 6-inch maximum thickness layers and compacted with suitable tampers to the density of the adjacent soil until there is a cover of not less than one foot. The backfill material in this portion of the trench shall consist of sandy clay, sand, gravel, soft shale, or other approved materials free from hard clods and stones larger than one inch in any dimension.

2. Remainder of Trench:

   a. The remainder of the trench shall be backfilled with material that is free of stones larger than 1 inch in any dimension. Backfill material shall be deposited in layers not exceeding the thickness specified, and each layer shall be compacted to the minimum density specified as applicable to the particular area.

   b. For installation involving directly buried cable, stones or pieces of paved surfacing larger than one inch in any dimension, or pieces of scrap cable, shall not be buried in the trench as a means of disposal.

   c. Routing of all underground conduits to be identified by placing a continuous plastic tape in the trench backfill 6" to 8" below finished grade. The tape is to be non-biodegradable type plastic at least 4" wide, red in color, and imprinted with the legend “Caution-Buried Electric Line Below”.

D. Construction shall be arranged so that trenches will be left open for the shortest practical time to avoid creating a hazard to the public and to minimize the likelihood of trench collapse due to other construction activity, rain, accumulation of water in the trench, etc.

3.10 CONCRETE ENCASED CONDUITS

A. Perform all necessary trenching and backfilling in accordance with procedures specified herein. Excavation and backfilling for the installation of concrete encased conduit envelopes shall be as follows:

1. Conduits shall be placed in trench neatly arranged as indicated and/or required. Horizontal and vertical separation shall be held captive by Carlon Snap-Loc or equal spacers proportionally spaced (max. 8'-0" spacing) for the length of installation.

2. PVC conduits shall be converted to rigid galvanized conduit at least 12 inches before leaving the encasement.

3. Concrete encasement shall be sized as required to provide a minimum of three (3) inches of concrete from all sides of raceway(s) and edges of encasement for both single and multiple conduit encasements. Top of encasement shall be not less than 30" below finish grade or finish grade of stone base under paved areas.

4. Concrete shall have 4000-psi compression strength at 28 days as per Section 03300.

5. Provide red dye on top surface of concrete for all electric duct banks.

3.11 ACCEPTANCE CABLE TESTING (SINGLE CONDUCTOR & MULTICONDUCTOR ASSEMBLIES)

A. Cables - Low Voltage (600 volts and less)

1. Visual and Mechanical Inspection

a. Cables to be inspected for physical damage and proper connection in accordance with single line diagram.
b. Cable mechanical connections shall be tested to manufacturer's recommended values with a calibrated torque wrench.

2. Electric Tests

a. Perform insulation resistance test on each cable with respect to ground and adjacent cables.
b. Perform continuity test to insure proper cable connections.

3. Test Values

a. Insulation resistance tests shall be performed at 1000 volts D.C. for one (1) minute.

b. When insulation resistance must be determined with all switchboards, panelboards, fuse holders, switches, and overcurrent devices in place, the insulation resistance when tested at 1000 volts D.C. shall be no less than the following:

MINIMUM INSULATION RESISTANCE

Conductor or Circuit Size	Minimum Resistance
No. 14 and 12 AWG	1,000,000 ohms
25 ampere circuits and above	250,000 ohms

3.12 EQUIPMENT CONTROL WIRING

A. Provide all wiring, conduit, and final connections for the interlock and control wiring of all equipment.

END OF SECTION 16050

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. Perform all work necessary and/or required and furnish all materials and equipment for a complete system of electrical service and distribution. Such work includes, but is not limited to, the following:

1. Coordination with National Grid for obtaining a new electric service. The electric service shall be rated 480Y/277 Volts, 1200 Amps, 3 Phase, 4 Wire with a pad-mounted transformer.

2. Complete system of power distribution for power, including, main breaker, panel boards, circuit breakers, and dry type transformers.

B. Section 16050 – Electrical Materials and Methods.

1.3 SUBMITTALS

A. Furnish Shop Drawings and descriptive data as per Section 01330, complete with project designation, for the following:

1. Panelboards and Circuit Breakers
2. Dry Type Transformers

1.4 SERVICE AND DISTRIBUTION TESTS AND INSPECTIONS

A. Contractor Responsibility: The Contractor shall provide all necessary supervision, labor, materials, tools, test instruments or other equipment or services and expenses required to inspect, test, adjust, set, calibrate, functionally and operationally check all work and components of the underground electrical systems throughout the installation. Also, the Contractor shall include the furnishing of sufficient personnel to assist operating forces in any additional checks they may require for acceptance, start-up and placing the equipment and systems into continuous service.

PART 2 – PRODUCTS

2.1 PANELBOARD AND CIRCUIT BREAKERS

A. Panelboards

1. Type: Factory assembled, dead front safety type.

2. Cabinet: Constructed in accordance with UL Standard 50 for cabinets, 30" minimum width, 14-gauge steel.

3. Door: Flush or surface type as required, with lock, two keys and typewritten directory.

4. Gutters: Sizes of gutters shall be in accordance with UL Standard 67 for panelboards; 5" minimum on top, bottom and sides.

5. Finish: Rust inhibiting primer and gray baked enamel finish.

6. Bussing assembly: Copper bus structure and main lugs or main breaker shall have current ratings as indicated. Ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or bus bar not to exceed 50° C rise above ambient and constructed in accordance with UL Standard UL 67. All bus work shall be constructed of copper.

7. Safety barriers: Main lugs, main breakers and bus structure shall be properly covered.

B. Circuit breakers

1. Type: Bolt on, quick make and quick break type with inverse time characteristics secured through use of bimetallic tripping element supplemented by magnetic trip.

2. Interrupting capacity: Minimum RMS symmetrical amperes rated shall be as indicated on drawings.

3. Tripping element: Non-interchangeable, non-removable type for 225 amperes and less: interchangeable type for over 225 amperes.

4. Tripping indication: Tripping indication shall be clearly visible by operating element assuming neutral position between "on" and "off".

5. Identification: Each breaker shall be identified by individual circuit number.

6. Multi-pole breakers: Breakers designed so that overload in one pole automatically causes all poles to open by means of common trip.

7. HACR breakers: Circuit breakers rated for use on feeding, heating, air conditioning and refrigeration equipment.

8. Motor Circuit Protector Type: Adjustable instantaneous trip circuit breakers. These circuit breakers shall contain a magnetic trip element in each pole with the trip point adjustable front the front of the breaker.

9. Branch circuit breakers feeding convenience outlets shall have instantaneous sensitive trip setting of not more than 10 times trip rating of breaker.

C. Standards: Panelboards shall be UL listed and bear UL Label.

D. Manufacturers: General Electric.

1. Distribution Panel – Spectra series.
2. Light & Power - Type A series

2.3 DRY TYPE TRANSFORMER

A. Construction:

1. Type: Totally Enclosed Ventilated Type general purpose type.

2. Taps: Transformer shall have two (2) 2-1/2 full capacity taps above and four (4) 2-1/2% full capacity taps below normal rated primary voltage.

3. Core and Coil: Manufactured from a high grade, non-aging, silicon steel with high magnetic permeabilites, low hysteresis and eddy current losses. Coils must be vacuum impregnated with non-hygroscopic, thermosetting varnish and have a final wrap of electrical insulation material designed to prevent injury to magnet wire. Visible magnet wire constructed coils will not be acceptable. The core and coil unit shall be isolated from enclosure by means of vibration absorbing mounts and be supported from base frame. Non-ventilated transformers to have an epoxy-resin encapsulated core and coil assembly. Aluminum windings.

4. Enclosure: Air ventilated transformer enclosures to be heavy gauge sheet steel, degreased, phosphatized and finished in baked enamel, NEMA 1 designed to be rodent, bird and tamper resistant

5. Insulation: Transformers 30 KVA and above shall be Class H, 115° C transformers and shall have the ability to carry a continuous 15% overload without exceeding 150° C rise above 40° C ambient.

B. Operation: Primary and transformed secondary voltages shall be as indicated.

C. Standards: Unit shall be tested in accordance with NEMA, meet ANSI Standards and to be UL listed.

D. Manufacturers: Type QL (General Purpose).

PART 3 - EXECUTION

3.1 ELECTRIC SERVICE INSTALLATION

A. Contractor shall coordinate with National Grid for the new service work.

B. Provide all materials and perform all work indicated and or as required to maintain electric power to the existing facilities while new construction is being performed.

C. Contractor shall perform all required excavation and backfilling for installation of conduits. Trench shall be made as per dimensions shown on drawings. Backfill material shall be deposited in 6-inch maximum thickness layers and compacted with suitable tempers to the density of adjacent soil until there is a cover of not less than one foot. The backfill material in this portion of trench shall consist of clean sand. The remainder of trench shall be filled with material that is free from stones larger than 1-inch diameter.

D. Place a continuous, red, non- biodegradable plastic warning tape 6”-8” below grade with imprint” CAUTION BURIED ELECTRIC LINE BELOW” along entire length of trench.

3.2 PANELBOARD INSTALLATION

A. Install panelboard in accordance with manufacturer's recommended procedures. Provide necessary protection during construction period to insure against mechanical damage and dust accumulation.

B. Field tests prior to energization:

1. Megger check of phase to phase and phase to ground insulation level.
2. Continuity.
3. Short Circuit.

C. Adjust operating mechanisms for free mechanical movement. Tighten bus connections and mechanical fasteners. Touch-up scratched or marred surfaces to match original finish.

D. Connect panelboard branch circuit loads so that the load is distributed as equally as possible between the phase busses.

E. Type circuit directories giving location and nature of load served. Install circuit directories in each panelboard.

F. Install markers on the front cover of all panelboards, which identify the voltage rating. Markers shall be made of self sticking B-500 vinyl cloth printed with black characters on an Alert Orange background, 2-1/4-inch high by 9-inch wide, Style A as manufactured by W.H. Brady Co. or equal.

G. Install a 1-inch by 3-inch laminated plastic nameplate with 1/4-inch white letters on a black background on each panelboard. Nameplate lettering shall be as shown on the Drawings. Nameplates shall be stainless steel screw mounted.

3.3 GROUNDING

A. Grounding electrode system shall be installed in accordance with the NEC and shall consist of the following:

1. Ground rods shall be copper clad steel and be a minimum of 3/4" Dia. x 10'-0" long. (Cadweld or Burndy).

B. Electrical System Ground: Bond neutral as indicated on drawings, and all non-current carrying metallic parts of electrical system to the grounding electrode system.

END OF SECTION 16400

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This section describes materials and installation requirements for transient voltage surge suppressors (TVSS) for the protection of all AC electrical circuits from the effects of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and/or capacitive load switching.

B. A surge suppressor herein described shall be provided installed where indicated.

1.3 SUBMITTALS

A. Shop drawings, product data and manufacturer's installation instructions shall be submitted as per Section 01330.

B. The submittals shall include:

1. Dimensional drawing of each suppressor type.
2. UL 1449, Standard for Safety, Transient Voltage Surge Suppressors, listing documentation.
3. UL 1283, Electromagnetic Interference Filters, listing documentation.
4. IEEE C62.41-1991 Category C3 (20 kV - 1.2/50s, 10 kA - 8/20s waveform clamping voltage test results.

1.4 MANUFACTURERS

A. Manufacturers: Suppressor shall be GE TRANQUELL SERIES

PART 2 - PRODUCTS

2.1 TVSS

A. Suppressors shall be listed in accordance with UL 1449, Standard for Safety, Transient Voltage Surge Suppressors, and UL 1283, Electromagnetic Interference Filters.

B. Suppressors shall be tested with the category C3 high exposure waveform (20 kV - 1.2/50s, 10 kA - 8/20s) per ANSI/IEEE C62.41- 1991.

C. Suppressors shall incorporate copper bus bars (electrical grade copper 1.5" wide, 0.25" thick) for the surge current path. Small gauge round wiring, plug-in type connections, or printed circuit boards shall not be used in the path for surge current diversion. Surge current diversion modules shall use bolted connections to the bus bars for reliable low impedance connections.

D. Suppressors shall be constructed using field replaceable surge current diversion modules (MOV based). Each module shall be fused with user replaceable 200,000 AIC rated fuses. The status of each module shall be monitored and indicated on the front of the suppressors enclosure as well as on each module.

E. All encapsulated suppressors, whether modular or chase nipple units, shall utilize an encapsulant that is UL listed and holds a 94-V2 fire retardant rating. No encapsulant compounds that incorporate epoxy shall be allowed.

F. Suppressors shall provide redundant suppression modules between each phase conductor and neutral, and between the neutral conductor and ground.

G. Suppressors shall be equipped with an audible alarm that shall activate when any one of the surge current modules have failed. An alarm on/off switch shall be provided to silence the alarm. An alarm push-to-test switch shall be provided to test the alarm. The switches and alarm shall be located on the front cover of the suppressors enclosure.

H. Suppressors shall meet or exceed the following criteria:

1. Maximum single impulse current rating shall be no less than 320 kA per phase for MCCB and 160 kA per phase for MCCR and MCCPS. The manufacture must provide documented proof of independent third-party verification of single impulse current withstand capabilities.

2. Pulse life test: Capable of protecting against and surviving 5000 ANSI/IEEE C62.41 Category C3 transients without failure or degradation of UL 1449 clamp voltage by more than 10%.

3. The suppressor shall have a response time no greater than one nanosecond for any of the individual protection modes.

4. Suppressors shall be designed to withstand a maximum continuous operating voltage (MCOV) of not less than 115% of nominal RMS voltage.

5. Visible indication of proper suppressor connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable/

6. Terminals shall be provided for all of the necessary power and ground connections. Each terminal shall accommodate wire sizes of #8 to #1 AWG.\

7. Suppressors shall have a minimum EFI/RFI filtering of 34 dB at 100 kHz with an insertion loss ratio of 50:1 using Mil Std. 220A methodology.

8. Suppressors shall be manufactured in the United States. All major components shall also be of American manufacture.

9. Suppressors shall have a five-year warranty, incorporating unlimited replacements of suppressor parts if they are destroyed by transients during the warranty period.

10. Suppressors shall be equipped with the following items:

    a. A transient voltage surge counter shall be located on the diagnostic panel on the front cover of the enclosure. The counter shall be equipped with a manual reset and battery backup to retain memory upon loss of AC power.

    b. A DB-9 connector shall be provided along with dry contacts (normally open or normally closed) to allow connection to a remote monitoring system. The output of the dry contacts shall indicate a failure of a phase or the entire unit.

    c. An internal UL listed disconnect switch.

PART 3 - EXECUTION

3.1 MOTOR CONTROL CENTERS

A. Install TVSS where indicated, according to manufacturer's recommendations.
B. Suppressor's ground shall be bonded to the service entrance ground.

END OF SECTION 16473

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This section provides specification requirements for enclosed variable frequency drive controllers, herein referred to as AC Drives for use with NEMA® B design AC motors.
B. The AC Drive manufacturer shall furnish, field test, adjust and certify all installed AC Drives for satisfactory operation.

1.3 REFERENCES

A. ANSI®/NFPA® 70 - National Electrical Code® (NEC®).
B. ANSI C84.1 - Voltages Tolerances for North America.
C. CSA® C22.2 No. 14-M91 - Industrial Control Equipment.
D. NEMA ICS 6 - Industrial Control and Systems Enclosures.
E. NEMA ICS, Part 4 Overload Relays.
F. NEMA 250 Enclosures for Electrical Equipment.
G. NEMA ICS 2-321 - Electrical Interlocks.
H. NEMA ICS7 - Industrial Control and Systems Adjustable Speed Drives.
I. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection Installation and Operation of Adjustable Speed Drives.
J. UL® 50 - UL Standard for Safety Enclosures for Electrical Equipment.
K. UL 98 - UL Standard for Disconnect Switches.
L. UL 507 - UL Standard for Safety Electric Fans.
M. UL 508 - UL Standard for Safety Industrial Control Equipment.
N. UL 508C - UL Standard for Safety Power Conversion Equipment.
O. UL 991 - UL Standard for Safety Tests for Safety Related Controls employing Solid State Devices.
P. OSHA® 1910.95 - AC Drive Controller Acoustical Noise.
Q. Confirming to National Safe Transmit Association and International Safe Transmit Association Test for Packages Weighing 100 lbs. or Over.

1.4 SUBMITTALS

A. Submit shop drawings and description data in accordance with Section 01330.

1.5 QUALITY ASSURANCE

A. The AC Drive and all associated optional equipment shall be UL Listed according to UL508C Power Conversion Equipment. A UL label shall be attached inside each enclosure as verification.

B. The AC Drive shall be designed, constructed, and tested in accordance with NEMA, NEC, VDE, IEC standards.

C. All Drive door mounted pilot devices shall be tested to verify successful operation. Documentation shall be furnished upon written request of the Engineer/Architect.

D. The AC Drive shall be submitted to a hi-pot test with all enclosed devices mounted and wired, prior to shipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The AC Drive shall be Grundfos CU 300 series for the recovery well pumps and ITT PS 200 series for all other pumps.

2.2 GENERAL DESCRIPTION

A. The CU 300 series AC Drive shall provide:

1. Full control of the pump

2. Two-way communication with the pump

3. Possibility of adjusting the pressure

4. Alarm indication (LED) when service is needed

5. Possibility of starting, stopping and resetting the pump simply by means of a push-button.

6. The AC Drive communicates with the pump via mains borne signaling (Power Line Communication), meaning that no extra cables are required between the control unit and the pump.

7. The AC Drive shall provide the following indications:

a. Pump running indicator

b. System pressure setting

c. System ON/OFF

d. Button lock indicator

e. Dry-running indicator

f. Service needed in case of:

1) No contact to pump
2) Overvoltage
3) Undervoltage
4) Speed reduction
5) Over temperature
6) Overload
7) Sensor defective.

8. The AC Drive shall incorporate:

a. External signal input for pressure sensor.
b. Connection to an operating relay for indication of pump operation.

B. The ITT PS200 series AC Drive shall provide:

1. The AC Drive shall convert the input AC mains power to an adjustable frequency and voltage as defined below.

2. The AC Drive manufacturer shall use 6-Pulse PWM.

3. Application data:

a. The speed range shall be from a minimum speed of 0.0 Hz to a maximum speed of 300 Hz.

4. Environmental ratings:

a. The AC Drive shall be designed to operate in an ambient temperature from -15 to + 40° C (+5 to 104° F).

b. The maximum relative humidity shall be 95% at 40° C, non-condensing.

c. The AC Drive shall be rated to operate at altitudes less than or equal to 3,300 ft (1000 m). For altitudes above 3,300 ft, de-rate the AC Drive by 1.0% for every 300 ft (100 m).

5. Electrical ratings:

a. The AC Drive shall be designed to operate from an input voltage of 208 to 690 +/- 10% Vac.
b. The AC Drive shall operate from an input voltage frequency range of 48-63 Hz.
c. The displacement power factor shall not be less than .98 lagging under any speed or load condition.
d. The efficiency of the AC Drive at 100% speed and load shall not be less than 98%.

6. Operator interface:

   a. The operator interface terminal will offer the modification of AC Drive adjustments via a touch keypad. All electrical values, configuration parameters, I/O assignments, application and activity function access, faults, local control, adjustment storage, self-test and diagnostics will be in plain English. There will be a standard selection of four additional languages built-in to the operating software as standard.

   b. As a minimum, the selectable display outputs shall consist of automatic/manual mode selection, speed reference, output frequency, output current, line voltage, output power, energy consumed, run time, motor thermal state, drive thermal state, and motor speed.

   c. A keypad scrolling function shall allow dynamic switching between display variables.

   d. A programmable access code will limit access to programmable functions. A hardware selector switch will allow the terminal keypad to be locked out from unauthorized personnel.

   e. The keypad shall store in non-volatile memory up to four user configuration parameters. An operator shall have the ability to download a stored configuration to multiple AC Drives.

   f. There will be arrow keys that will provide the ability to scroll through menus and screens select or activate functions or increase the value of a selected parameter.

   g. A data entry key will allow the operator to confirm a selected menu, numeric value, or allow selection between multiple choices.

   h. A RUN key and a STOP key will command normal starting and stopping as programmed when the AC Drive is in keypad control mode. The STOP key must be active in all control modes.

   i. A user interface shall be available that is a Windows-based personal computer, serial communication link or detachable operator interface

   j. The keypad and all door-mounted controls must be Type 12 rated.

7. Control:

   a. External pilot devices shall be able to be connected to a terminal strip for starting/stopping the AC Drive, speed control and displaying operating status. All control inputs and outputs will be software assignable.

   b. Strategies for 2-wire or 3-wire control shall be defined within the software.

   c. The control power for the digital inputs and outputs shall be 24 Vdc.

   d. All logic connections shall be furnished on pull-apart terminal strips.

e. There will be two 4-20 ma analog inputs. The other analog input shall be 0 to 10 Vdc.

f. There will be seven isolated logic inputs.

g. There shall be two 4-20 ma analog current outputs.

h. Three voltage-free Form C relay output contacts will be provided.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that the location is ready to receive work and the dimensions are as indicated.

3.2 PROTECTION

A. Before and during the installation, the AC Drive equipment shall be protected from site contaminants.

3.3 INSTALLATION

A. Installation shall comply with manufacturer's instructions, drawings and recommendations.

END OF SECTION 16483

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. Perform all work necessary and/or required and furnish all materials and equipment for construction of a complete system of indoor and outdoor building lighting.
B. Consult Section 16050 for related work, materials and methods specified in that Section and the general provisions of Section 16010.

1.3 SUBMITTAL

A. Furnish shop drawings and descriptive data as per Section 01330, complete with project designation for all the light fixtures specified in this Section.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES

A. Provide lighting fixtures and lighting equipment as indicated and listed in "Lighting Fixture Schedule".

1. Connect fixtures and equipment to building electric wiring.
2. Provide any fixtures inadvertently omitted from schedule similar to those in corresponding locations or as directed.
3. Provide materials and accessories, whether or not specifically described of best grade of commercial manufacture.

B. The Contractor shall check final ceiling construction with type of recessed lighting fixtures specified and bring any discrepancies to Engineer/Architec's attention before fixtures are ordered.

C. Fixture parts constructed of aluminum, brass, bronze, copper, steel or other metal as required must be composition and temper required by manufacturing process involved.

1. Metal suitable for duty or function of particular fixture part.

2. Shells, canopies and husks constructed of not less than 22-gauge.

3. Parts 8" in diameter or larger constructed of not less than 20-gauge.

4. In cases where aluminum members are to be fastened to steel or other dissimilar metal parts, effectively break contact between them with insulation fiber, aluminum or bituminous paint.

5. All burs, fins and sharp edges must be removed from fixture parts before fixtures are assembled.

6. Canopies, holders, etc., spun or drawn in one piece unless otherwise indicated or noted.

7. Fixture requiring stems shall be provided and installed as recommended by fixture manufacturer.

8. Provide fixture chain for hanging of fixtures where indicated.

D. Provide manufacturer's standard finish on fixtures except as otherwise noted. "Color by Engineer" denotes that Engineer/Architect shall select color during shop drawing phase.

1. Reflecting surface of metal bowls and shades finished synthetic white, baked at 250°F or higher, except as otherwise noted.
2. Use of word "acrylic" in lighting fixture description means 100% virgin acrylic UV resistant, non-yellowing plastic.

E. Fasten exterior fixtures with brass screws and anchors.

F. All fixtures shall bear the UL label.

2.2 LAMPS

A. The Contractor shall provide lamps for all fixtures.

1. Fluorescent lamps: Provide GE ECOLUX, TCLP compliant, reduced mercury lamps with STARCOAT, 3500K, 75 CRI, T-8 type lamps unless noted otherwise. Compact fluorescent lamps shall have color temperature specified, 80 CRI minimum and shall be suitable for the fixture in which they are installed. Compact fluorescent lamps shall be Triplex Biax Plug-In type.

2. High Pressure Sodium Vapor: GE ECOLUX, Non-cycling, TCLP compliant clear bulb.

B. All fixtures shall have lamps in proper working order at time of final acceptance of building by Owner.

C. All lamps shall be as manufactured by GE Co.

2.3 FLUORESCENT LIGHTING

A. Lamp holders: Designed so that lamps may be inserted or removed easily, but hold lamps firmly in place.

B. Ballasts:

1. Type: Instant start for T8 type lamps, Rapid-start for other lamps. Both ballasts shall be electronic type, high power factor (over 90%) with sound rating "A", unless otherwise noted. Ballast shall have a maximum third harmonic distortion of 20%.

2. Operation: Ballasts shall operate lamps greater than 20,000 hertz.

3. Overload protection: Non-resetting thermal protectors; fuses not acceptable.

4. Ambient conditions: Contractor responsible for proper ballasts to meet ambient conditions.

5. Standards: Ballasts shall meet applicable ANSI, FCC & UL Standards.

6. Noise level: Ballasts shall have sound rating of “A”.

7. Ballast factor shall be 0.87 to 0.90.

8. Current Crest Factor to be 1.7 max.

9. Acceptable Manufacturers: Osram Sylvania, Magnetek and Advance.

PART 3 - EXECUTION

3.1 LIGHTING FIXTURE INSTALLATION

A. Supporting lighting fixtures from structure:

1. All troffer fixtures shall be tied at each corner to the ceiling grid.
2. All surface and stem suspension fixtures shall be anchored to the ceiling in a secure manner.
3. Provide suitable support independent of outlet boxes as required.
4. Supports for fixtures other than by outlet box shall be preset concrete inserts, or caulking anchors as required.
5. All surface mounting fixtures more than 18" wide, in addition to the support from the outlet box, shall be supported at, or near, each corner.
6. All supports for fixtures shall be furnished.

B. Polarize each fixture.

C. Fixtures shall be wired in strict accordance with latest requirements of NFPA.

1. Protect wiring with tape or tubing at all points where abrasion is liable to occur.
2. Conceal all wiring within fixture construction.
3. Do not locate splice or tap within arm or stem.
4. Install wire continuous from splice in outlet box on building wiring system to lamp holder or to ballast and from ballast to lamp holder.
5. Approved solderless connectors may be used in making connections in wiring within fixture or in connecting fixture wire to wiring of building.
6. No exposed wiring permitted on outdoor fixtures; conceal wiring in bases, poles or fixtures.

D. Lighting layouts indicated are generally diagrammatic and location of outlets and equipment is approximate; exact location of fixtures shall be governed by the physical conditions and adjustments to provide clearances with other trades.

END OF SECTION 16500

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This Section prescribes the general requirements for the design and installation of an electrical heat tracing system to prevent freezing of water throughout a pipe distribution system.

1.3 REFERENCES

A. The publications listed below form part of this specification. Each publication shall be latest revision and addendum in effect on the date this specification is issued for construction unless noted otherwise. Except as modified by the requirements specified herein or the details of the drawings, Work included in this specification shall conform to the applicable provisions of these publications.

1. National Electrical Code (NEC)

   NEC 427 – Fixed Electric Heating Equipment for Pipelines and Vessels

2. Institute of Electrical and Electronics Engineers (IEEE)

   IEEE 515 Recommended Practice For The Testing, Design, Installation And Maintenance of Electrical Resistance Heat tracing For Industrial Applications.

3. Underwriters Laboratories, Inc. (UL)

   746B Polymeric Materials

1.4 SUBMITTAL

A. Furnish shop drawings of heat tracing devices and panels as per Section 01330.

PART 2 - PRODUCTS

2.1 HEATER CABLE

A. The heating cable shall consist of two parallel #14AWG nickel-plated copper bus wires embedded in a semi-conductive polymer core that forms a continuous matrix heating element. A polyethylene dielectric insulating jacket is extruded over the heating element core.

B. The basic cable shall be covered by a metallic braid of tinned copper. The braid shall provide a nominal coverage of 80%.

C. The cable shall have an outer polyolefin over-jacket.

D. The cable shall be capable of being cut to a desired length to suit the installation conditions and must form a continuous heating circuit.

E. The self-regulating heating cable shall be capable of maintaining process temperatures up to 150º F and continuous exposure to temperatures of 185º F while de-energized.

F. All heating cables and accessories shall be listed or approved for use in Class I, Division 2, Group C and D locations by either Factory Mutual or Underwriters Laboratories.

G. The heating cable shall be type BSX as manufactured by Thermon Manufacturing Co. or equal by Raychem Chemelex.

2.2 CONTROL PANEL

A. A control panel shall be supplied to provide branch circuit protection, control and monitoring for the heat trace system. It shall be a non-classified rated, NEMA 4X stainless steel enclosure containing a main circuit breaker, branch circuit breakers, contractor, monitoring module, pilot lights, terminal blocks, etc, pre-wired for single point 120/208 VAC 3-phase, 4-wire power supply, heat trace circuit, thermostat and remote alarm signal connections. The panel shall have an interior hinged door with a high impact resistant, gasketed window for viewing the monitoring module. The main cabinet door shall have a full view, impact resistant, gasketed window for viewing all control components.

B. The following control devices shall be mounted on the hinged interior door:

1. Power Available pilot light.
2. Heater System On pilot light.
3. Alarm pilot light.
4. Hand-Off-Auto selector switch.
5. Alarm Acknowledge push button.
6. Lamp Test push button.
7. Control devices shall be Class 9001, Type K, as manufactured by Square D Co. or equal. Pilot lights shall be LED type.

C. The circuit breaker panelboard assembly shall be copper. Circuit breakers shall be 30ma equipment protection ground fault type, rated at 20 amperes (Square D type QO-EDP, UL Class B, or equal). For specific load conditions, circuit breakers may be rated as high as 30 amperes. Circuit loading shall not exceed 80 percent of the circuit breaker rating.

D. The monitoring module shall be a Thermon CVM-12, a twelve circuit microprocessor-based module designed specifically for multi-point heat tracing monitoring. It shall monitor loss of voltage in each heat tracing circuit. Alarm contacts shall be provide for local indication and for remote monitoring. The alarm contacts for remote monitoring shall be 5A, 240 VAC rated, single pole, double throw.

E. Temperature control shall be by a remote mounted ambient thermostat operating a 3 pole contactor applying power to the circuit breaker panel main lugs.

F. The heat tracing system shall operate automatically by the ambient temperature sensor in the automatic position. The hand position shall by-pass the temperature control for manual operation and for testing.

2.3 THERMOSTAT REQUIREMENTS

A. Thermostats for freeze protection shall be liquid filled thermostats each with a stainless steel ambient sensing bulb.

B. All thermostats shall have contacts rated for 20 amperes at 120 volts, 60 hertz , resistive loading.

C. Enclosure for the thermostats shall be NEMA standards for the environment and area classification.

D. All thermostats shall be field adjustable over their entire temperature range and temperature setpoint adjustment potentiometers for the thermostats shall be located inside the enclosure. The thermostat shall be set at 40º F for water freeze protection.

E. The thermostat shall be a Thermon Type B7-15140, adjustable ambient control with 22 amp 120 VAC rated SPDT contacts and attached sensing bulb in Nema 7/9 aluminum enclosure.

2.5 HEAT TRACE SYSTEM ACCESSORIES

A. Heating cable shall be attached to the pipe with high temperature polyester or glass cloth tape. Minimum width shall be 1/2 inch.
B. Power connection and end terminations included in kits shall provide both a water resistant connection and a low resistance bonding connection for the braid.
C. Weatherproof, adhesive backed caution label shall be at least three (3) inches high with 1/8" black letters on a yellow background.

2.6 HEATING POWER SUPPLY AND WIRING

A. Heater cable branch circuits shall be supplied from the control panel and each heater cable branch circuit shall be supplied by a separate circuit breaker.
B. Branch circuits shall be a conduit and wiring system as specified in Section 16050 - Basic Materials and Methods.

PART 3 - EXECUTION

3.1 TESTING

A. As a minimum, the heating cable shall be tested with a 1000 volt Meg-ohmmeter at the following times:

1. Prior to installation on piping.
2. After installation on piping, before application of thermal insulation.
3. After insulation and over-jacket have been installed, prior to energization.

B. The heating cable shall satisfactorily test to 2 meg-ohms.

C. Cable not passing the testing requirements shall be completely removed and replaced with new materials. No splicing shall be permitted.

3.2 INSTALLATION

A. The surface of the pipe or equipment on which the heater cable is to be installed shall be cleaned of any loose foreign material (scale, rust, or dirt).

B. All pipe pressure testing shall have been completed prior to beginning installation of the heat tracing cables.

C. The heater cables shall be positioned on the pipelines per manufacturer's details.

D. A loop of heater cable of the proper length shall be provided for flanges, valves and equipment on the pipeline. For added length, use supplier's standard valve, flange and instrument allowance.

E. The power connection kit for the heater cable shall be installed at the pipe surface with a strap on either side of the box.

F. The heater cable shall be installed parallel to the pipe in one continuous piece. No splicing shall be allowed.

G. The heater cable shall be installed to allow separation of pipe flanges, removal of valves, and equipment without removal of the heater cable from the pipe. See manufacturer's standard details for valves, flanges, pumps, etc.

3.3 DEMONSTRATION

A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
B. Review data in the operation and maintenance manual.

3.4 PROTECTION

A. Provide final protection and maintain conditions in a manner acceptable to Manufacturer and Installer to ensure that installed electric heating cables, including leads, are not damaged or crushed prior to Substantial Completion.

END OF SECTION 16856

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This section provides a detailed description of the process control and logic for the Phase 4 Design project.

B. Related instruments are specified under Section 16910. Programmable Controller (PLC) and input/output hardware are specified under Section 16930.

C. Related Sections include the following:

1. Section 16050: Basic Materials and Methods.

PART 2 - SYSTEM DESCRIPTION:

2.1 CONTROL SYSTEM ARCHITECTURE

A. The existing Treatment Plant Control System controls (2) process trains for treating recovery water prior to discharge to the Hudson River. Each process train has a main PLC [90-30 CPU 374] for controlling the process equipment. A PC based SCADA operator station [Proficy iFIX ver. 4.5] in the control room provides an operator interface to the process.

B. In the Pre-Treatment Building, a 90-30 PLC, connected by Genius Bus controls the pumps to the plant influent tanks. The Tunnel Drain Collection System [TDCS] is monitored from the control room, using Versamax remote I/O, over a fiber optic Ethernet link.

C. Phase 4 will add local PLC control to the Recovery Well pump stations RW-100, RW-103, RW-104, RW-105, and RW-110. These local PLCs will monitor the Recovery Well level and discharge flow and will control the recovery well pump speed PLC based on level setpoints entered by the operator at the control room SCADA station.

D. RW-103, RW-105 and RW-110 will communicate via RS-485, using Modbus RTU protocol to the train 2 main PLC in the treatment plant. A Modbus TCP protocol converter will be used to convert the RS-485 signal to Ethernet for communication with the main PLC.

E. RW-100 and RW-104 will communicate over a radio modem to an Ethernet protocol converter, located in the TDCS area, where it will be connected to the plant Ethernet network.

F. Phase 4 will also include de-commissioning the existing Pre-Treatment building. The existing Genius Bus, currently connecting the Pre-Treatment building to the main plant,

will be extended to a new North Basin pump station for control of the North Basin pumps.

G. An existing alarm dialer, located in the train 2 main PLC control cabinet will be configured to send messages for alerting plant personnel of alarm conditions during off-hours when the plant is unattended.

H. A motor operated valve (MOV) will be added to the TDCS pump station recirculation line to control the recirculation line flow.

2.2 PROCESS CONTROL DESCRIPTION

A. For Phase 4, monitoring and control of recovery wells/pumps RW-100, RW-103, RW-104, RW-105, and RW-110 will be added to the control system. The recovery well pumps operation will also be interlocked with the influent storage levels in the main plant and will shut-down based on Rail Car Pit high level.

B. A new DNAPL separator (T-1010), a new Feed Tank (T-1020) and (2) feed pumps (P-1020A and P-1020B) will be added to process recovery water prior to pumping the recovery water to the plant Influent Feed Tanks (T-2100 and T-2200). Overflow storage of the untreated process water will be provided by the new Rail Car Pit (T-1040).

C. The existing Pre-Treatment area will be de-commissioned and the North Basin (T-1030) will be re-purposed to hold plant storm water (roof leaders and drains) for processing as plant capacity is available.

D. The 250 gpm process train (Train 2) will be modified for continuous (24x7) unattended operation with an alarm dialer to notify the plant operator in event of process upset.

E. Recovery Well Monitoring and Control

1. There are (5) recovery wells (RW-100, RW-103, RW-104, RW-105, and RW-110) that will be monitored/controlled by the treatment plant control system. Each recovery well will include the following:

a. Each recovery well will include a DNAPL pump which is manually controlled separately from the process control system.
b. Each recovery well pumps will have continuous level probe and flow meter for monitoring the recovery well level and flow output.
c. A VFD will be used to control the recovery well pump speed in order to maintain the recovery well level at an operator selected level setpoint. The recovery well VFDs will also provide pump protection against running dry and other fault conditions.
d. A local PLC will be used to monitor and control each recovery well pump. The local PLC will monitor the recovery well level, flow, pump run status, and pump fault status for communication to the main plant PLC. The local PLC will also output a pump speed reference (output) to the VFD, for maintaining the recovery well level setpoint and will start/stop the pump based on operator input.
e. The Pump Start/Stop command will be interlocked with high-high RCP (T-1040) level signal (LSHH-1041) and with high-high Feed Tank (T-

1020) level signal (LSHH-1021) from the main PLC to shutdown the recovery well pumps in case of lack of treatment plant storage capacity.

f. At each recovery well pump station, a wall-mounted PLC control panel will be provided for monitoring/control for the recovery well pump

F. DNAPL Separator (T-1010)

1. A new DNAPL Separator (T-1010) will accept the recovery water discharge from the TDCS and from the recovery water pumps and will separate the DNAPL from the recovery water. The operator will manually check the DNAPL level in the DNAPLE separator and extract the DNAPL from the separator.

2. The DNAPL separator will overflow into a new Feed Tank (T-1020) for pumping into the plant influent tanks.

3. The total influent flow to the DNAPL separator is monitored by new flow meter FE/FT-1010.

4. A DNAPL separator bypass line to the plant influent tanks is provided to bypass plant flow for DNAPL separator maintenance. Flow though the bypass line is monitored by FE/FT-1010A.

5. There is an existing Motor Operated Valve (MOV-1020A) in the bypass line. This MOV does no control at this time and will be programmed to be always open

G. Feed Tank (T-1020) and Feed Pumps (P-1020A and P-1020B)

1. A new Feed Tank (T-1020) will take the overflow from the DNAPL Separator (T-1010) and serve as a pump tank for pumping the treated recovery water into the plant influent tanks (T-2100 and T-2200) with Influent Transfer Pumps P-1020A and P-1030B.

a. The Feed Tank (T-1020) will have a continuous level probe (LT-1020) which will be used to control the pump speed for the Influent Transfer Pumps.

b. The Feed Tank (T-1020) will have a High-High point level probe (LSHH-1021) to trigger an alarm dial-out in event of high-high level and shutdown of the RW pumps.

c. The Feed Tank will also have a Low-Low point level probe (LSLL-1021) for shut-down of the Influent Transfer Pumps P-1020A and P-1030B in case of Low-Low level, to prevent the pumps from running dry.

d. There will be (2) Influent Transfer Pumps (P-1020A and P-1030B) for pumping the treated recovery water from the Feed Tank (T-1020) to the Influent Tank (T-2100). These pumps will have VFDs and run on a primary/backup basis to maintain the Feed Tank (T-1020) level.

e. A flow meter (FE/FT-1020) on the discharge of the Influent Transfer Pumps (P-1020A and P-1030B) will monitor the treated recovery water flow to the plant Influent Feed Tanks (T-2100 and T-2200).

H. Plant Influent Feed Tanks (T-2100 and T-2200)

1. The existing plant Influent Feed Tanks (T-2100 and T-2200) serve as head-tanks for the plant process treatment. The (2) influent tanks have a cross-tie to equalize level between the two tanks.

2. The plant Influent Feed Tanks accept treated recovery water from the DNAPL separator, storm water from the North Basin (T-1030) and overflow water from the Rail Car Pit (T-1040).

3. Excess water in the Influent Feed Tanks (T-2100 and T-2200) will overflow by gravity to the Rail Car Pit (T-1040).

4. Each Influent Feed tanks has a continuous level probe (LT-2101 and LT-2201). The operator at the SCADA operator station selects which level signal is active.

5. Influent Feed Tanks Level setpoints, based on the active level signal, are used are permissives, to Start/Stop the North Basin (T-1030) pumps (P-1030A and P-1030B) and the Rail Car Pit (T-1040) pump (P-1040) and maintain the treatment plant flow rate.

6. The Influent Feed Tank Level is also used as a primary variable for increasing/decreasing the treatment plant flow rate, when in cascade mode (Refer to 250 pm Train Control Modifications).

I. North Basin (T-1030) and North Basin Pumps (P-1030A and P-1030B)

1. The North Basin provides storage for plant storm water (roof leaders and drains) until processing plant capacity is available. The North Basin includes the following control equipment:

   a. The North Basin (T-1030) has a continuous level probe for monitoring the North Basin level at the control Room SCADA operator station.
   b. The North Basin has a High-High Level point level probe (LSHH-1031) for triggering an alarm dial-out based in event of North Basin High-High Level.
   c. The North Basin will also have a Low-Low point level probe (LSLL-1031) for shut-down of the North Basin Pumps P-1030A and P-1030B in case of Low-Low level tank level, to prevent the pumps from running dry.
   d. There will be (2) North Basin Transfer Pumps (P-1030A and P-1030B) for pumping storm water into the plant Influent Feed Tanks (T-2100 and T-2200) for treatment by the treatment plant. These pumps will have VFDs will operate based on operator request from the treatment plant control room SCADA operator station.
   e. When a North Basin Transfer Pump (P-1030A or P-1030B) is requested to run by the plant operator, the pump will run, at the speed requested by the plant operator, on an ON/OFF basis, as enabled by the Influent Feed Tank level setpoints, until the pump is shut-down by the North Basin Low-Low level probe (LSLL-1031).

f. A flow meter (FE/FIT-1031) on the discharge of the North Basin Transfer Pumps (P-1030A and P-1030B) is used for monitoring the North Basin discharge flow at the control Room SCADA operator station.
g. A wall-mounted PLC remote I/O panel will be provided in the North Basin pump station for monitoring / control on the North Basin pumps

J. Rail Car Pit (T-1040) and Rail Car Pit Pump (P-1040)

1. The Rail Car Pit (T-1040) provides overflow storage capacity for the plant Influent Feed Tanks (T-2100 and T-2200). The Rail Car Pit (T-1040 includes the following control equipment:

a. The Rail Car Pit (T-1040) has a continuous level probe (LT-1040) for monitoring the Rail Car Pit level at the control Room SCADA operator station. Rail Car Pit High Level setpoints (LSH-1040) will be interlocked with the Recovery Well PLCs to stop the recovery well pumps on high Rail Car Pit (T-1040) level.
b. The Rail Car Pit (T-1040) has a High-High Level point level probe (LSHH-1041) for triggering an alarm dial-out in event of a Rail Car Pit High-High Level and for shut-down of the RW pumps and the North Basin pumps.
c. The Rail Car Pit (T-1040) will also have a Low-Low point level probe (LSLL-1031) for shut-down of the Rail Car Pit Pump P-1040 on Low-Low Rail Car Pit (T-1040) level, to prevent the pump from running dry.
d. A Rail Car Pit Pump (P-1040) will be used for pumping overflow plant influent water back into the plant Influent Feed Tank for treatment by the treatment plant. This pump will have VFD, The pump will operate based on operator request from the treatment plant control room SCADA operator station. The operator will also set the VFD speed from the treatment plant control room SCADA operator station
e. When the Rail Car Pit Pump (P-1040) is requested to run by the plant operator, The pump will run, on an ON/OFF basis, as enabled by the Influent Feed Tank level setpoints, until the pump is shut-down by the Rail Car Pit Low-Low level probe (LSSS-1041)

K. 250 GPM Process Train (Train 2) Modifications

1. To accommodate the lower flow rates required for treatment plant 24x7 operation. The one of the UV CHEMOX trains must be place on standby. The flow through the ’Standby’ process train is re-circulated back to the plant Influent Feed Tanks. The flow through the ‘Active’ UV CHEMOX train is passed on to the Air Stripper and the GAC and finally plant Effluent tank for discharge to the Hudson River.

2. The flow is balanced between the ‘Standby’ and ‘Active’ UV CHEMOX trains by proportioning valves FV-5630 and FV-5631. In the existing program, these valves are manually positioned by the operator from the control room SCADA operator station.

3. For Phase 4, the PLC program will be modified to position these valves to maintain the 'Active' UV CHEMOX train flow either: 1) based on a flow setpoint entered by the operator ('Local Mode'), or 2) based on a flow setpoint determined by the Influent plant Feed Tank level ('Cascade' mode).

L. TDCS Recirculation Line MOV & Flow meter

1. A new Motor Operated Valve (MOV-407) will be added to the recirculation line in the TDCS sump. This valve will be an ON/OFF valve and will close-off the TDCS pump recirculation in the closed position. Reducing the pump recirculation flow and increasing the TDCS flow to the treatment plant.

2. This valve will be controlled based on TDCS Sump Level (LT-402). On high sump level, MOV-407 will close, increasing the TDCS flow to the treatment plant. On Low sump level, MOV-407 will open, increasing the recirculation flow and thus reducing the TDCS flow to the treatment plant.

3. A new flow meter (FE/FIT-400) will be added on TDCS pumps discharge line inside a valve vault for measuring and displaying that flow on the SCADA operator station in the plant control room.

M. Tail Race + Recovery Well 104 Flow

1. The Tail Race and Recovery Well 104 are currently routed to the TDCS sump. A new flow meter (FE/FIT-104A) will be added in the TDCS tunnel for measuring and displaying that flow on the SCADA operator station in the plant control room.

N. Alarm Dial-Out

1. There is an existing Alarm Dialer mounted in the 250 GPM Main Control Panel that is currently un-configured and is not connected to an outside phone line. For 24x7 operation of the treatment plant, this auto-dialer will be connected and configured. Conditions which trigger alarm callout to include:

   a. Feed Tank (T-1020) High-High Level (LSHH-1021).
   b. North Basin (T-1030) High-High Level (LSHH-1031).
   c. Rail Car Pit (T-1040) High-High Level (LSHH-1041).
   d. TDCS Sump High Sump Level (Based on High Alarm Setpoint on LT-402)

O. SCADA HMI Monitoring

1. Graphics will be added to the SCADA HMI for monitoring / control of:

   a. The Recovery Wells and North Basin Flows and Levels
   b. DNAPL Separator, Feed Tank and Rail Car Pit
   c. Pump / VFD Runtimes
   d. Trending of Level and Flow Values
   e. Display of 125 train GAC, RayOX and GAC status.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of all instruments shall be in accordance with the manufacturer's recommended procedures. Provide necessary protection during construction period to insure against mechanical damage or dust accumulation.

B. Equipment power wiring and wiring between field devices and control panels, unless specifically noted to be included under this Section, shall be as per Section 16050.

C. PLC program modifications and SCADA system / display changes will be implemented as part of system commissioning and are not part of this Installation scope.

GE HUDSON FALLS TDCS Phase 4 Design											
I/O List (Recovery Well Pump Station RW-100)											
Inst.	**Tag**	**Description**	**AI**	**AO**	**DI**	**DO**	**Location**	**PLC Signal**	**Power**	**Range/Units**	**Comments**
LT-100	LI-100	Recovery Well RW-100 Level	1				RW-100	4-20ma	loop-power	0-100 psi	Pressure Transmitter
FT-100	FI-100	Recovery Well RW-100 Flow	1				RW-100	4-20ma	4-wire, 120vac	0-50 gpm	Badger Flow Meter
SC-100	SC-100	Recovery Well RW-100 Speed Reference		1			RW-100	4-20ma	4-wire	0-100%	Grundfos CU-300 VFD, SPD Ref.
YA-100	YA-100	Recovery Well RW-100 Pump Alarm			1		RW-100	DI	24vdc	FAULT	Grundfos CU-300 VFD, K1
YI-100	YI-100	Recovery Well RW-100 Pump Running			1		RW-100	DI	24vdc	RUN	Grundfos CU-300 VFD, AUX
HS-100	HS-100	Recovery Well RW-100 Local AUTO Status			1		RW-100	DI	24vdc	AUTO	RW-100, HS-1
YC-100	YC-100	Recovery Well RW-100 Pump START				1	RW-100	DO	Dry Contact	START	Grundfos CU-300 VFD, START
N/A	N/A	RW-100 PLC Panel					RW-100				See DWG I-2 through I-6
I/O List (Recovery Well Pump Station RW-103)											
Inst.	**Tag**	**Description**	**AI**	**AO**	**DI**	**DO**	**Location**	**PLC Signal**	**Power**	**Range/Units**	**Comments**
LT-103	LI-103	Recovery Well RW-103 Level	1				RW-103	4-20ma	loop-power	0-75 psi	Pressure Transmitter
FT-103	FI-103	Recovery Well RW-103 Flow	1				RW-103	4-20ma	4-wire, 120vac	0-50 gpm	Badger Flow Meter
SC-103	SC-103	Recovery Well RW-103 Speed Reference		1			RW-103	4-20ma	4-wire	0-100%	Grundfos CU-300 VFD, SPD Ref.
YA-103	YA-103	Recovery Well RW-103 Pump Alarm			1		RW-103	DI	24vdc	FAULT	Grundfos CU-300 VFD, K1
YI-103	YI-103	Recovery Well RW-103 Pump Running			1		RW-103	DI	24vdc	RUN	Grundfos CU-300 VFD, AUX
HS-103	HS-103	Recovery Well RW-103 Local AUTO Status			1		RW-103	DI	24vdc	AUTO	RW-103, HS-1
YC-103	YC-103	Recovery Well RW-103 Pump START				1	RW-103	DO	Dry Contact	START	Grundfos CU-300 VFD, START
N/A	N/A	RW-103 PLC Panel					RW-103				See DWG I-2 through I-6
I/O List (Recovery Well Pump Station RW-104)											
Inst.	**Tag**	**Description**	**AI**	**AO**	**DI**	**DO**	**Location**	**PLC Signal**	**Power**	**Range/Units**	**Comments**
LT-104	LI-104	Recovery Well RW-104 Level	1				RW-104	4-20ma	loop-power	0-75 psi	Pressure Transmitter
FT-104	FI-104	Recovery Well RW-104 Flow	1				RW-104	4-20ma	4-wire, 120vac	0-50 gpm	Badger Flow Meter
SC-104	SC-104	Recovery Well RW-104 Speed Reference		1			RW-104	4-20ma	4-wire	0-100%	Grundfos CU-300 VFD, SPD Ref.
YA-104	YA-104	Recovery Well RW-104 Pump Alarm			1		RW-104	DI	24vdc	FAULT	Grundfos CU-300 VFD, K1

GE HUDSON FALLS TDCS Phase 4 Design											
YI-104	YI-104	Recovery Well RW-104 Pump Running			1		RW-104	DI	24vdc	RUN	Grundfos CU-300 VFD, AUX
HS-104	HS-104	Recovery Well RW-104 Local AUTO Status			1		RW-104	DI	24vdc	AUTO	RW-104, HS-1
YC-104	YC-104	Recovery Well RW-104 Pump START				1	RW-104	DO	Dry Contact	START	Grundfos CU-300 VFD, START
N/A	N/A	RW-104 PLC Panel					RW-104				See DWG I-2 through I-6
I/O List (Recovery Well Pump Station RW-105)											
Inst.	**Tag**	**Description**	**AI**	**AO**	**DI**	**DO**	**Location**	**PLC Signal**	**Power**	**Range/Units**	**Comments**
LT-105	LI-105	Recovery Well RW-105 Level	1				RW-105	4-20ma	loop-power	0-75 psi	Pressure Transmitter
FT-105	FI-105	Recovery Well RW-105 Flow	1				RW-105	4-20ma	4-wire, 120vac	0-50 gpm	Badger Flow Meter
SC-105	SC-105	Recovery Well RW-105 Speed Reference		1			RW-105	4-20ma	4-wire	0-100%	Grundfos CU-300 VFD, SPD Ref.
YA-105	YA-105	Recovery Well RW-105 Pump Alarm			1		RW-105	DI	24vdc	FAULT	Grundfos CU-300 VFD, K1
YI-105	YI-105	Recovery Well RW-105 Pump Running			1		RW-105	DI	24vdc	RUN	Grundfos CU-300 VFD, AUX
HS-105	HS-105	Recovery Well RW-105 Local AUTO Status			1		RW-105	DI	24vdc	AUTO	RW-105, HS-1
YC-105	YC-105	Recovery Well RW-105 Pump START				1	RW-105	DO	Dry Contact	START	Grundfos CU-300 VFD, START
N/A	N/A	RW-105 PLC Panel					RW-105				See DWG I-2 through I-6
I/O List (Recovery Well Pump Station RW-110)											
Inst.	**Tag**	**Description**	**AI**	**AO**	**DI**	**DO**	**Location**	**PLC Signal**	**Power**	**Range/Units**	**Comments**
LT-110	LI-110	Recovery Well RW-110 Level	1				RW-110	4-20ma	loop-power	0-50 psi	Pressure Transmitter
FT-110	FI-110	Recovery Well RW-110 Flow	1				RW-110	4-20ma	4-wire, 120vac	0-50 gpm	Badger Flow Meter
SC-110	SC-110	Recovery Well RW-110 Speed Reference		1			RW-110	4-20ma	4-wire	0-100%	Grundfos CU-300 VFD, SPD Ref.
YA-110	YA-110	Recovery Well RW-110 Pump Alarm			1		RW-110	DI	24vdc	FAULT	Grundfos CU-300 VFD, K1
YI-110	YI-110	Recovery Well RW-110 Pump Running			1		RW-110	DI	24vdc	RUN	Grundfos CU-300 VFD, AUX
HS-110	HS-110	Recovery Well RW-110 Local AUTO Status			1		RW-110	DI	24vdc	AUTO	RW-110, HS-1
YC-110	YC-110	Recovery Well RW-110 Pump START				1	RW-110	DO	Dry Contact	START	Grundfos CU-300 VFD, START
N/A	N/A	RW-110 PLC Panel					RW-110				See DWG I-2 through I-6

GE HUDSON FALLS TDCS Phase 4 Design											
I/O List (North Basin Remote I/O)											
Inst.	**Tag**	**Description**	**AI**	**AO**	**DI**	**DO**	**Location**	**PLC Signal**	**Power**	**Range/Units**	**Comments**
LT-1030	LI-1030	Noth Basin Level	1				North Basin	4-20ma	loop-power	0-15 ft	Ultrasonic Level
FE/FT-1030	FI-1030	Noth Basin Discharge Flow	1				North Basin	4-20ma	4-wire, 120vac	0-500gpm	Badger Flow Meter
LSHH-1031	LAHH-1031	North Basin High-High Level (Alarm)			1		North Basin	DI	24vdc	High-High	Float Switch
LSLL-1031	LALL-1031	North Basin Low-Low Level (Pump Shutdown)			1		North Basin	DI	24vdc	Low-Low	Float Switch
YA-1030A	YA-1030A	North Basin P-1030A Pump Ready			1		North Basin	DI	24vdc	FAULT	VFD
YI-1030A	YI-1030A	North Basin P-1030A Pump Running			1		North Basin	DI	24vdc	RUN	VFD
HS-1030A	HS-1030A	North Basin P-1030A Pump Local AUTO Status			1		North Basin	DI	24vdc	AUTO	VFD
YC-1030A	YC-1030A	North Basin P-1030A Pump START				1	North Basin	DO	Dry Contact	START	VFD
SC-1030A	SC-1030A	North Basin P-1030A Speed Reference		1			North Basin	4-20ma		0-100%	VFD
YA-1030B	YA-1030B	North Basin P-1030B Pump Ready			1		North Basin	DI	24vdc	FAULT	VFD
YI-1030B	YI-1030B	North Basin P-1030B Pump Running			1		North Basin	DI	24vdc	RUN	VFD
HS-1030B	HS-1030B	North Basin P-1030B Pump Local AUTO Status			1		North Basin	DI	24vdc	AUTO	VFD
YC-1030B	YC-1030B	North Basin P-1030B Pump START				1	North Basin	DO	Dry Contact	START	VFD
SC-1030B	SC-1030B	North Basin P-1030B Speed Reference		1			North Basin	4-20ma		0-100%	VFD
N/A	N/A	North Basin PLC Panel					North Basin				See DWG I-7 through I-11
I/O List (Additional for TDCS Remote I/O)											
Inst.	**Tag**	**Description**	**AI**	**AO**	**DI**	**DO**	**Location**	**PLC Signal**	**Power**	**Range/Units**	**Comments**
MOV-407	MOV-407-CL	TDCS Recirculation Line MOV - CLOSE Command				1	TDCS	DO	120vac	OPEN	
MOV-407	MOV-407-CL	TDCS Recirculation Line MOV - CLOSE Command				1	TDCS	DO	120vac	OPEN	
ZSO-407	ZSO-407	TDCS Recirculation Line MOV - OPEN Limit Switch			1		TDCS	DI	120vac	OPEN	
ZSC-407	ZSC-407	TDCS Recirculation Line MOV - CLOSE Limit Switch			1		TDCS	DI	120vac	Close	
FE/FIT-104A	FI-104A	Tail Race + RW-104 Flow	1				TDCS	4-20ma	4-wire, 120vac	0-50 gpm	Badger Flow Meter

GE HUDSON FALLS TDCS Phase 4 Design											
FE/FIT-400	FI-400	TDCS Pump Discharge Flow	1				TDCS	4-20ma	4-wire, 120vac	0-500 gpm	Badger Flow Meter
I/O List (Additional for Main PLC Panel - Train 2)											
FE/FT-1010	FI-1010	DNAPL Separator Influent Flow	1				Main PLC	4-20ma	4-wire, 120vac	0-500gpm	Badger Flow Meter
FE/FT-1010A	FI-1010A	DNAPL Separator Bypass Flow	1				Main PLC	4-20ma	4-wire, 120vac	0-500gpm	Re-Use FE/FT-2241
LSHH-1010	LAHH-1010	DNAPL Separator High-High Level (Alarm)			1		Main PLC	DI	120vac	High-High	Float Switch
LT-1020	LI-1020	Feed Tank Level	1				Main PLC	4-20ma	4-wire, 24vdc	0-6 ft	Ultrasonic Level
FE/FT-1020	FI-1020	Feed Tank Discharge Flow	1				Main PLC	4-20ma	4-wire, 120vac	0-500gpm	Badger Flow Meter
LSHH-1021	LAHH-1021	Feed Tank High-High Level (Alarm)			1		Main PLC	DI	120vac	High-High	Multipoint Probe
LSLL-1021	LALL-1021	Feed Tank Low-Low Level (Pump Shutdown)			1		Main PLC	DI	120vac	Low-Low	Multipoint Probe
YA-1020A	YA-1020A	Feed Tank P-1020A Pump Ready			1		Main PLC	DI	120vac	FAULT	VFD
YI-1020A	YI-1020A	Feed Tank P-1020A Pump Running			1		Main PLC	DI	120vac	RUN	VFD
HS-1020A	HS-1020A	Feed Tank P-1020A Pump Local AUTO Status			1		Main PLC	DI	120vac	AUTO	VFD
YC-1020A	YC-1020A	Feed Tank P-1020A Pump START				1	Main PLC	DO	Dry Contact	START	VFD
SC-1020A	SC-1020A	Feed Tank P-1020A Speed Reference		1			Main PLC	4-20ma		0-100%	VFD
YA-1020B	YA-1020B	Feed Tank P-1020B Pump Ready			1		Main PLC	DI	120vac	FAULT	VFD
YI-1020B	YI-1020B	Feed Tank P-1020B Pump Running			1		Main PLC	DI	120vac	RUN	VFD
HS-1020B	HS-1020B	Feed Tank P-1020B Pump Local AUTO Status			1		Main PLC	DI	120vac	AUTO	VFD
YC-1020B	YC-1020B	Feed Tank P-1020B Pump START				1	Main PLC	DO	Dry Contact	START	VFD
SC-1020B	SC-1020B	Feed Tank P-1020B Speed Reference		1			Main PLC	4-20ma		0-100%	VFD
LT-1040	LI-1040	RCP Level	1				Main PLC	4-20ma	4-wire, 24vdc	0-15 ft	Ultrasonic Level
LSHH-1041	LAHH-1041	RCP High-High Level (Alarm)			1		Main PLC	DI	120vac	High-High	Float Switch
LSLL-1041	LALL-1041	RCP Low-Low Level (Pump Shutdown)			1		Main PLC	DI	120vac	Low-Low	Float Switch
YI-1040	YI-1040	RCP P-1040 Pump Running			1		Main PLC	DI	120vac	RUN	VFD
HS-1040	HS-1040	RCP P-1040 Pump Local AUTO Status			1		Main PLC	DI	120vac	AUTO	VFD
YC-1040	YC-1040	RCP P-1040 Pump START				1	Main PLC	DO	Dry Contact	START	VFD

GE HUDSON FALLS TDCS Phase 4 Design										
FE/FT-1040	FI-1020	PCR Pump Discharge Flow	1				Main PLC	4-20ma	4-wire, 120vac	0-500gpm	Badger Flow Meter

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This section covers furnishing and installation of the process instrumentation for this project.

B. Primary devices include pressure elements, level elements, flow elements, float switches, and pressure gauges. Transmitters include electronic type for pressure, flow and level. Process indicators, controllers, switches and status lights are included on the control panels.

C. Process Control Systems and logic description are specified under Section 16900. Programmable Controller (PLC), input/output hardware, and Man Machine Interface (MMI) are specified under Section 16930.

D. Related Sections include the following:

1. Section 16050: Basic Materials and Methods.

1.3 QUALITY ASSURANCE

A. Drawing and specifications are based on instrumentation equipment manufactured by first named manufacture. Any changes to equipment, piping, structure, electrical or other work, required for other approved manufacturers is to be borne by the Instrumentation Supplier. Submit drawings to Engineer/Architect for approval, showing proposed changes to equipment, piping, structure, electrical or other work required to accommodate another approved manufacturer’s equipment.

B. Following codes and standards apply:

1. IEEE-Institute of Electrical and Electronic Engineering

2. ISA-Instrumentation Society of America

3. ANSI-American National Standards Institute

4. JIC-Joint Industrial Council

5. OSHA-Occupational Safety and Health Act

6. NEC-National Electrical Code

7. UL-Underwriter Laboratories

C. Any special standard or code requirements of State, County or Local regulatory body and any other agency also apply herein. Where a conflict arises between codes, the one containing more stringent requirements as determined by the Engineer/Architect applies.

D. Field test all equipment provided under this Section to full satisfaction of Engineer/Architect such that each part and all components function together in manner intended by functional descriptions specified herein.

E. Intent of Specifications and Drawings covering instrumentation is to outline design concept and control mode of instrumentation system. It also defines various functions that are to be measured, monitored and controlled. Various types of instruments and controls have been selected as best for intended service and, where practical, name and model number of a particular manufacture has been given. Reason for mentioning a particular manufacturer's item is to establish a minimum standard of quality, as determined by Engineer/Architect, below which equipment will not be acceptable.

F. No attempt was made on Drawings or in specifications to list all of accessory hardware, such as power supplies, transformers, relays, signal isolators, terminal blocks and other devices that may be required to augment instrumentation equipment. Nevertheless, furnish these accessories, where required, to degree that connecting wiring between terminal blocks in panels and Field devices is all that is required to complete instrumentation system.

G. Store all equipment, instruments and accessories specified in this Section, which are delivered to project site prior to time Contractor is ready to install them, according to specifications. Verify from instrumentation manufacturer maximum and minimum temperature and maximum relative humidity for storing equipment and conform to suppliers' requirements. In any case, minimum storage temperature is 50 degrees F. Protect equipment from humid conditions that might cause corrosion of electrical and electronic parts of equipment. Failure to store equipment in specified or approved manner is sufficient reason for not accepting equipment, regardless of outside appearance or warranty of manufacturer. Protect all electronic equipment from wet, humid, dusty or other unfavorable environment by sealing equipment in plastic.

H. Control and instrument panels to be pre-wired and, where practical, pre-mount instruments before delivery to job site. Where it is not practical to pre-mount instruments, Instrumentation Supplier is responsible for work of mounting and wiring instruments at job site. Any field modification in equipment or in wiring required is responsibility of Instrumentation Supplier. Fieldwork to be performed under prevailing conditions.

I. No form of energy to be turned on to any part of instrumentation system prior to receipt by Engineer/Architect of a certified statement of approval of installation from Instrumentation Supplier, containing authorization for turning on energy to system.

1.4 SUBMITTALS

A. Submit manufacturer's literature, illustration, shop drawings, flow charts, specifications and engineering data including design performance, material, weights, dimensions, and wiring diagrams for all products included in this Specification Section and as per Section 01330..

B. Shop Drawings to include following:

1. Control wiring diagrams and loop sheets with terminal numbers and all control devices identified. Sheets to be 8 1/2 x 11 inches or 11 x 17 inches in size. Indicate terminal numbers for all field equipment, regardless of supplier or whether equipment is new or existing.

2. Drawings for Panel to contain internal and external ladder and point to point wiring schematics with identified terminal numbers, relays and other control devices. Control electrical diagrams to be drawn with circuitry arranged in functional sequence on ladder type diagrams. Instrument logic diagrams and schematics to be prepared using ISA S5.1, IEEE 315 and 315A and NEMA standards and symbols and identification letters.

3. Submit input/output point lists and alarm summary forms according to requirements in this Specification.

4. Submit a listing of all signal names and alarms according to requirements in this Specification.

5. Prepare a tabulated list of instrumentation and electrical devices furnished under this Section. Include ampere and voltage operating characteristics for all devices.

6. Submit panel construction drawings to include following:

   a. Panel legends listing front panel devices by tag number, nameplate inscription and service legends.
   b. Bill of materials for each panel listing devices mounted within panel, which are not listed in panel legend. Include in bill of materials manufacture model number, tag number and description.
   c. Construction details of each panel including NEMA rating, materials, material thickness, structural stiffeners and brackets, and lifting lugs.
   d. Product Certificates: For each type of instrument, signed by product manufacturer.

PART 2 - PRODUCTS:

2.1 PRESSURE (LEVEL) TRANSMITTERS

A. The pressure (level) transmitter shall be level or depth pressure transmitter that is suitable for ground water borehole to surface water level measurements in wells, rivers, canals and reservoirs. The pressure transmitter shall output a 4-20ma DC signal corresponding to the measured pressure.

B. The transmitter shall be fully submersible titanium high performance sensors for measurement of hydrostatic liquid levels. The silicon element shall be sealed within an all-titanium pressure module assembly, fully isolated from the pressure media. This is contained in a slimline, welded titanium body, terminated in an injection molded cable assembly. The cable features a Kevlar® strain cord and is IP68/Type 6 rated for indefinite immersion in pressure of 1000 psi. A simple datum marked cable system shall be provided for ease of installation. 1 ft datum points clearly marked for quick and accurate cable alignment below ground level.

C. Transmitter shall feature:

Ranges from 1 psi to 900 psi
Accuracy ±0.06% full scale (FS) best straight line (BSL)
Fully welded 0.69 in titanium construction
Integral lightning surge arrestor
Polyurethane and flourpolymer cables
Full range of installation accessories
5 year anti corrosion warranty

D. The pressure transmitter shall be suitable for:

Operating Temperature Range	-5 to 140 °F (-21 to 60°C)
Overpressure Limits	4 x for ranges above 5 psi
Accuracy	Standard: ±0.1% FS BSL maximum
Long-Term Stability	±0.1% typically per annum
Shock and Vibration	20 g peak shock half sine wave 9 ms duration in all axes

E. The pressure transmitter output shall be 2-wire, 4-20mA DC output. Electrical connection shall be vented polyurethane cable with integral Kevlar® strain relief cord rated to 119 lb load.

F. Pressure transmitters shall be Druck Model PTX-1830.

2.2 MAGNETIC FLOWMETER

A. The magnetic flowmeter shall consist of two components. A detector, which is mount in-line in the process stream, and an amplifier (indicator/transmitter), which can be mounted either integral or remotely in an operator accessible location.

B. The magnetic flowmeter shall output a 4-20ma DC signal corresponding to the measured process flow.

C. The magnetic flow meter shall use dual frequency excitation and shall be provided with diagnostics to measure the level of insulation substance on the electrodes, making it possible to determine when maintenance is required.

D. The flow tube shall be a flanged type flow meter with remote electronics. Flow tube housing and flange shall be stainless steel. Flanges shall be ANSI Class 150. Flow tube electrodes shall be 316L stainless steel.

E. Flow tube shall be supplied with stainless steel grounding rings.

F. The amplifier (indicator/transmitter) power supply shall be 85-265 VAC (45-60 Hz)’

G. The amplifier (indicator/transmitter) shall be provided with an 4 x 20 character LCD display for display of process parameters and entry of setup parameters.

H. The amplifier (indicator/transmitter) outputs shall include a 4-20mA DC output, and four total configurable digital outputs.

I. The amplifier indicator/transmitter shall be supplied with stainless steel brackets for wall mounting, and with 15 feet (or as required) dedicated signal cable.

J. The magnetic flowmeter flow tube and remote indicator/transmitter shall be supplied with stainless steel tags with project number, tag number and service description.

K. The magnetic flowmeter shall be a Badger M-Series Mag Meter model M-2000 flow tube with a Badger model M-2000 detector or approved equal.

2.3 MOTOR OPERATED VALVE (MOV)

A. The Motor Operated Valve (MOV) shall be mounted in the TDCS sump to control the recycle flow from the TDCS discharge line. This valve will be normally open, to balance the TDCS discharge flow with the water collection rate. This valve will close on sump high level to stop the recycle flow and force a higher discharge flow rate, thus maintaining the sump level.

B. The MOV shall be a 2” PVC butterfly valve with an electric quarter-turn actuator.

C. The electric actuator shall utilize modular PC boards and employ an epicyclic gear design.

D. Standard features shall include:

Four Limit Switches (Two Auxiliary)
Internal Low Power Heater
NEMA 4/4X Enclosure
Position Indicator
Clutchless Manual Override
Self-Locking Drive
Permanently Lubricated
Thermal Overload Protection
CE and CSA Approved
ISO 5211 Mounting Base
Voltage: 120 VAC

E. The motor operated valve (MOV) shall be supplied with stainless steel tags with project number, tag number and service description.

F. The motor operated valve (MOV) actuator shall be a Hayward EPM series actuator or approved equal appropriately sized for the associated valve.

2.4 ULTRASONIC LEVEL TRANSMITTER

A. The ultrasonic level transmitter shall be a 2-wire loop powered ultrasonic transmitter for level, volume and flow monitoring of liquids in open channels, storage vessels and simple process vessels.

B. The ultrasonic level transmitter shall provide continuous level measurement up to 12 m (40 ft) range.

C. The ultrasonic level transmitter shall be programmed using infrared Intrinsically Safe handheld programmer, SIMATIC PDM or HART® Communicator and shall include the following features:

PVDF transducers for chemical compatibility
Patented Sonic Intelligence signal processing
Extremely high signal-to-noise ratio
Auto False-Echo Suppression for fixed obstruction avoidance
Level to volume or level to flow conversion
Interface Local: LCD display with bar graph

D. Ambient conditions

Location	Indoor/outdoor
Ambient temperature	-40 to +80 °C (-40 to +176 °F)
Relative humidity/ingress protection	Suitable for outdoor

E. The ultrasonic level transmitter shall be supplied with stainless steel tags with project number, tag number and service description.

F. The ultrasonic level transmitter shall be Siemens-Miltronics model SITRANS Probe LU or approved equal and a compatible hand-held programmer with infrared receiver.

2.5 LEVEL SWITCHES (FLOAT)

A. The level switches shall be provided in the North Basin, and the Rail Car pit for level alarming, to interlock (enable) the process pump(s)

B. The level switches shall be float type switch with 1 pole (dry contact), ‘Close on Rise’ and come with 20 foot of cord

C. The float switches shall include the following features:

Length:	4.25
Width:	2.81"
Height:	8.25"
Contact Type:	1 Pole
Switch Function:	Close on Rise
Amps:	10 at 120V, 5A at 240V
Voltage:	120/240
Float Material:	ABS
Float Dia. (In.):	2-13/16
Ambient Temp. Range:	32-190
Max. Water Level Adjustment:	8.28
Min. Water Level Adjustment:	8.25
Conduit Size (In.):	.5-.75

Includes 20' Cord, Weight, Float

D. Mounting bracket(s) shall be coordinated with the installation contractor.

E. The float switches shall be General Electric model 2900B3S1C1-20 or approved equal.

2.6 LEVEL SWITCHES (MULTIPOINT)

A. The Multipoint II Level control shall consist of three components,

1. A sensing unit,
2. An Electronics unit,
3. An inter-connecting cable - in cases where it is suitable to mount the electronics integrally with the sensing element in one housing, the need for the interconnecting cable is eliminated

B. Sensing Element - The sensing element shall be furnished with a condulet that meets Nema 1-5 and 12 area classification. The sensing unit shall be integrally mounted with the electronics. The sensing element shall be supplied will be flange mounted to the top of the process tank.

C. The electronics integrally with the sensing element in one housing The electronic unit shall be a solid state, radio frequency admittance type, with circuitry de-signed to ignore errors generated by coating build-up on the sensing element. Ambient tem-perature limits of the electronics shall be -40°F to 140°F. The electronic unit shall have two DPDT relay contacts. Contact ratings shall be 120VAC: 5A

D. Only one sensing element shall be required for all points. There will be (2) process setpoints:

1. Setpoint 1 - The setpoint shall be field selectable High Level Fail Safe (HLFS) or Low Level Fail Safe (LLFS) and adjustable over the full range of the sensing element provided. The setpoints shall have a variable field selectable time delay from 0 to 90 seconds response time.
2. Setpoint 2 - The setpoint shall be field selectable High Level Fail Safe (HLFS) or Low Level Fail Safe (LLFS) and adjustable over the full range of the sensing element provided. The setpoint shall have an adjustable dead band/differential (pump/valve) control, where the differential span may be locked for calibration, or where the differential points may be independently calibrated. This option must field selectable.

E. Power supply to the unit shall be protected from radio frequency interference (RFI) to the extent that less than 1/2" shift in an operating point would occur from a 5 Watt field @ 27 MHz, 150 MHz, or 450 MHz at a distance of 5 feet from an exposed cable or power lines.

F. The Multi-point level switches shall be provided in the Feed Tank (T-1020), to interlock (enable) the process pump(s)

G. The multi-point level switches shall be Drexelbrook Multipoint II model 506-3100-001-00 with integral sensing unit model 700-0001-022-406-3033-009-00- or approved equal.

2.7 COMMUNICATION INTERFACES

A. The communication interfaces for communicating from the RW pump stations to main PLC in the Treatment plant will use ModBus RTU Protocol over a RS-484 communica-

tion interface. In the main PLC panel, two Modbus RTU to Modbus/TCP protocol converters shall be used to allow the PLC to interface with the Modbus RTU interface. A third Modbus RTU to Modbus/TCP protocol converter will be mounted at the TDCS to interface with RW-100 and RW-104. The protocol converters shall be B&B Electronics model MESR902T 2-port Modbus Ethernet Serial Servers or approved equal.

B. For extending the serial communication link from the RW-100 and the RW-104 pump stations with the TDCS, a wireless Radio Modems shall be used. The wireless modems shall be B&B Electronics model ZP9D-115RM-LR Zlinx Wireless Radio Modem or approved equal.

C. The wireless modems at the RW-100 and RW-104 pump station shall use B&B Electronics model YS8963 Yagi Antenna or approved equal.

D. The wireless modem at the TDCS pump station shall use B&B Electronics model FG9023 Omni Antenna or approved equal.

E. The TDCS antenna will be mounted ‘line-of-sight’ with the RW-104 and RW-100 antenna.

F. Each antenna will be supplies with lightning arrestors and sufficient coax antenna cable to reach the radio modem mounted in the pump station.

2.8 CONTROL PANELS

Wall-Mounted PLC control panels will be provided to house the PLC / PLC Remote I/O for RW-100, RW-103, RW-104, RW-105, RW-110 and North Basin. The control panel enclosures will be rated suitable for a NEMA 4 environment. Drawings I-2 through I-11 provide typical control panel layout / wiring details.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of all instruments shall be in accordance with the manufacturer’s recommended procedures. Provide necessary protection during construction period to insure against mechanical damage or dust accumulation.

B. Equipment power wiring and wiring between field devices and control panels, unless specifically noted to be included under this Section, shall be as per Section 16050.

PART 4 - INSTRUMENT LIST

GE HUDSON FALLS TDCS Phase 4 Design Instrument List										
I/O List (Recovery Well Pump Station RW-100)			PLC INPUT/OUTPUT							
Inst.	**Tag**	**Description**	**AI**	**AO**	**DI**	**DO**	**Location**	**Power**	**Range/Units**	**Comments**
LT-100	LI-100	Recovery Well RW-100 Level	1				RW-100	loop-power	0-100 psi	New Druck Level (Pressure) Transmitter
FT-100	FI-100	Recovery Well RW-100 Flow	1				RW-100	4-wire, 120vac	0-50 gpm	New Badger Flow Meter, 1" - Replace existing battery powered flow meters
SC-100	SC-100	Recovery Well RW-100 VFD		1	3	2	RW-100	230V/1ph/60HZ	0-100%	New Grundfos CU-300 VFD
	N/A	RW-100 DNAPL Recovery System					RW-100	compressed air		New QED, self contained system
	N/A	RW-100 PLC Control Panel								
I/O List (Recovery Well Pump Station RW-103)										
Inst.	**Tag**	**Description**	**AI**	**AO**	**DI**	**DO**	**Location**	**Power**	**Range/Units**	**Comments**
LT-103	LI-103	Recovery Well RW-103 Level	1				RW-103	loop-power	0-75 psi	New Druck Level (Pressure) Transmitter
FT-103	FI-103	Recovery Well RW-103 Flow	1				RW-103	4-wire, 120vac	0-50 gpm	New Badger Flow Meter, 1" - Replace existing battery powered flow meters
SC-103	SC-103	Recovery Well RW-103 VFD		1	3	2	RW-103	230V/1ph/60HZ	0-100%	New Grundfos CU-300 VFD
	N/A	RW-103 DNAPL Recovery System					RW-103	compressed air		New QED, self contained system
	N/A	RW-103 PLC Control Panel								
I/O List (Recovery Well Pump Station RW-104)										
Inst.	**Tag**	**Description**	**AI**	**AO**	**DI**	**DO**	**Location**	**Power**	**Range/Units**	**Comments**
LT-104	LI-104	Recovery Well RW-104 Level	1				RW-104	loop-power	0-75 psi	New Druck Level (Pressure) Transmitter
FT-104	FI-104	Recovery Well RW-104 Flow	1				RW-104	4-wire, 120vac	0-50 gpm	New Badger Flow Meter, 1" - Replace existing battery powered flow meters
SC-104	SC-104	Recovery Well RW-104 VFD		1	3	2	RW-104	230V/1ph/60HZ	0-100%	New Grundfos CU-300 VFD
	N/A	RW-104 DNAPL Recovery System					RW-104	compressed air		New QED, self contained system
	N/A	RW-104 PLC Control Panel								
I/O List (Recovery Well Pump Station RW-105)										
Inst.	**Tag**	**Description**	**AI**	**AO**	**DI**	**DO**	**Location**	**Power**	**Range/Units**	**Comments**
LT-105	LI-105	Recovery Well RW-105 Level	1				RW-105	loop-power	0-75 psi	New Druck Level (Pressure) Transmitter
FT-105	FI-105	Recovery Well RW-105 Flow	1				RW-105	4-wire, 120vac	0-50 gpm	New Badger Flow Meter, 1" - Replace existing battery powered flow meters
SC-105	SC-105	Recovery Well RW-105 VFD		1	3	2	RW-105	230V/1ph/60HZ	0-100%	New Grundfos CU-300 VFD

	N/A	RW-105 DNAPL Recovery System					RW-105	compressed air		New QED, self contained system
	N/A	RW-105 PLC Control Panel								
I/O List (Recovery Well Pump Station RW-110)										
Inst.	**Tag**	**Description**	**AI**	**AO**	**DI**	**DO**	**Location**	**Power**	**Range/Units**	**Comments**
LT-110	LI-110	Recovery Well RW-110 Level	1				RW-110	loop-power	0-50 psi	New Druck Level (Pressure) Transmitter
FT-110	FI-110	Recovery Well RW-110 Flow	1				RW-110	4-wire, 120vac	0-50 gpm	New Badger Flow Meter
SC-110	SC-110	Recovery Well RW-110 VFD		1	3	1	RW-110	230V/1ph/60HZ	0-100%	Grundfos CU-300 VFD
	N/A	RW-110 DNAPL Recovery System					RW-110	compressed air		QED, self contained system
	N/A	RW-110 PLC Control Panel								
I/O List (North Basin Genius Remote I/O)										
Inst.	**Tag**	**Description**	**AI**	**AO**	**DI**	**DO**	**Location**	**Power**	**Range/Units**	**Comments**
LT-1030	LI-1030	Noth Basin Level	1				North Basin	4-wire, 24vdc	0-15 ft	Ultrasonic Level Siemens 'The Probe', Re-use level transmitter
FE/FT-1030	FI-1030	Noth Basin Discharge Flow	1				North Basin	4-wire, 120vac	0-500gpm	New Badger Flow Meter, 4"
LSHH-1031	LAHH-1031	North Basin High-High Level (Alarm)			1		North Basin	24vdc	High-High	New GE Float Switch - similar to existing
LSLL-1031	LALL-1031	North Basin Low-Low Level (Pump Shutdown)			1		North Basin	24vdc	Low-Low	New GE Float Switch - similar to existing
SC-1030A	SC-1030A	North Basin P-1030A VFD		1	3	1	North Basin	460V/3ph/60Hz	0-100%	New ITT PumpSmart VFD stand mounted in Pump Shed, 7.5 Hp
SC-1030A	SC-1030B	North Basin P-1030B VFD		1	3	1	North Basin	460V/3ph/60Hz	0-100%	New ITT PumpSmart VFD stand mounted in Pump Shed, 7.5 Hp
	N/A	North Basin PLC Control Panel								
I/O List (Additional for TDCS Remote I/O)										
Inst.	**Tag**	**Description**	**AI**	**AO**	**DI**	**DO**	**Location**	**Power**	**Range/Units**	**Comments**
MOV-407	MOV-407-xx	TDCS Recirculation Line MOV			2	2	TDCS	120vac	OPEN/CLOSE	New Hayward Electric Actuator with limit switches & override handle, with PVC Ball or butterfly valve
FE/FIT-104A	FI-104A	Tail Race + RW-104 Flow	1				TDCS	4-wire, 120vac	0-50 gpm	New Badger Flow Meter, 1"
FE/FT-400	FI-400	TDCS Discharge Flow (Valve Pit)	1				TDCS	4-wire, 120vac	0-500gpm	New Badger Flow Meter, 3"
I/O List (Additional for Main PLC Panel - Train 2)										
FE/FT-1010	FI-1010	DNAPL Tank Influent Flow	1				Main PLC	4-wire, 120vac	0-500gpm	New Badger Flow Meter, 4"
FE/FT-1010A	FI-1010A	DNAPL Tank Bypass Flow	1				Main PLC	4-wire, 120vac	0-500gpm	Re-Use FE/FT-2241, 4"

LSHH-1010	LAHH-1010	DNAPL Tank High-High Level (Alarm)			1		Main PLC	120vac	High-High	New GE Float Switch - similar to existing in North Basin
LT-1020	LI-1020	Feed Tank Level	1				Main PLC	Loop Powered	0-6 ft	New Ultrasonic Level transmitter, Siemens 'The Probe'
FE/FT-1020	FI-1020	Feed Tank Discharge Flow	1				Main PLC	4-wire, 120vac	0-500gpm	New Badger Flow Meter, 4"
LSHH-1021	LAHH-1021	Feed Tank High-High Level (Alarm)			1		Main PLC	120vac	High-High	New Drexelbrook Multi-Point Level Switch
LSLL-1021	LALL-1021	Feed Tank Low-Low Level (Pump Shutdown)			1		Main PLC	120vac	Low-Low	New Drexelbrook Multi-Point Level Switch
SC-1020A	SC-1020A	Feed Tank P-1020A VFD		1	3	1	Main PLC	460V/3ph/60Hz	0-100%	Re-use existing ITT PumpSmart VFD from end of tunnel, stand mount near pumps, 3 Hp
SC-1020B	SC-1020B	Feed Tank P-1020B VFD		1	3	1	Main PLC	460V/3ph/60Hz	0-100%	Re-use existing ITT PumpSmart VFD from end of tunnel, stand mount near pumps, 3 HP
LT-1040	LI-1040	RCP Level	1				Main PLC	Loop Powered	0-15 ft	New Ultrasonic Level transmitter, Siemens 'The Probe'
LSHH-1041	LAHH-1041	RCP High-High Level (Alarm)			1		Main PLC	120vac	High-High	New GE Float Switch - similar to existing in North Basin
LSLL-1041	LALL-1041	RCP Low-Low Level (Pump Shutdown)			1		Main PLC	120vac	Low-Low	New GE Float Switch - similar to existing in North Basin
FE/FT-1040	FI-1040	RCP Pump Discharge Flow	1				Main PLC	4-wire, 120vac	0-500gpm	New Badger Flow Meter, 4"

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Conditions and Special Conditions of the Contract, as well as Technical Documents including Contract Drawings, apply to this Section.

1.2 SUMMARY

A. This section covers Programmable Controller (PLC), input/output hardware, and Man Machine Interface (MMI).

B. A single supplier shall be responsible for a complete Supervisory Control System consisting of PLC, MMI and ancillary devices, including developing and implementing programming for the pump control sequence and other control strategies, as indicated on Contract Drawings and in these specifications.

C. Process Control Systems and logic description are specified under Section 16900. Process instrumentations are specified under Section 16910.

D. Related Sections include the following:

1. Section 16050: Basic Materials and Methods.

2. Section 16900: Process Control System with Process Control I/O List

3. Section 16910: Process Control Instrumentation with Products Instrument List

1.3 QUALITY ASSURANCE

A. Drawing and specifications are based on instrumentation equipment manufactured by first named manufacture. Any changes to equipment, piping, structure, electrical or other work, required for other approved manufacturers is to be borne by the Instrumentation Supplier. Submit drawings to Engineer/Architect for approval, showing proposed changes to equipment, piping, structure, electrical or other work required to accommodate another approved manufacturer’s equipment.

B. Following codes and standards apply:

1. IEEE-Institute of Electrical and Electronic Engineering

2. ISA-Instrumentation Society of America

3. ANSI-American National Standards Institute

4. JIC-Joint Industrial Council

5. OSHA-Occupational Safety and Health Act

6. NEC-National Electrical Code

7. UL-Underwriter Laboratories

C. Any special standard or code requirements of State, County or Local regulatory body and any other agency also apply herein. Where a conflict arises between codes, the one containing more stringent requirements as determined by the Engineer/Architect applies.

D. Field test all equipment provided under this Section to full satisfaction of Engineer/Architect such that each part and all components function together in manner intended by functional descriptions specified herein.

E. Intent of Specifications and Drawings covering instrumentation is to outline design concept and control mode of instrumentation system. It also defines various functions that are to be measured, monitored and controlled. Various types of instruments and controls have been selected as best for intended service and, where practical, name and model number of a particular manufacture has been given. Reason for mentioning a particular manufacturer's item is to establish a minimum standard of quality, as determined by Engineer/Architect, below which equipment will not be acceptable.

F. No attempt was made on Drawings or in specifications to list all of accessory hardware, such as power supplies, transformers, relays, signal isolators, terminal blocks and other devices which may be required to augment instrumentation equipment. Nevertheless, furnish these accessories, where required, to degree that connecting wiring between terminal blocks in panels and Field devices is all that is required to complete instrumentation system.

G. Store all equipment, instruments and accessories specified in this Section, which are delivered to project site prior to time Contractor is ready to install them, according to specifications. Verify from instrumentation manufacturer maximum and minimum temperature and maximum relative humidity for storing equipment and conform to suppliers' requirements. In any case, minimum storage temperature is 50 degrees F. Protect equipment from humid conditions that might cause corrosion of electrical and electronic parts of equipment. Failure to store equipment in specified or approved manner is sufficient reason for not accepting equipment, regardless of outside appearance or warranty of manufacturer. Protect all electronic equipment from wet, humid, dusty or other unfavorable environment by sealing equipment in plastic.

H. Control and instrument panels to be pre-wired and, where practical, pre-mount instruments before delivery to job site. Where it is not practical to pre-mount instruments, Instrumentation Supplier is responsible for work of mounting and wiring instruments at job site. Any field modification in equipment or in wiring required is responsibility of Instrumentation Supplier. Field work to be performed under prevailing conditions.

I. No form of energy to be turned on to any part of instrumentation system prior to receipt by Engineer/Architect of a certified statement of approval of installation from Instrumentation Supplier, containing authorization for turning on energy to system.

1.4 SUBMITTALS

A. Submit manufacturer's literature, illustration, shop drawings, flow charts, specifications and engineering data including design performance, material, weights, dimensions and wiring diagrams for all products included in this Specification Section and as per Section 01330.

B. Shop Drawings to include following:

1. Control wiring diagrams and loop sheets with terminal numbers and all control devices identified. Sheets to be 8 1/2 x 11 inches or 11 x 17 inches in size. Indicate terminal numbers for all field equipment, regardless of supplier or whether equipment is new or existing.

2. Drawings for Panel to contain internal and external ladder and point to point wiring schematics with identified terminal numbers, relays and other control devices. Control electrical diagrams to be drawn with circuitry arranged in functional sequence on ladder type diagrams. Instrument logic diagrams and schematics to be prepared using ISA S5.1, IEEE 315 and 315A and NEMA standards and symbols and identification letters.

3. Submit input/output point lists and alarm summary forms according to requirements in this Specification.

4. Submit a listing of all signal names and alarms according to requirements in this Specification.

5. Prepare a tabulated list of instrumentation and electrical devices furnished under this Section. Include ampere and voltage operating characteristics for all devices.

6. Submit panel construction drawings to include following:

a. Panel legends listing front panel devices by tag number, name plate inscription and service legends.
b. Bill of materials for each panel listing devices mounted within panel that are not listed in panel legend. Include in bill of materials manufacture model number, tag number and description.
c. Construction details of each panel including NEMA rating, materials, material thickness, structural stiffeners and brackets and lifting lugs.
d. Product Certificates: For each type of instrument, signed by product manufacturer.
e. Source quality-control test reports.
f. Operation and Maintenance manuals.

PART 2 - PRODUCTS

2.1 PLC PROCESSOR HARDWARE

A. This section covers the technical requirement for a programmable controller which can receive discrete and analog inputs. Through the use of relay ladder logic and other IEC languages, including "C". The unit can control discrete and analog output functions, perform data handling operations and communicate with external devices.

B. The programmable controller and all of the corresponding components within the family of controller products shall be offered by a company that regularly manufactures and services this type of equipment.

C. All products shall be designed, manufactured, and tested in accordance with recognized UL, C-UL, CSA, IEC and CE mark industrial standards. The system shall be operational during and after testing. The manufacturer shall have a fully operational quality assurance and quality control program in place and shall comply with ISO9001 standards for "Quality Systems- Model for Quality Assurance in Design/Development, Production, Installation, and Servicing."

D. Complete documentation describing installation, operation, programming and simple field maintenance shall be available in paper format and on CD-ROM.

E. The system shall consist of rugged components designed specifically for industrial environments. A complete system shall consist of one or more racks containing I/O modules, interconnected by signal cables. All components shall be housed in structurally secure enclosures.

F. The system shall be modular and DIN rail mounted with added provisions for panel mounting. When mounted on the system base, each I/O module shall not occupy more than one available slot. The electronic components of each I/O module shall be separate from the I/O wiring carrier termination.

G. I/O modules shall be retained with a lock down mechanism. I/O modules shall require no tools for insertion or extraction. Module insertion or removal shall not disturb field wiring

H. The I/O system shall have a keying system to prevent modules from being installed into the wrong field wiring carrier.

I. All components of the controller system, except CRT terminals and programming workstations, shall meet the following environmental specifications:

TEMPERATURE :	0 to 60 degrees Celsius
HUMIDITY:	5 to 95% relative humidity, non-condensing

J. The power supply shall be modular in design, separate from the CPU or Network Interface Unit, for easy replacement in the unlikely event of failure. The power supply shall be compatible with main CPU or Network Interface Unit stations, as well as with expansion stations and booster power supply carriers.

K. The CPU provided shall be modular. The CPU shall have the capability to solve application logic, store the application program, and store numerical values related to the application processes and logic, and interface to the I/O system. The CPU shall provide at least the following advanced programming features: PID, Modulo, Math, Floating Point Math, Double Precision math, Logical functions, Subroutines, Data Array Move and Indirect Addressing.

L. The CPU shall contain a real-time calendar and clock that can be accessed by the user program. This Time of Day clock and calendar shall be battery-backed and maintain seven time functions: Year (4 digits), Month, Day of Month, Hour, Minute, Second, and Day of week and be year 2000 compliant.

M. The CPU shall be capable of controlling up to 8 local I/O carriers in the basic configuration and up to 56 additional I/O carriers remotely. The CPU shall support a total of 256 local I/O and a total of 4096 I/O in a local and remote configuration

N. The CPU shall provide 2 serial ports, (1) 9 pin RS232 and (1) 15 pin RS485 for communications. Both ports shall support CPU programming. Both ports are configurable for SNP slave or RTU master/slave operation. Both ports shall support 4-wire and 2-wire Modbus RTU.

O. Application programs, configurations, and data are maintained in non-volatile RAM and protected by a super-capacitor and/or optional battery. This data is saved if power is cycled to the CPU. Using the programmer, all data can be saved to flash memory, which does not require battery backup. The CPU can be configured to automatically restore data each time it powers up.

P. With a battery, data shall be retained for 3 months in storage or approximately 7 months with the CPU powered up for 50% of the time. The battery shall be easily removed and readily available through commercial outlets.

Q. The I/O modules shall be supported by individual field wiring carriers that connect the I/O electronics to the I/O bus. Each CPU and Network Interface Unit shall support eight I/O carriers locally. The carriers shall be capable of accepting modules with up to 32 points.

R. A Software programming package running on a PC compatible laptop or desktop computer shall be used to program the CPU. The software shall be Windows 95, Windows 98, Windows NT and Windows XP compatible.

S. The programming software shall have access to the application program, the CPU and I/O system configurations, all registers, CPU and I/O status, system diagnostic relays, and I/O over-ride capabilities

T. The software shall have the capability of programming the relay ladder program, store the program to the CPU, monitor program and reference address status while the CPU is in Run or Stop mode.

U. The PLC processor shall be a GE FANUC model VersaMax PLC, and VersaMax remote I/O or approved equal.

2.2 REMOTE INPUT/OUTPUT HARDWARE

A. The remote Input/Output hardware shall consist of rugged components designed specifically for industrial environments. A complete system shall consist of one or more stations containing DIN-rail-mounted I/O modules, I/O field wiring carriers, CPU or Network Interface Unit (NIU), and power supply interconnected by signal/power cables.

B. All components shall be housed in structurally secure modules that are fully enclosed within a durable plastic shroud. The system shall be modular and DIN rail mounted with added provisions for panel mounting. When mounted on the system base, each I/O module shall not occupy more than one available slot. The electronic components of each I/O module shall be separate from the I/O wiring carrier termination. The depth of the system shall not exceed 70mm when mounted on a DIN rail with a power supply. I/O modules shall be retained with a lock down mechanism. I/O modules shall require no tools for insertion or extraction. Module insertion or removal shall not disturb field wiring. Modules shall connect electrically via a pin and socket connector. The markings shall be placed on the front of each product and include the manufacturer's catalog number, product manufacturing date code, and certifications.

C. All components shall be manufactured with a high degree of durability. All switches and other operator-controlled devices shall be of the size and durability for the intended use as is normally offered for industrial applications. All signal cables furnished by the manufacturer shall be constructed so as to withstand, without damage, all normal use and handling.

D. The I/O system shall have a keying system to prevent modules from being installed into the wrong field wiring carrier. Wherever possible, all assemblies and sub-assemblies performing similar functions shall be interchangeable.

E. As an I/O system a networked master shall communicate with the I/O through a Network Interface Unit. The following networks shall be supported as Network Interface Units:

1. Ethernet

2. Genius™

3. Profibus-DP

4. DeviceNet

5. The Ethernet Network Interface Unit shall support up Ethernet Global Data and Modbus TCP with multiple connections. The Ethernet Network Interface Unit shall have a RJ-45 connector and support 10/100Mbps.

6. The Profibus-DP Network Interface Unit shall support a minimum of 125 nodes per bus.

7. The DeviceNet Network Interface Unit shall support a minimum of 63 nodes per bus.

8. The Genius Network Interface Unit shall support a minimum of 31 nodes per bus.

F. The I/O modules shall be supported by individual field wiring carriers that connect the I/O electronics to the I/O bus. Each CPU and Network Interface Unit shall support eight I/O carriers locally. The carriers shall be capable of accepting modules with up to 32 points.

G. There shall be at least four styles of I/O carrier wiring terminations – IEC box style, barrier style, spring clamp style, and connector style. The I/O carriers shall be universal and accept any discrete or analog I/O modules.

H. The I/O modules and carriers shall be the same for either direct connection to the CPU or connection to the Network Interface Unit as distributed I/O. Each I/O carrier shall have a clear plastic door that covers the wiring terminals. Each I/O carrier shall include a label with the module description, catalog number, and wiring diagram for that module type. The outside of the label shall have user legend space to record wiring information.

I. I/O modules connected to a Network Interface Unit shall have reference addressing assigned automatically upon power up. I/O reference addressing for modules connected to a CPU shall be assigned automatically upon power up or may be assigned through the use of the Windows compatible configuration and programming software. There shall be no DIP switch settings required to address I/O modules.

J. Each I/O module shall have an OK LED to indicate when backplane power is present to the module. Output modules shall have a field power LED to indicate when field power is applied to the module. Each discrete I/O module shall have individual LEDs to indicate the on/off state of the I/O points. The diagnostic status of the Electronic Short Circuit Protection (ESCP), for those discrete output modules containing ESCP, shall be indicated by a green LED during normal operation per point and amber during a fault. The fault should be auto-corrective without the need to cycle power.

K. As a minimum, the following discrete I/O modules shall be available:

Description	Points/Module
120 VAC, 0.5A, Isolated	8 and 16
120 VAC, 2A, Isolated	8
24 VDC Positive Logic, 0.5A	16 and 32
24 VDC Positive Logic, 0.5A with Electronic Short Circuit Protection	16 and 32
24 VDC Positive Logic, 2A with Electronic Short Circuit Protection	8
Relay, Normally Open, 2A Isolated	8 and 16

L. The analog voltage/current input module shall be capable of converting 4 channels of inputs in the range of -10 to +10 volts, 0 – 10 volts, and 4mA to 20mA. Resolution of the converted analog voltage/current input signal shall be available in 12 bit and 16 bit versions. All of the channels of converted analog voltage/current input signals shall be updated each scan into a dedicated area of data registers in a 16-bit 2's complement format. The conversion speed for all of the analog voltage/current input channels shall be no less than 2 milliseconds and no greater than 13 milliseconds.

M. An analog current output module shall be capable of converting 4 channels of digital data to analog outputs in the range of 4 to 20 mA. Resolution of the converted output signal shall be 12 bits. All channels of analog output data shall be updated each scan from a dedicated area of data registers in a 16-bit 2's complement format. The analog current outputs shall be configurable to default to 0 current or hold-last-state in the event of a CPU failure.

N. As a minimum, the following analog modules shall be available:

Description	Channels/Module
Analog Input Voltage/Current	4 and 8
Analog Input RTD	4
Analog Input Thermocouple	7
Analog Output Current	4
Analog Output Voltage	4
Analog Inputs/Outputs Current	4 Inputs and 2 Outputs
Analog Inputs/Outputs Voltage	4 Inputs and 2 Outputs

O. The Remote Input/Output hardware shall be a GE FANUC model VersaMax or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of all instruments shall be in accordance with the manufacturer's recommended procedures. Provide necessary protection during construction period to insure against mechanical damage or dust accumulation.

B. Equipment power wiring and wiring between field devices and control panels, unless specifically noted to be included under this Section, shall be as per Section 16050.

END OF SECTION 16930