COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

APPLICATION OF NORTHERN KENTUCKY WATER DISTRICT FOR APPROVAL OF RESIDUALS HANDLING EQUIPMENT REPLACEMENT AND IMPROVEMENTS AS AN ORDINARY EXTENSION	)))))	Case: 2020-00283

PETITION

Northern Kentucky Water District (NKWD), by counsel, petitions for an order approving the acquisition, installation, and financing of residuals handling equipment replacement and improvements at its Fort Thomas Treatment Plant as described below as an ordinary extension of existing facilities in the usual course of business pursuant to KRS 278.020(1)(a) and 807 KAR 5:001(15)(3).

I. General Information:

In support of the application, the following information is provided:

1. NKWD's office address is 2835 Crescent Spring Rd., Erlanger, KY 41018-0640. Its principal officers are listed in its current Annual Report, which is filed with the Public Service Commission (as are NKWD's prior year reports), and is incorporated herein by reference.

NKWD's contact officers/employees are:

Lindsey Rechtin, Vice President of Finance and Support Services, and
Stacey Kampsen, Finance Manager
2835 Crescent Spring Rd.
Erlanger, KY 41018-0640
(859) 578 9898 Phone
(859) 578-3668 fax
lrechtin@nkywater.org
skampsen@nkywater.org

2. NKWD is a non-profit water district organized under Chapter 74 and has no

separate articles of incorporation.

3. A description of NKWD's water system and its property stated at original cost by accounts is contained in its Annual Report, which is incorporated by reference. No material changes have occurred since the end of the latest 12-month period.

4. NKWD serves retail customers in Kenton, Boone, and Campbell counties and sells water at wholesale to non-affiliated water distribution systems in Kenton, Boone, Pendleton and Campbell counties.

II. Proposed Construction:

5. NKWD proposes to replace the existing plant residuals handling system and related facilities at its Fort Thomas Treatment Plant as described in Exhibit A. A separate petition for confidentiality for the Plans and Specifications has been submitted with this petition. This is an essential piece of equipment utilized by NKWD in the water treatment process. The current residuals handling system is approximately 28 years old and has reached the end of its useful life and the reliability of this key piece of equipment is in question. The estimated cost of the total project with engineering, construction, and contingencies is $3,000,000.

6. This project will be paid from NKWD's Five-Year Capital Budget, PSC No. 166, FTTP Residuals Handling Improvements, with a budget of $3,000,000 which includes construction cost, engineering, and contingencies. A summary of the project costs is provided below:

• Design Engineering	$	180,000
• Construction Engineering	$	70,000
• Contractor's Bid	$	2,177,000
• Misc. & Contingencies	$	573,000
Total Project Cost	$	3,000,000

This project will be funded using $3,000,000 from a future Bond Anticipation Note.

7. NKWD requests that this project be declared an ordinary extension of facilities by the Commission and that a Certificate of Public Convenience and Necessity and approval of financing pursuant to KRS 278.020 and 278.300 are not required.

8. The project involves the replacement and upgrading of existing residuals handling equipment. This will improve the operational capability of the Fort Thomas Treatment Plant by replacing 2 existing belt filter presses with 2 new presses, replacement of the residuals conveyor, polymer feed system, transfer pumps, gravity thickener troughs and weirs, along with other piping, electrical, lighting, heating/ventilation, instrumentation, and control upgrades. See Exhibit A.

9. KRS 278.020(1) does not define "ordinary extensions of existing systems in the usual course of business," but 807 KAR 5:001, Section 15(3) defines this exception as follows:

> A certificate of public convenience and necessity shall not be required for extensions that do not create wasteful duplication of plant, equipment. property, or facilities, or conflict with the existing certificates or service of other utilities operating in the same area and under the jurisdiction of the commission that are in the general or contiguous area in which the utility renders service, and that do not affect the existing financial condition of the utility involved, or will not result in increased charges to its customers.

The regulation provides for three areas of inquiry: 1) whether there will be wasteful duplication of plant, including interference with another utility's certificates or services; 2) whether the capital required is so minimal that it will not "materially affect the financial condition of the utility in question; and 3) whether the utility's rates will increase as a result of the construction project.

a. There is no wasteful duplication or interference with any other utility operations. The upgrades replace existing equipment to allow for more efficient operations and improve the reliability of the equipment. *See* Exhibit A. In *City of*

Covington v. Board of Commissioners of Kenton County Water District, it was determined that a facility is not "duplicative" unless there is an existing facility that is "reasonably available for the present and future needs of those who will be served by it. The mere existence of a similar physical plant is not enough." 371 S.W.2d 20, 23 (Ky. 1963). Because this is a replacement and upgrade of outdated facilities, there is no wasteful duplication.

b. There will be no material financial impact on the NKWD. The $3,000,000 cost of the project is 0.87% of the district's net plant. Given that the estimated capital cost of the proposed construction represents approximately 0.87% percent of NKWD's net utility plant, the proposed construction will have an insignificant impact on its financial condition. The Commission has previously ruled that projects with costs ranging from 2% to approximately 3.25% of a utility's net plant to be considered in the ordinary course of business. *See* Commission Case Nos. 2019-00257 and 2018-00281. In addition, any depreciation expense related to this equipment is minimal when considering NKWD's overall operating expenses.

c. Rates will not be raised as a result of this project. Because of the relatively limited scope of the project, the proposed construction will not have an immediate or significant impact on rates.

10. The construction is in the public interest and is required to allow NKWD to continue to provide adequate potable water service to its customers. The project, its cost, need and other details are contained in the Project Description and Exhibit A.

11. Approval from the DOW for the Plans and Specifications and funding for this improvement was not required because it is a replacement of existing equipment. Easements and rights of way are not required. All equipment is being installed into existing facilities at NKWD's Fort Thomas Treatment Plant.

12. This service will not compete with any other utility in the area.

13. The proposed construction project identified in Exhibit A is scheduled to begin construction in October, 2020 or upon PSC approval and the expected in-service date is on or before January, 2022. Bid specifications for the project are included in Exhibit B. The bids were opened July 2, 2020 and are subject to acceptance for 180 days. Bid tabs are included in Exhibit C. Bids will expire December 29, 2020. The NKWD Board of Commissioners accepted the bid and authorized a contract at its regular meeting on July 16, 2020.

14. No new franchises are required.

15. Project specifications and descriptions are in Exhibits A and B. Facts relied on to justify the public need are included in the project descriptions in Exhibit A.

16. Maps are not applicable as no new facilities are being constructed.

17. The construction costs will be funded by as described above.

18. Estimated operating costs for operation and maintenance, depreciation and debt service after construction are shown in Exhibit D.

19. A description of the facilities and operation of the system are in Exhibit A.

20. A full description of the location of the project, description of construction, and related information is in Exhibit A.

21. The total estimated cost of construction at completion is referenced in Exhibits A, B and C.

22. CWIP at end of test year is listed in the Annual Report incorporated by reference.

23. Plant retirements are listed in the Annual Report. No salvage values are included as booked.

24. The use of the funds and need for the facilities is justified based on the engineering report included as Exhibit A.

25. No rate adjustment is being proposed.

26. Depreciation cost, cost of operation after installation and debt service are in Exhibit D.

27. The following information is provided pursuant to 807 KAR 5:001(12):

a. Financial operations for twelve-month period not less than 90 days prior – See Exhibit F. The attached financial statement reflects the year end information which has not materially changed.

b. No stock is authorized; No stock is issued.

c. There are no stock preferences.

d. Mortgages are listed in Exhibit E.

e. Bonds are listed in Exhibit E.

f. Notes are listed in Exhibit E.

g. Other indebtedness is listed in Exhibit E.

h. No dividends have been paid.

i. Current balance sheet and income statement are attached as Exhibits F.

28. The following information is provided as required by 807 KAR 5:001(18):

a. A general description of the property is contained in the Annual Report. The 2019 Report and attached financial information is the latest available from the NKWD.

b. No stock is to be issued; No bonds are to be issued in this case;

c. There is no refunding or refinancing;

d. The proceeds of the future Bond Anticipation Note are to acquire and install the property described in Exhibit A.

e. The par value, expenses, use of proceeds, interest rates and other information is not applicable because no bonds are being issued at this time.

29. The following exhibits are provided pursuant to 807 KAR 5:001 (18)(2):

a. There are no trust deeds. All notes, indebtedness and mortgages are

included in Exhibit E.

b. No property is to be acquired. 807 KAR 5:001(18)(2)(c).

30. Plant additions will be classified according to USoA. See Exhibit D.

31. The Kentucky Debt Officer was notified.

For these reasons, NKWD requests issuance of an order as soon as possible granting authority to acquire, install, and finance the replacement residual handling facilities and related improvements as an ordinary extension of existing facilities in the usual course of business.

SUBMITTED BY:

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Attorneys for Northern
Kentucky Water District

NORTHERN KENTUCKY
WATER DISTRICT

Case No. 2020-00283

Project

Fort Thomas Treatment Plant Residuals Handling Improvements Campbell County, Kentucky

184-4008

NORTHERN KENTUCKY WATER DISTRICT
Fort Thomas Treatment Plant Residuals Handling Improvements
184-4008

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Exhibit ____A____

NORTHERN KENTUCKY WATER DISTRICT

Project

Fort Thomas Treatment Plant Residuals Handling Improvements Campbell County, Kentucky

184-4008

ENGINEERING REPORTS AND INFORMATION

Project Map (A.1)

Preliminary Engineering Report (A.2)

Engineer's Opinion of Probable Total Construction Cost (A.3)

Plans prepared by Burgess & Niple, titled "Fort Thomas Treatment Plant Residuals Handling Improvements" dated April 2020, sealed by a P.E. (A.4)

Specifications prepared by Burgess & Niple, titled "Fort Thomas Treatment Plant Residuals Handling Improvements" dated April 2020, sealed by a P.E. (A.5)

Addendum No. 1, 2, & 3 dated 6/12/20, 6/23/20, and 6/29/20 respectively (A.6)

Case No. 2020-00283
Exhibit A.1 & 2

NORTHERN KENTUCKY
WATER DISTRICT

Project

Fort Thomas Treatment Plant Residuals Handling Improvements Campbell County, Kentucky

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Project Map (A.1)

And

Preliminary Engineering Report prepared by Burgess & Niple, titled "Ft. Thomas Treatment Plant Residuals Handling Improvements Preliminary Engineering Report" dated February 25, 2019 (A.2).

(Included as separate file)

Case No. 2020-00283
Exhibit A.3

NORTHERN KENTUCKY
WATER DISTRICT

Project

Fort Thomas Treatment Plant Residuals Handling Improvements Campbell County, Kentucky

184-4008

Engineer's Opinion
Of Probable
Construction Cost

NKWD FTTP Residuals Handling Improvements

100-Percent Complete Cost Estimate

Description	Quantity	Unit	Material Unit Price	Amount	Installation Unit Price	Amount	Total Unit Price	Amount
Spent Backwash Tank and Pump Room Modifications								
Demo	1	LS	$ -	$ -	$ 55,000	$ 55,000	$ 55,000	$ 55,000
30" Flanged Pipe	80	LF	$ 150	$ 12,000	$ 75	$ 6,000	$ 225	$ 18,000
30" Flanged Wye	1	EA	$ 15,000	$ 15,000	$ 2,000	$ 2,000	$ 17,000	$ 17,000
30" 45 Deg Bend	1	EA	$ 6,500	$ 6,500	$ 2,000	$ 2,000	$ 8,500	$ 8,500
30" 90 Deg Bend	1	EA	$ 8,500	$ 8,500	$ 2,000	$ 2,000	$ 10,500	$ 10,500
Extend 10" Return Suction Pipes	1	LS	$ 10,000	$ 10,000	$ 5,000	$ 5,000	$ 15,000	$ 15,000
FRP Ladded in Backwash Tank with Wall Mount Davit Base	1	LS	$ 3,500	$ 3,500	$ 2,000	$ 2,000	$ 5,500	$ 5,500
Alum Grating	230	SF	$ 65	$ 14,950	$ 25	$ 5,750	$ 90	$ 20,700
Confined Space Working Conditions	1	LS	$ -	$ -	$ 15,000	$ 15,000	$ 15,000	$ 15,000
Concrete Equipment Base	1	LS	$ 1,000	$ 1,000	$ 2,000	$ 2,000	$ 3,000	$ 3,000
6" Piping	1	LS	$ 4,000	$ 4,000	$ 2,000	$ 2,000	$ 6,000	$ 6,000
6" Check Valve	2	EA	$ 2,500	$ 5,000	$ 1,000	$ 2,000	$ 3,500	$ 7,000
6" Plug Valve	2	EA	$ 2,000	$ 4,000	$ 1,000	$ 2,000	$ 3,000	$ 6,000
4" Plug Valve	2	EA	$ 1,000	$ 2,000	$ 1,000	$ 2,000	$ 2,000	$ 4,000
42" x 42" Access Hatch Backwash Tank Top Slab	2	EA	$ 3,500	$ 7,000	$ 1,500	$ 3,000	$ 5,000	$ 10,000
New Sludge Transfer Pump (Flygt)	2	EA	$ 15,000	$ 30,000	$ 5,000	$ 10,000	$ 20,000	$ 40,000
Pump Flushing Connections	1	LS	$ 1,000	$ 1,000	$ 2,000	$ 2,000	$ 3,000	$ 3,000
Suspended Solids Meter	1	EA	$ 2,500	$ 2,500	$ 3,500	$ 3,500	$ 6,000	$ 6,000
LED Lighting and Controls	7	EA	$ 400	$ 2,800	$ 100	$ 700	$ 500	$ 3,500
PLC Panel Modifications (Fiber Patch Panel, Network Switch, UG Fiber)	1	LS	$ 3,000	$ 3,000	$ 7,000	$ 7,000	$ 10,000	$ 10,000
Variable Frequency Drives for Sludge Feed Pumps, NEMA 12	2	EA	$ 15,000	$ 30,000	$ 3,000	$ 6,000	$ 18,000	$ 36,000
Pressure Gauges/Switches/Elect/Controls for Sludge Transfer Pumps	1	LS	$ 33,500	$ 33,500	$ -	$ -	$ 33,500	$ 33,500
Subtotal								$ 333,200
Gravity Thickener Modifications								
Trough Demo	1	LS	$ -	$ -	$ 10,000	$ 10,000	$ 10,000	$ 10,000
New S.S. Troughs and V.Notch Weirs and Supports	1	LS	$ 120,000	$ 120,000	$ -	$ -	$ 120,000	$ 120,000
Subtotal								$ 130,000
Dewatering Building Modifications								
Demolition of Existing BFPs, Belt Conveyors, and Polymer System	1	LS	$ -	$ -	$ 35,000	$ 35,000	$ 35,000	$ 35,000
Belt Presses (1.5m, Pneumatic Components)	2	EA	$ 260,000	$ 520,000	$ 65,000	$ 130,000	$ 325,000	$ 650,000
Screw Conveyors (12" Inclined Collection and Two Disposal)	1	LS	$ 212,000	$ 212,000	$ 74,200	$ 74,200	$ 286,200	$ 286,200
Screw Conveyor Supports	1	LS	$ 25,000	$ 25,000	$ 6,250	$ 6,250	$ 31,250	$ 31,250
Polymer Feed System (Dry Feeder and Mixing/Aging Tanks)	1	EA	$ 96,000	$ 96,000	$ 24,000	$ 24,000	$ 120,000	$ 120,000
Polymer Metering Pumps (Two Pumps on One Skid)	1	EA	$ 28,000	$ 28,000	$ 4,200	$ 4,200	$ 32,200	$ 32,200
Polymer Piping (1" Dia, Schedule 80 PVC)	1	LS	$ 5,000	$ 5,000	$ 1,250	$ 1,250	$ 6,250	$ 6,250
Water Heater, Shower/Eyewash, Pressure Washer, Copper Piping	1	LS	$ 17,000	$ 17,000	$ 4,250	$ 4,250	$ 21,250	$ 21,250
Concrete Curb and Ramp	1	LS	$ 4,400	$ 4,400	$ 1,100	$ 1,100	$ 5,500	$ 5,500
Fiberglass Grating	150	SF	$ 35	$ 5,250	$ 9	$ 1,313	$ 44	$ 6,563
Sludge Line Monitoring (Solids Density, Pressure Gauge, Flow Meter)	1	LS	$ 18,000	$ 18,000	$ 4,500	$ 4,500	$ 22,500	$ 22,500
Loadout Area Concrete Slab	55	CY	$ 400	$ 22,000	$ 100	$ 5,500	$ 500	$ 27,500
Loadout Area Trench Drains (12" Wide, Traffic-Rated Grating)	76	LF	$ 145	$ 11,020	$ 36	$ 2,755	$ 181	$ 13,775
Loadout Area Dumpster Hardened Steel Wear Plates (24" Wide)	160	LF	$ 180	$ 28,800	$ 45	$ 7,200	$ 225	$ 36,000
Loadout Area Dumpster Wear Plate Support Concrete (24" Wide, 6" Deep)	6	CY	$ 600	$ 3,600	$ 150	$ 900	$ 750	$ 4,500
Temporary Dewatering (Sludge Piping Connection and Rental)	1	LS	$ 30,000	$ 30,000	$ 2,500	$ 2,500	$ 32,500	$ 32,500
LED Lighting and Controls	28	EA	$ 400	$ 11,200	$ 200	$ 5,600	$ 600	$ 16,800
Ethernet Cameras NEMA 4X	4	EA	$ 500	$ 2,000	$ 100	$ 400	$ 600	$ 2,400
120/208V, NEMA 4X Panelboards	3	EA	$ 4,000	$ 12,000	$ 2,000	$ 6,000	$ 6,000	$ 18,000
NEMA Size 1, NEMA 4X FVR Starters for Conveyors	3	EA	$ 3,500	$ 10,500	$ 1,000	$ 3,000	$ 4,500	$ 13,500
30A/3P, NEMA 4X Disconnect Switches for Slide Gates	2	EA	$ 850	$ 1,700	$ 200	$ 400	$ 1,050	$ 2,100
500 KCMIL Feeder Condcutors	150	LF	$ 12	$ 1,800	$ 4	$ 525	$ 16	$ 2,325
Magnetic Flowmeters	2	EA	$ 4,000	$ 8,000	$ 2,000	$ 4,000	$ 6,000	$ 12,000
Suspended Solids Meter	2	EA	$ 2,500	$ 5,000	$ 3,500	$ 7,000	$ 6,000	$ 12,000
Power Wiring and Conduit	7000	LF	$ 8	$ 56,000	$ 13	$ 91,000	$ 21	$ 147,000
Control Wiring and Conduit	3000	LF	$ 5	$ 15,000	$ 10	$ 30,000	$ 15	$ 45,000
Gas Fired Make-Up Air Unit and Controls	1	EA	$ 30,000	$ 30,000	$ 10,000	$ 10,000	$ 40,000	$ 40,000
Exhaust Fan and Controls	1	EA	$ 5,000	$ 5,000	$ 1,000	$ 1,000	$ 6,000	$ 6,000
Rounded Subtotal								$ 1,648,000
Dewatering Building Modifications								

Cost Summary	**Base Scope**
Spent Backwash Tank and Pump Room Modifications	$ 333,200
Gravity Thickener Modifications	$ 130,000
Dewatering Building Modifications	$ 1,648,000
Subtotal	$ 2,111,200
Contingency (10%)	$ 211,100
Rounded Total	**$ 2,322,000**

Case No. 2020-00283
Exhibit A.4

NORTHERN KENTUCKY
WATER DISTRICT

Project

Fort Thomas Treatment Plant Residuals Handling Improvements Campbell County, Kentucky

184-4008

Plans prepared by Burgess & Niple, titled "Fort Thomas Treatment Plant Residuals Handling Improvements" dated April 2020, sealed by a P.E. (A.4)

(Included as separate file)

Case No. 2020-00283
Exhibit A.5

NORTHERN KENTUCKY
WATER DISTRICT

Project

Fort Thomas Treatment Plant Residuals Handling Improvements Campbell County, Kentucky

184-4008

Specifications prepared by Burgess & Niple, titled "Fort Thomas Treatment Plant Residuals Handling Improvements" dated April 2020, sealed by a P.E. (A.5)

Advertisement, Bid, Contract, and Specifications

Ft. Thomas Treatment Plant Residuals Handling Improvements

Northern Kentucky Water District

April 2020

NORTHERN KENTUCKY WATER DISTRICT

FORT THOMAS TREATMENT PLANT

RESIDUALS HANLDING IMPROVEMENTS

ADVERTISEMENT, BID, CONTRACT, AND SPECIFICATIONS

April 2020

GOVERNING BODY

COMMISSIONERS:

DOUG WAGNER – CHAIR
JOSEPH J. KOESTER – VICE CHAIR
FRED MACKE, JR - SECRETARY
JODY R. LANGE, CPA, CGMA - TREASURER
CLYDE CUNNINGHAM - COMMISSIONER
DR. PATRICIA SOMMERKAMP - COMMISSIONER

RON LOVAN, PRESIDENT/CEO

BURGESS & NIPLE, INC.
525 Vine Street, Suite 1300
Cincinnati, OH 45202
Phone: 513-579-0042
www.burgessniple.com

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INVITATION TO BID

Date: May 28, 2020

PROJECT**:** Ft. Thomas Treatment Plant Residuals Handling Improvements
City of Fort Thomas, Campbell County, Kentucky

LOCATION WHERE SEALED BIDS WILL BE RECEIVED:

Northern Kentucky Water District (Owner)
2835 Crescent Springs Road
P.O. Box 18640
Erlanger, Kentucky 41018

UNTIL: Date: July 2, 2020
Time: 2:00 p.m., local time

At said place and time, and promptly thereafter, all Bids that have been duly received will be opened.

The proposed Work is generally described as follows:

Furnish and install two belt filter presses to replace two existing units, replace existing belt conveyor with new screw conveyor system, replace existing dry polymer and pumping components with new dry polymer system, and add two transfer pumps. Conduct temporary sludge dewatering as necessary during equipment improvements. Piping, electrical, lighting, instrumentation, and control upgrades, along with coordinating temporary dewatering sludge disposal during the dewatering facility modifications, are also included in the project scope.

All Bids must be in accordance with the Instructions to Bidders and Contract Documents on file. Contract Documents will be posted to a website for examination, download, and use in bid preparation. To register as a plan holder and obtain access to pdf files of Bidding Documents, email a request to Jeff Eilers, PE, Burgess & Niple, Inc. (jeff.eilers@burgessniple.com). Access to the Bidding Documents will be provided at no cost.

Bids will be received on lump sum basis as described in the Contract Documents.

Bid security, in the form of a certified check or a Bid Bond (insuring/bonding company shall be rated "A" by AM Best) in the amount of ten percent (10%) of the maximum total bid price, must accompany each Bid.

The Successful Bidder will be required to furnish a Construction Payment Bond and a Construction Performance Bond (insuring/bonding company shall be rated "A" by AM Best) as security for the faithful performance of the contract and the payment of all bills and obligations arising from the performance of the Contract.

Evaluation of Bids and the awarding of a final contract are subject to the reciprocal preference for Kentucky resident bidders pursuant to KRS 45A490 to 45A.494 and (KAR 200 5:400).

Owner reserves the right to reject any or all Bids, including without limitation the right to reject any or all nonconforming, non-responsive, incomplete, unbalanced, or conditional Bids, to waive informalities, and to reject the Bid of any Bidder if Owner believes that it would not be in the best interest of Owner to make an award to that Bidder. Owner also reserves the right to negotiate with the apparent qualified Bidder to such an extent as may be determined by Owner.

A non-mandatory virtual prebid meeting will be held via Microsoft Teams on June 10, 2020, starting at 10:00 am. To obtain an invitation to this virtual prebid meeting, please email a request to Jeff Eilers, PE, Burgess & Niple, Inc. (jeff.eilers@burgessniple.com). There will be no site visit as part of this prebid meeting. Site visits are permitted on Fridays by appointment only. On request 72 hours in advance, Owner will provide each Bidder access to the site to conduct such investigations and tests as each Bidder deems necessary for submission of a Bid. Bidders shall provide and utilize face masks and gloves while on site. Arrangements for site visits shall be made by calling Kyle Ryan, PE, with the Northern Kentucky Water District at (859) 426-2713.

Minority Bidders are encouraged to bid.

Bids shall remain subject to acceptance for 180 days after the day of bid opening or for such longer period of time to which a Bidder may agree in writing upon request of the Owner. If a Contract is to be awarded, the Owner will give the successful Bidder a Notice of Award during the period of time during which the successful Bidder's bid remains subject to acceptance.

Amy Kramer, Vice President of Engineering, Production & Distribution
Northern Kentucky Water District

End of Section

SECTION 00 21 13

INSTRUCTIONS TO BIDDERS

1. DEFINED TERMS. Terms used in these Instructions to Bidders will have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below which are applicable to both the singular and plural thereof:

A. *Bidder* - The individual or entity who submits a Bid directly to Owner.

B. *Successful Bidder* - The lowest responsible Bidder submitting a responsive Bid to whom Owner (on the basis of Owner's evaluation as hereinafter provided) makes an award.

2. COPIES OF CONTRACT DOCUMENTS. Complete sets of Contract Documents must be used in preparing Bids; Bidder shall have sole responsibility for errors or misrepresentations resulting from the use of incomplete sets of Bidding Documents.

Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not confer a license or grant for any other use.

3. QUALIFICATIONS OF BIDDERS. To demonstrate Bidder's qualifications to perform the Work, within five days of Owner's request Bidder shall submit written evidence such as financial data, previous experience, present commitments, and such other data as may be requested by Owner. Bidders who have not, in the Owner's opinion, had sufficient experience in the size and type of work involved may not be considered.

Each Bid must contain evidence of Bidder's qualifications to transact business in the State of Kentucky or covenant to obtain such qualifications prior to award of the Contract. The Bidder's Organization Number from the Kentucky's Secretary of State and principal place of business as filed with Kentucky's Secretary of State must be included where applicable.

Each Bidder must be registered as a plan holder with the Issuing Office or Engineer on record in the advertised "Invitation to Bid". There shall be no substitution of bidders without proper registration with the Issuing Office or Engineer on record in the advertised "Invitation to Bid"

4. EXAMINATION OF CONTRACT DOCUMENTS AND SITE. It is the responsibility of each Bidder, before submitting a Bid, to:

a. thoroughly examine and study the Instructions to Bidders and the Contract Documents, including any Addenda;

b. visit the Site and become familiar with and satisfy Bidder as to the general, local, and site conditions that may affect cost, progress, performance, or furnishing of the Work;

c. become familiar with and satisfy Bidder as to all federal, state, and local Laws and Regulations that may affect cost, progress, performance, or furnishing of the Work;

d. agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times and in accordance with the other terms and conditions of the Contract Documents;

e. correlate the information known to Bidder, information and observations obtained from visits to the Site, and all additional examinations, investigations, explorations, tests, studies, and data with the Contract Documents;

f. promptly give Owner written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Contract Documents and confirm that the written resolution thereof by Owner is acceptable to Bidder; and

g. determine that the Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.

4.01. Underground Facilities. Information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner or others, and Owner and Engineer disclaim responsibility for the accuracy or completeness thereof, unless it is expressly provided otherwise in the Supplementary Conditions.

4.02. Additional Information. Before submitting a Bid, each Bidder may, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests, and studies and obtain any additional information and data which pertain to subsurface or physical conditions at or contiguous to the Site or otherwise, which may affect cost, progress, performance, or furnishing of the Work and which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price, and other terms and conditions of the Contract Documents. Each Bidder shall be responsible for any claims for personal injury, death or damage to property caused by Bidder's entry on public or private property and shall defend and indemnify Owner and all other parties against any such claims.

On request 72 hours in advance, Owner will provide each Bidder access to the site to conduct such explorations and tests as each Bidder deems necessary for submission of a Bid. Bidder shall fill all holes and clean up and restore the site to its former condition upon completion of such explorations. Currently, site visits may only be scheduled on Fridays. Arrangements for site visits shall be made by calling Kyle Ryan, PE, with the Northern Kentucky Water District at (859) 426-2713.

4.03. Bidder's Representation. The submission of a Bid will constitute an incontrovertible representation and covenant by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the Work required by the Contract Documents and applying any specific means, methods, techniques, sequences, and procedures of construction that may be shown or indicated or expressly required by the Contract Documents, that Bidder has given Owner written notice of all conflicts, errors, ambiguities, and discrepancies that Bidder has discovered in the Contract Documents and the written resolutions thereof are acceptable to Bidder, and that the Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.

5. SITE AND OTHER AREAS. The Site is identified in the Contract Documents. All additional lands and access thereto required for temporary construction facilities, construction equipment, or storage of materials and equipment to be incorporated in the Work are to be obtained and paid for by Contractor. Easements for permanent structures or permanent changes in existing facilities are to be obtained and paid for by Owner unless otherwise provided in the Contract Documents.

6. INTERPRETATIONS AND ADDENDA. All questions about the meaning or intent of the Bidding Documents are to be submitted to Owner in writing. Any interpretations or clarifications that are considered necessary by Owner in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by Owner as having received the Bidding Documents. Questions received less than 72 hours prior to the date for opening of Bids may not be answered. The person submitting questions shall be responsible for their prompt delivery. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

Addenda may be issued to clarify, correct, or change the Bidding Documents as deemed advisable by Owner or Engineer.

Owner will not be responsible for explanations or interpretations of the Bidding Documents or Contract Documents except as issued in accordance herewith.

7. BID SECURITY. Each Bid must be accompanied by Bid security made payable to Owner in an amount of 10 percent of Bidder's maximum Bid price and in the form of a Bid Bond (on the form attached) issued by a surety meeting the requirements of paragraphs 5.01 and 5.02 of the General Conditions and shall be rated “A” by AM BEST.

Bid security of the Successful Bidder will be retained until such Bidder has executed the Contract Documents, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Owner may annul the Notice of Award and Bid security of that Bidder will be forfeited. Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Agreement or one day after the last day the Bids remain subject to acceptance, whereupon Bid security furnished by such Bidders will be returned.

8. CONTRACT TIMES. The numbers of days within which, or the dates by which, the Work is to be (a) Substantially Completed and (b) also completed and ready for final payment are set forth in the Agreement.

9. LIQUIDATED DAMAGES. Provisions for liquidated damages, if any, are set forth in the Agreement.

10. SUBSTITUTE OR "OR-EQUAL" ITEMS. The Contract, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration of possible substitute or "or-equal" items. Whenever it is specified or described in the Bidding Documents that a substitute or "or-equal" item of material or equipment may be furnished or used by Contractor if acceptable to Owner, application for such acceptance will not be considered by Owner until after the Effective Date of the Agreement. The procedure for submission of any such application by Contractor and consideration by Owner is set forth in the General Conditions and may be supplemented in the General Requirements.

11. PREPARATION OF BID. The Bid form is included with the Bidding Documents. Additional copies may be obtained from Owner.

All blanks on the Bid form shall be completed by printing in ink or by typewriter and the Bid signed. A Bid price shall be indicated for each lump sum bid item and/or unit price item listed therein, or the words "No Bid", "No Change", or "Not Applicable" entered.

A Bid by a corporation shall be executed in the corporate name by the president or a vice-president or other corporate officer accompanied by evidence of authority to sign. The corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown below the signature.

A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership shall be shown below the signature.

A Bid by a limited liability company shall be executed in the name of the firm by a member (if member-managed) or manager (if manager-managed) and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm must be shown below the signature.

A Bid by an individual shall show the Bidder's name and official address.

A Bid by a joint venture shall be executed by each joint venturer in the manner indicated on the Bid form. The official address of the joint venture must be shown below the signature.

All names shall be typed or printed in ink below the signatures.

The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid form.

The address and telephone number for communications regarding the Bid shall be shown.

The Bid shall identify whether the Bidder is a resident or nonresident bidder for purposes of Kentucky's reciprocal preference statute (KRS 45A.490 to 45A.494 and 200 KAR 5:400). If the Bidder is claiming a "resident bidder" status as defined in KRS 45A.494(2), the Bid shall include a properly executed and notarized affidavit affirming that it meets the criteria to be considered such a resident bidder. If requested by Owner, Bidder shall also provide documentation proving such resident bidder status; failure to do so shall result in disqualification of the Bidder or contract termination.

While the Bidder should consult the applicable statutes and regulation, generally speaking, a "resident bidder" is an individual or business entity that, on the date the contract is first advertised or announced as available for bidding: (a) is authorized to transact business in the Commonwealth; AND (b) has for one (1) year prior to and through the date of the advertisement, (i) filed Kentucky corporate income taxes, (ii) made payments to the Kentucky unemployment insurance fund established in KRS 341.490, and (iii) maintained a Kentucky workers' compensation policy in effect. A "nonresident bidder" is any other individual or business entity.

12. BASIS OF BID. The lump sum price shall be based on the Work as indicated on the Drawings and as specified.

13. SUBMITTAL OF BID. Due to the Covid-19 situation, the Northern Kentucky Water District (NKWD) has implemented temporary changes that will impact the bidding of projects, goods, and services. The lobby is closed to the public at the District's Erlanger office. All hand delivered bids to this location must be turned in via the drive-thru window. Additionally, the District will not be hosting group meetings or gatherings, including public bid openings. All bid openings will be conducted by NKWD staff only at the date and time indicated in the Invitation to Bid. The general public will not be permitted to attend the bid openings as has traditionally occurred in the past. Bid results will be available upon

request by contacting Denise Manning at 859-426-2718 or dmanning@nkywater.org. These changes will remain in place until further notice.

A Bid shall be submitted no later than the date and time prescribed and at the place indicated in the advertisement or invitation to Bid and shall be enclosed in an opaque sealed envelope plainly marked with the Project title, the name and address of Bidder, and shall be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate envelope plainly marked on the outside with the notation "Bid Enclosed".

Bids shall be addressed to Owner at:

Northern Kentucky Water District (Owner)
2835 Crescent Springs Road
P.O. Box 18640
Erlanger, Kentucky 41018

Two complete and executed Bid Form along with "Non-Collusion Affidavit" and Bid Bond shall be submitted. Bids shall be typed or in ink. Bidder shall assume full responsibility for timely delivery at the location designated for receipt of Bids. Bids received after the time and date for receipt of Bids may be returned unopened. Oral, telephone, facsimile, or telegraph Bids are invalid and will not receive consideration.

If included with the Contract Documents, Bidder shall prepare and submit with its Bid the Questionnaire listing the Suppliers and manufacturers of items of equipment and materials that Bidder proposes to furnish.

14. MODIFICATION AND WITHDRAWAL OF BIDS. A Bid may be modified or withdrawn by an appropriate document duly executed in the manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. For a period ending 72 hours after Bids are opened, any Bidder may request the withdrawal of its Bid by filing with Owner a duly signed written notice and otherwise demonstrating by clear and convincing evidence to the reasonable satisfaction of Owner that the Bid was submitted in good faith but there was a material and/or substantial mistake in the preparation of its Bid. If the withdrawal of the Bid is approved by the Owner in its sole discretion, the Bid security will be returned. Without the advanced full disclosure by the withdrawing Bidder to and written consent of the Owner, (a) no Bid shall be withdrawn under this section when the result would be the awarding of the contract on another Bid of the same Bidder or of another Bidder in which the withdrawing Bidder has a direct or indirect equitable interest and (b) no Bidder who is permitted to withdraw a Bid shall, for compensation, supply any material or labor to or perform any subcontract or other work agreement for the Bidder to whom the contract is awarded or otherwise benefit, directly or indirectly, from the performance of the Project.

15. OPENING OF BIDS. Bids will be opened at the time and place indicated in the advertisement or invitation to Bid. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

16. BIDS TO REMAIN SUBJECT TO ACCEPTANCE. All Bids will remain subject to acceptance for the period of time stated in the Bid form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

17. AWARD OF CONTRACT. Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, non-responsive, incomplete, unbalanced, or conditional Bids. Owner further reserves the right to reject the Bid of any Bidder which it finds, after reasonable inquiry and evaluation, to be non-responsive. Owner may also reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project to make an award to that Bidder. Owner also reserves the right to waive all informalities not involving price, time, or changes in the Work and to negotiate with the apparent Successful Bidder to such an extent as may be determined by Owner. The Owner also reserves the right to increase or decrease the quantities of work per the General Conditions.

In the case of Bids for equipment and materials only, Owner may award the Contract to a responsible Bidder other than the lowest in the interest of standardization or ultimate economy, as determined by Owner.

In evaluating Bids, Owner will consider, among other lawful considerations, the following:

a. Whether or not the Bid complies with the prescribed requirements, and provides such alternates, unit prices and other information or data as may be requested in the Bid form or prior to the Notice of Award.

b. The qualifications of the Bidder.

c. If the Bidder maintains a permanent place of business.

d. If the Bidder has adequate personnel and equipment to perform the Work properly and expeditiously.

e. Bidder's financial status to meet all obligations and incidentals to the Work.

f. Whether the Bidder has appropriate technical expertise and experience.

g. Bidder's performance record.

h. The amount of the Total Base Bid, exclusive of any additive alternates, if applicable. Any additive alternates will be considered after selection of the lowest Total Base Bid. Each additive alternate will be considered and selected or not selected individually, at Owner's discretion, for inclusion in the work.

In addition, the evaluation of Bids will be subject to the reciprocal preference for Kentucky resident bidders pursuant to KRS 45A.490 to 45A.494 and KAR 200 5:400. These statutes and regulation provide in part as follows: (a) a resident bidder of the Commonwealth shall be given a preference against a nonresident bidder registered in any state that gives or requires a preference to bidders from that state; (b) the preference shall be equal to the preference given or required by the state of the nonresident bidder; (c) this preference shall not be applied against nonresident bidders residing in states that do not give preference against Kentucky bidders; (d) if a procurement determination results in a tie between a resident bidder and a nonresident bidder, preference shall be given to the resident bidder; and (e) the preference shall not result in a nonresident bidder receiving a preference over another nonresident bidder.

Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders to perform the Work in accordance with the Contract Documents, including, without limitation, a Bidder's claim that it is a resident bidder for purposes of Kentucky's preference statute.

18. CONTRACT SECURITY AND INSURANCE. Article 5 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment Bonds and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it must be accompanied by such Bonds.

19. SIGNING OF AGREEMENT. When Owner gives a Notice of Award to the Successful Bidder, it will be accompanied by the required number of unsigned counterparts of the Agreement with the other Contract Documents identified in the Agreement as attached thereto. Within **15 days** thereafter, the Successful Bidder shall sign, leaving the dates blank, and deliver the required number of counterparts of the Agreement and attached documents to Owner. Within **15 days** thereafter, Owner shall deliver one fully signed counterpart to Successful Bidder with a complete set of the Drawings with appropriate identification.

20. RETAINAGE. Provisions concerning retainage are set forth on the Agreement.

End of Section

SECTION 00 41 13

BID FORM

PROJECT IDENTIFICATION:

Ft. Thomas Treatment Plant Residuals Handing Improvements

THIS BID IS SUBMITTED TO:

Northern Kentucky Water District (Owner)
P.O. Box 18640
2835 Crescent Springs Road
Erlanger, Kentucky 41018

THIS BID IS SUBMITTED BY: _____
(Bidder's Company Name)

1. The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Contract Documents to perform all Work as specified or indicated in the Contract Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

2. Bidder accepts all of the terms and conditions of the Invitation to Bid and the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for **180** calendar days after the Bid opening, or for such longer period of time to which the Bidder may agree in writing upon request of Owner. Bidder understands that certain extensions to the time for acceptance of this Bid may require the consent of the surety for the Bid Bond.

3. In submitting this Bid, Bidder represents and covenants, as set forth in the Agreement, that:

   a. Bidder has examined and carefully studied the Contract Documents, the other related data identified in the Contract Documents, and the following Addenda, receipt of all of which is hereby acknowledged:

      No. _____ Dated _____

      No. _____ Dated _____

      No. _____ Dated _____

   b. Bidder has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

   c. Bidder is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.

   d. Bidder has obtained and carefully studied (or assumes responsibility for having done so) all additional or supplementary explorations, investigations, explorations, tests, studies and data

concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents to be employed by Bidder, and safety precautions and programs incident thereto.

e. Bidder does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times and in accordance with the other terms and conditions of the Bidding Documents.

f. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.

g. Bidder has correlated the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Bidding Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents.

h. Bidder has given Owner written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by Owner is acceptable to Bidder.

i. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Bid is submitted.

j. Check the One Condition that Applies Below:

_____ Bidder is a "resident bidder" as defined in KRS 45A.494(2) of Kentucky's resident bidder reciprocal preference statute AND submits with this Bid a properly executed and notarized Affidavit that affirms that Bidder meets the resident bidder criteria, which Affidavit is hereby incorporated herein and made a part of this Bid.

Or

_____ Bidder is a "nonresident bidder" as defined in KRS 45A.494(3) of Kentucky's resident bidder reciprocal preference statute AND its principal place of business as identified its Certificate of Authority to transact business in Kentucky as filed with Kentucky's Secretary of State or, if Bidder hereby represents and covenants that it is not required to obtain a Certificate of Authority to transact business in Kentucky, its mailing address, is:

_____

_____

_____

k. Bidder's Organization Number from Kentucky's Secretary of State is #_____ [if applicable] and Bidder is qualified to transact business in the State of Kentucky or hereby covenants to obtain such qualifications prior to award of the Contract.

4. Bidder further represents that this Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any agreement or rules of any group, association, organization, or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any individual or entity to refrain from bidding; and Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over Owner.

5. The Bidder understands and agrees that during the performance of the Contract, it shall maintain a presence within such proximity of the Work Site which will allow it to respond to an emergency at the Work Site within one hour of receiving notice of an emergency, including emergencies occurring during non-working hours. The Bidder shall provide a list of emergency phone numbers for such purposes. If the Bidder does not have such a presence, it may satisfy this requirement by sub-contracting with a sub-contractor that does have such a presence, provided that any such sub-contractor must be approved by the Owner, in its sole discretion, prior to the project pre-construction meeting.

6. Bidder will complete the Work for the following lump sum and provide the equipment as indicated in Section 00 41 20 "Bid Equipment and Components," which shall accompany this bid form.

Bidder agrees to perform all the following Work described in the specifications and shown on the drawings, for the following lump sum price:

Lump Sum Bid of $ (in numbers)

(in words)

7. Bidder agrees that the Work will be substantially complete within **420** calendar days after the date when the Contract Times commence to run as provided in paragraph 2.03 of the General Conditions, and completed and ready for final payment in accordance with paragraph 14.07.B of the General Conditions within **450** calendar days after the date when the Contract Times commence to run.

The terms used in this Bid with initial capital letters have the meanings indicated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

8. References

Contact Person	Company Name	Phone No.	Project Name
1.			
2.			
3.			
4.			

SUBMITTED on _____, 2020.

9. Communications concerning this Bid shall be sent to Bidder at the following address:

_____

_____

_____

_____

10. The terms in this Bid, which are defined in the General Conditions included as part of the Contract Documents, have the meanings assigned to them in the General Conditions.

SIGNATURE OF BIDDER

If an Individual

Name (typed or printed): _____

By_____ (SEAL)
(Individual's signature)

doing business as _____

Business address _____

_____

Phone No.: _____ Fax No.: _____

Date _____

If a Partnership

Partnership Name: _____ (SEAL)

By_____
(Signature of general partner - attach evidence of authority to sign)

Name (typed or printed): _____

Business address _____

_____

Phone No. _____ Fax No.: _____

Date _____

If a Corporation

Corporation Name: _____ (SEAL)

State of Incorporation: _____

Type (General, Professional Service): _____

By_____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

(CORPORATE SEAL)

Attest _____

Business address _____

_____

Phone No. _____ Fax No.: _____

Date _____

If a Limited Liability Company

Company Name: _____ (SEAL)

State of Organization: _____

Type (General, Professional): _____

By_____
S*ignature of Member or Manager (as applicable)- attach evidence of authority to sign)*

Name (typed or printed): _____

Title: _____

(COMPANY SEAL)

Attest _____

Business address _____

_____

Phone No. _____ Fax No.: _____

Date _____

If a Joint Venture

(Each joint venturer must sign. The manner for signing for each individual, partnership, and corporation that is party to the joint venture should be in the manner indicated above.)

Joint Venturer Name: _____ (SEAL)

By: _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

_____

Phone No.: _____ Fax No.: _____

Date _____

Joint Venturer Name: _____ (SEAL)

By: _____
(Signature - attach evidence of authority to sign)

Name (typed or printed): _____

Title: _____

Business address: _____

_____

Phone No.: _____ Fax No.:_____

Date _____

SECTION 00 41 20

BID EQUIPMENT AND COMPONENTS

NORTHERN KENTUCKY WATER DISTRICT
FTTP RESIDUALS HANDLING IMPROVEMENTS

BIDDER shall indicate by placing an "X" in the "( )" space below for the equipment which shall be furnished in performance of the Work. Only one "X" shall be entered for a category of equipment or component identified by product name and specification number.

For the Dewatering Polymer System and Metering Pumps, BIDDER shall include base bid manufacturer indicated in lump sum bid indicated on the Bid Form. BIDDER may enter add / deduct to the Bid Form sum for alternative equipment, as noted in each category below. BIDDER must indicate whether the alternate is an add or deduct by circling the word which does apply and crossing out the word which does not apply. If no amount is entered, bidder agrees to perform Alternative at no change in cost. If neither add nor deduct is identified as stated herein, the bidder agrees to do the work described in the Alternative as a deduct. BIDDER shall follow these directions. Any Bid Form that is submitted not in compliance with these required identifications may be rejected by the OWNER and that Bid not considered in determining Award.

Equipment (Specification Section)	**Product Manufacturer or Supplier**
Sludge Transfer Pumps (33 32 16)	( ) a. Flygt ( ) b. KSB ( ) c. Ebara
Belt Filter Press Dewatering System (44 72 70)	( ) a. Andritz ( ) b. Komline-Sanderson ( ) c. Phoenix
Dewatering Polymer System (44 72 72)	Base Bid Manufacturer: Acrison Add / Deduct: ( ) a. ProMinent $_____ ( ) b. UGSI $_____ ( ) c. Velodyne $_____
Dewatering Polymer Metering Pumps (44 72 74)	Base Bid Manufacturer: Watson-Marlow Add / Deduct: ( ) a. Vector $_____ ( ) b. ProMinent $_____
Dewatered Sludge Screw Conveyor System (44 72 90)	( ) a. Custom Conveyor ( ) b. Jim Meyers and Sons ( ) c. JDV

End of Section

SECTION 00 41 33

NON-COLLUSION AFFIDAVIT

STATE OF: _____

COUNTY OF: _____

_____, being first duly sworn, deposes

and says that he/she is the _____ of
(sole owner, a partner, president, secretary, etc.)

_____, the party making the foregoing bid; that such bid is genuine and not collusive or sham; that said bidder is not financially interested in, or otherwise affiliated in a business way with any other bidder on the same contract; that said bidder has not colluded, conspired, connived, or agreed, directly or indirectly, with any bidder or person, to put in a sham bid, or that such other person shall refrain from bidding, and has not in any manner directly or indirectly sought by agreement or collusion, or communication or conference, with any person, to fix the price or affidavit of any other bidder, or that of any other bidder, or to secure any advantage against Owner, or any person or persons interested in the proposed Contract; and that all statements contained in said bid are true; and further, that such bidder has not, directly or indirectly submitted this bid, or the contents thereof, or divulged information of data relative thereto to any association or to any member or agent thereof.

_____
AFFIANT

Sworn to and subscribed before me, a Notary Public in and for the above named

State and County, this _____ day of _____, 20 ____.

_____
NOTARY PUBLIC

End of Section

FT. THOMAS TREATMENT PLANT
RESIDUALS HANDLING IMPROVEMENTS

REQUIRED NOTARIZED AFFIDAVIT FOR BIDDERS, OFFERORS AND CONTRACTORS CLAIMING KENTUCKY RESIDENT BIDDER STATUS

FOR BIDS AND CONTRACTS IN GENERAL:
The bidder or offeror hereby swears and affirms under penalty of perjury that, in accordance with KRS 45A.494(2), the entity bidding is an individual, partnership, association, corporation, or other business entity that, on the date the contract was first advertised or announced as available for bidding:

1. Is authorized to transact business in the Commonwealth of Kentucky; AND
2. Has for one year prior to and through the date this contract was first advertised or announced as available for bidding:
    a. Filed Kentucky corporate income taxes;
    b. Made payments to the Kentucky unemployment insurance fund established in KRS 341.490; and
    c. Maintained a Kentucky workers' compensation policy in effect.

The undersigned acknowledges that the District reserves the right to request documentation supporting a bidder's claim of resident bidder status. Failure to provide such documentation upon request shall result in disqualification of the bidder or contract termination.

_____ _____
Signature Printed Name

_____ _____
Title (if signing on behalf of an entity) Date

State of _____)

County of _____)

Subscribed and sworn to before me by _____, as the _____, of _____, this _____ day of _____, 2020.

_____
Notary-at-Large
Commission Expiration_____

SECTION 00 52 13

AGREEMENT
FT. THOMAS TREATMENT PLANT RESIDUALS HANDLING IMPROVEMENTS

THIS AGREEMENT is by and between the Northern Kentucky Water District (herein called Owner) and_____ (herein called Contractor).

Owner and Contractor, in consideration of the mutual covenants herein set forth, agree as follows:

Article 1. WORK.

Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:

> Furnish and install two belt filter presses to replace two existing units, replace existing belt conveyor with new screw conveyor system, replace existing dry polymer and pumping components with new dry polymer system, and add two transfer pumps. Conduct temporary sludge dewatering as necessary during equipment improvements. Piping, electrical, lighting, instrumentation, and control upgrades, along with coordinating temporary dewatering sludge disposal during the dewatering facility modifications, are also included in the project scope.

Article 2. ENGINEER.

The Project has been designed by Burgess & Niple, 525 Vine Street, Cincinnati OH, who is referred to in the Contract Documents as Engineer. Engineer, and its duly authorized agents, are to act as Owner's representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

Article 3. CONTRACT TIMES, LIQUIDATED DAMAGES, DELAYS, AND DAMAGES.

All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

3.1. Contract Times. The Work will be substantially completed within **420** days after the date when the Contract Times commence to run as provided in paragraph 2.03 of the General Conditions, and completed and ready for final payment in accordance with paragraph 14.07 of the General Conditions within **450** days after the date when the Contract Times commence to run.

3.2. Liquidated Damages. Owner and Contractor recognize that time is of the essence of this Agreement and that Owner will suffer financial loss if the Work is not completed within the times specified in paragraph 3.1 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expenses, and difficulties involved in proving in a legal proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty), Contractor shall pay Owner **$ 750.00** for each day that expires after the time specified in paragraph 3.1 for Substantial Completion until the Work is substantially complete. After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times or any proper extension thereof granted by Owner, Contractor shall pay Owner as liquidated damages (but not as a penalty) **$ 500.00** for each day that expires after the time specified in paragraph 3.1 for completion and readiness for

final payment until the Work is completed and ready for final payment.

Owner shall have the right to deduct the liquidated damages from any money in its hands, otherwise due, or to become due, to Contractor, or to initiate action to recover liquidated damages for nonperformance of this Contract within the time stipulated.

3.3. Delays and Damages. In the event Contractor is delayed in the prosecution and completion of the Work because of any delays caused by Owner or Engineer, Contractor shall have no claim against Owner or Engineer for damages (including but not limited to acceleration costs or damages) or contract adjustment other than an extension of the Contract Times and the waiving of liquidated damages during the period occasioned by the delay.

Contractor shall provide advance written notice to Owner and Engineer of Contractor's intention to accelerate the Work prior to commencing any acceleration. Such written notice shall include a detailed explanation of the nature and scope of the acceleration, the reason for the acceleration, the anticipated duration of the acceleration, and the estimated additional costs to Contractor, if any, related to the acceleration. This requirement shall not in any way affect or alter the agreement of Owner and Contractor with respect to delays and damages as set forth above and in Article 7 of the General Conditions.

Article 4. CONTRACT PRICE.

Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds equal to the sum of the established unit price for each separately identified item of Unit Price Work times the estimated quantity of that item as indicated in the Contractor's Bid, attached hereto as an exhibit, for the total amount of:

_____(words)

$_____(figures)

As provided in paragraph 11.03 of the General Conditions, estimated quantities are not guaranteed, and determinations of actual quantities and classifications are to be made as provided in paragraph 9.08 of the General Conditions and as modified by the Supplementary Conditions. Unit Prices have been computed as provided in paragraph 11.03 of the General Conditions.

Article 5. PAYMENT PROCEDURES.

Contractor shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by Owner as provided in the General Conditions and as modified by the Supplementary Conditions.

5.1. Progress Payments. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the 25th day of each month during performance of the Work. All such payments will be measured by the schedule of values established in paragraph 2.07.A of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements.

5.2. Retainage. In addition to any amounts withheld from payment in accordance with Paragraph 14.02 of the General Conditions, Owner shall retain from progress payments amounts equal to the following percentages:

a. Ten percent (10%) of the amount of the Work completed. This amount may be reduced by the Owner in its sole and absolute discretion, if the project is substantially completed; and

b. Ten percent (10%) of the value of materials and equipment that are not incorporated in the Work but are delivered, suitably stored, and accompanied by documentation satisfactory to Owner as provided in paragraph 14.02 of the General Conditions. Retainage for stored materials and equipment will be released when the materials and equipment are incorporated in the Work.

All retainage will be paid to Contractor when the Work is completed and ready for final payment in accordance with paragraph 14.07 of the General Conditions. Consent of the Surety shall be obtained before retainage is paid by Owner. Consent of the Surety, signed by an agent, must be accompanied by a certified copy of such agent's authority to act for the Surety.

5.3. Final Payment. Upon final completion and acceptance of the Work in accordance with paragraphs 14.07 of the General Conditions, Owner shall pay the remainder of the Contract Price as provided in said paragraph 14.07.

Article 6. CONTRACTOR'S REPRESENTATION

In order to induce Owner to enter into this Agreement Contractor makes the following representations:

a. Contractor has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents

b. Contractor has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

c. Contractor is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.

d. Contractor has obtained and carefully studied (or assumes responsibility for having done so) all additional or supplementary explorations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including applying the specific means, methods, techniques, sequences, and procedures of construction, if any, expressly required by the Contract Documents to be employed by Contractor, and safety precautions and programs incident thereto.

e. Contractor does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.

f. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.

g. Contractor has correlated the information known to Contractor, information and observations obtained from visits to the Site, reports and drawings identified in the Contract Documents, and

all additional examinations, investigations, explorations, tests, studies, and data with the Contract Documents.

h. Contractor has given Owner written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Owner is acceptable to Contractor.

i. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

Article 7. CONTRACT DOCUMENTS.

The Contract Documents, which are incorporated as part of the Agreement, consist of the following:

A. This Agreement;
B. Performance Bond;
C. Payment Bond;
D. General Conditions;
E. Supplementary Conditions;
F. Specifications as listed in the table of contents of the Project Manual;
G. Drawings consisting of a cover sheet and sheets numbered ____ through ____ inclusive, with each sheet bearing the following general title;
   Northern Kentucky Water District
   FTTP Residuals Handling Improvements
H. Addenda (numbers ___ to ___, inclusive);
I. Exhibits to this Agreement (enumerated as follows):
   1. Notice to Proceed;
   2. Contractor's Bid;
   3. Documentation submitted by Contractor prior to Notice of Award;
J. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:
   1. Written Amendments;
   2. Work Change Directives;
   3. Change Orders.

There are no Contract Documents other than those listed above in this Article 7. The Contract Documents may only be amended, modified, or supplemented as provided in paragraphs 3.05 of the General Conditions.

Article 8. CONTRACT CORRECTION PERIOD

Notwithstanding the reference to “one year after the date of Substantial Completion” at the beginning of paragraph 13.07.A of the General Conditions, the Contractor’s Correction Period with respect to the obligations set forth in paragraph 13.07.A of the General Conditions shall be twenty-four (24) months after the issuance of “Certificate of Substantial Completion” for all machinery, piping, materials, equipment, fittings, roadway pavement work, general restoration, shoulder & ditch restoration furnished under the Contract Documents. The correction period referenced in paragraph 13.07.C of the General Conditions shall be twenty-four (24) months for all machinery, piping, materials, equipment, fittings and all roadway pavement work.

Article 9. COMPLIANCE WITH KENTUCKY LAW

Contractor represents and warrants that it has revealed to Owner any and all final determinations of a violation of KRS Chapters 136, 139, 141, 337, 338, 341, and 342 by Contractor or any subcontractor within the past five years. Contractor further represents and warrants that it and each of its subcontractors will remain in continuous compliance with the provisions of KRS Chapters 136, 139, 141, 337, 338, 341 and 342 for the duration of this Agreement. Contractor understands that its failure to reveal a final determination of a violation or to comply with the above statutory requirements constitutes grounds for cancellation of the Agreement and for disqualification of Contractor from eligibility for any contracts for a period of two years.

Article 10. EQUAL OPPORTUNITY

Unless exempted under KRS 45.590, during the performance of the Agreement, the Contractor agrees as follows:

a. Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, age forty (40) and over, disability, veteran status, or national origin;

b. Contractor will take affirmative action in regard to employment, upgrading, demotion, transfer, recruitment, recruitment advertising, layoff, termination, rates of pay or other forms of compensation, and selection for training, so as to ensure that applicants are employed and that employees during employment are treated without regard to their race, color, religion, sex, age forty (40) and over, disability, veteran status, or national origin;

c. Contractor will state in all solicitations or advertisements for employees placed by or on behalf of Contractor that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, age forty (40) or over, disability, veteran status, or national origin;

d. Contractor will post notices in conspicuous places, available to employees and applicants for employment, setting forth the provisions of the nondiscrimination clauses required by this section; and

e. Contractor will send a notice to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding advising the labor union or workers' representative of Contractor's commitments under the nondiscrimination clauses.

Article 11. MISCELLANEOUS.

a. Terms used in this Agreement will have the meanings indicated in the General Conditions.

b. No assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

c. Owner and Contractor each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect of all covenants, agreements, and obligations contained in the

Contract Documents.

d. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement. One counterpart each has been delivered to Owner, Contractor, Surety, and Engineer.

This Agreement will be effective on _____ (which is the Effective Date of the Agreement).

OWNER: **Northern Kentucky Water District**

_____

_____

_____of Engineering & Water Quality & Production

Address for giving notices

2835 Crescent Springs Road
PO Box 18640
Erlanger, Kentucky 41018

CONTRACTOR:_____

By:_____
Signature

_____
Printed Name

_____
Title

(Corporate Seal)

Address for giving notices

_____

_____

_____

Joint Venture

CONTRACTOR:_____

By:_____
(Corporate Seal)

Address for giving notices

_____

_____

_____

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly by

ACEC
American Council of Engineering Companies

The Associated General Contractors of America
Skill · Responsibility · Integrity

ASCE American Society of Civil Engineers

National Society of Professional Engineers
Professional Engineers in Private Practice

AMERICAN COUNCIL OF ENGINEERING COMPANIES

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PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
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NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

Endorsed by

CONSTRUCTION SPECIFICATIONS INSTITUTE

These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor (EJCDC C-520 or C-525, 2007 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other. Comments concerning their usage are contained in the Narrative Guide to the EJCDC Construction Documents (EJCDC C-001, 2007 Edition). For guidance in

the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (EJCDC C-800, 2007 Edition).

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.

3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Bid*—The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

6. *Bidder*—The individual or entity who submits a Bid directly to Owner.

7. *Bidding Documents*—The Bidding Requirements and the proposed Contract Documents (including all Addenda).

8. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.

9. *Change Order*—A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

10. *Claim*—A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract*—The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents*—Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

13. *Contract Price*—The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).

14. *Contract Times*—The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any; (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.

15. *Contractor*—The individual or entity with whom Owner has entered into the Agreement.

16. *Cost of the Work*—See Paragraph 11.01 for definition.

17. *Drawings*—That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.

18. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

19. *Engineer*—The individual or entity named as such in the Agreement.

20. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.

21. *General Requirements*—Sections of Division 1 of the Specifications.

22. *Hazardous Environmental Condition*—The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto.

23. *Hazardous Waste*—The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

24. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

25. *Liens*—Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

26. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

27. *Notice of Award*—The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.

28. *Notice to Proceed*—A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.

29. *Owner*—The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.

30. *PCBs*—Polychlorinated biphenyls.

31. *Petroleum*—Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

32. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

33. *Project*—The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

34. *Project Manual*—The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

35. *Radioactive Material*—Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

36. *Resident Project Representative*—The authorized representative of Engineer who may be assigned to the Site or any part thereof.

37. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

38. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.

39. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

40. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

41. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.

42. *Specifications*—That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.

43. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.

44. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

45. *Successful Bidder*—The Bidder submitting a responsive Bid to whom Owner makes an award.

46. *Supplementary Conditions*—That part of the Contract Documents which amends or supplements these General Conditions.

47. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or Subcontractor.

48. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

49. *Unit Price Work*—Work to be paid for on the basis of unit prices.

50. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

51. *Work Change Directive*—A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an

addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 *Terminology*

A. The words and terms discussed in Paragraph 1.02.B through F are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives:*

1. The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.

C. *Day:*

1. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective:*

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

a. does not conform to the Contract Documents; or

b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

c. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

E. *Furnish, Install, Perform, Provide:*

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.

F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor up to ten printed or hard copies of the Drawings and Project Manual. Additional copies will be furnished upon request at the cost of reproduction.

2.03 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.04 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to the date on which the Contract Times commence to run.

2.05 *Before Starting Construction*

A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.06 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.07 *Initial Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on

Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that reasonably may be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the indicated result will be provided whether or not specifically called for, at no additional cost to Owner.

C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 *Reference Standards*

A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

1. *Contractor's Review of Contract Documents Before Starting Work*: Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor discovers, or has actual knowledge of, and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.

2. *Contractor's Review of Contract Documents During Performance of Work*: If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation , (b) any standard, specification, manual, or code, or (c) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

a. the provisions of any standard, specification, manual, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference in the Contract Documents); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.

B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:

1. A Field Order;

2. Engineer's approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 6.17.D.3); or

3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions; or

2. reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.06 *Electronic Data*

A. Unless otherwise stated in the Supplementary Conditions, the data furnished by Owner or Engineer to Contractor, or by Contractor to Owner or Engineer, that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

ARTICLE 4 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS

4.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 *Subsurface and Physical Conditions*

A. *Reports and Drawings:* The Supplementary Conditions identify:

1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and

2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4.03 *Differing Subsurface or Physical Conditions*

A. *Notice:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed either:

1. is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or

2. is of such a nature as to require a change in the Contract Documents; or

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

B. *Engineer's Review*: After receipt of written notice as required by Paragraph 4.03.A, Engineer will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Engineer's findings and conclusions.

C. *Possible Price and Times Adjustments:*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and

b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:

a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or

b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and

contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or

c. Contractor failed to give the written notice as required by Paragraph 4.03.A.

3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

A. *Shown or Indicated:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data provided by others; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

a. reviewing and checking all such information and data;

b. locating all Underground Facilities shown or indicated in the Contract Documents;

c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and

d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated:*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the

consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.05 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.06 *Hazardous Environmental Condition at Site*

A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.

D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 4.06.E.

E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.

F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 – BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.

B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.

C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also

meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 *Certificates of Insurance*

A. Contractor shall deliver to Owner, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Owner or any other additional insured) which Contractor is required to purchase and maintain.

B. Owner shall deliver to Contractor, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.

C. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.

D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.

E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

5.04 *Contractor's Insurance*

A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;

2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;

3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;

4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:

a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or

b. by any other person for any other reason;

5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

B. The policies of insurance required by this Paragraph 5.04 shall:

1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, be written on an occurrence basis, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

3. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;

4. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);

5. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and

6. include completed operations coverage:

a. Such insurance shall remain in effect for two years after final payment.

b. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.05 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

5.06 *Property Insurance*

A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee;

2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by the Supplementary Conditions.

3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. allow for partial utilization of the Work by Owner;

6. include testing and startup; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued.

B. Owner shall purchase and maintain such equipment breakdown insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors,

members, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other loss payee to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.

D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under this Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

5.07 *Waiver of Rights*

A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or loss payees thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the loss payees, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order.

B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

5.09 *Acceptance of Bonds and Insurance; Option to Replace*

A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's

interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

A. If Owner finds it necessary to occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 14.05, no such use or occupancy shall commence before the insurers providing the property insurance pursuant to Paragraph 5.06 have acknowledged notice thereof and in writing effected any changes in coverage necessitated thereby. The insurers providing the property insurance shall consent by endorsement on the policy or policies, but the property insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy.

ARTICLE 6 – CONTRACTOR'S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

6.02 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

6.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and "Or-Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.

1. *"Or-Equal" Items:* If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that:

1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and

3) it has a proven record of performance and availability of responsive service.

b. Contractor certifies that, if approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times; and

2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

2. *Substitute Items:*

a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.

b. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.

c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented by the General Requirements, and as Engineer may decide is appropriate under the circumstances.

d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

1) shall certify that the proposed substitute item will:

a) perform adequately the functions and achieve the results called for by the general design,

b) be similar in substance to that specified, and

c) be suited to the same use as that specified;

2) will state:

a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time,

b) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and

c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;

3) will identify:

a) all variations of the proposed substitute item from that specified, and

b) available engineering, sales, maintenance, repair, and replacement services; and

4) shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.

B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.

C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.

D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

E. *Engineer's Cost Reimbursement*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

F. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.06 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be

required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity; nor

2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.

E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.

F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner,

Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.07 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

6.08 *Permits*

A. Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.09 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 *Taxes*

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

6.11 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas:*

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought

by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.12 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, and written interpretations and clarifications in good order and annotated to show changes made during construction. These record documents together with all approved Samples and a counterpart of all approved Shop Drawings will be available to Engineer for reference. Upon completion of the Work, these record documents, Samples, and Shop Drawings will be delivered to Engineer for Owner.

6.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and

shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.

D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

E. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

F. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

6.15 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

6.16 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is

required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

6.17 *Shop Drawings and Samples*

A. Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals (as required by Paragraph 2.07). Each submittal will be identified as Engineer may require.

1. *Shop Drawings:*

a. Submit number of copies specified in the General Requirements.

b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. *Samples:*

a. Submit number of Samples specified in the Specifications.

b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.

B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Submittal Procedures:*

1. Before submitting each Shop Drawing or Sample, Contractor shall have:

a. reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

c. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop Drawings or Sample submittal; and, in addition, by a specific notation made on each Shop Drawing or Sample submitted to Engineer for review and approval of each such variation.

D. *Engineer's Review:*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. *Resubmittal Procedures:*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

6.18 *Continuing the Work*

A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on representation of Contractor's warranty and guarantee.

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;

2. recommendation by Engineer or payment by Owner of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. use or occupancy of the Work or any part thereof by Owner;

5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;

6. any inspection, test, or approval by others; or

7. any correction of defective Work by Owner.

6.20 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .

B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 *Delegation of Professional Design Services*

A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.

B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 – OTHER WORK AT THE SITE

7.01 *Related Work at Site*

A. Owner may perform other work related to the Project at the Site with Owner's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to Contractor prior to starting any such other work; and

2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.

B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:

1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;

2. the specific matters to be covered by such authority and responsibility will be itemized; and

3. the extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

7.03 *Legal Relationships*

A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.

B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's wrongful actions or inactions.

C. Contractor shall be liable to Owner and any other contractor under direct contract to Owner for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's wrongful action or inactions.

ARTICLE 8 – OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

8.02 *Replacement of Engineer*

A. In case of termination of the employment of Engineer, Owner shall appoint an engineer to whom Contractor makes no reasonable objection, whose status under the Contract Documents shall be that of the former Engineer.

8.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

8.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in Paragraphs 14.02.C and 14.07.C.

8.05 *Lands and Easements; Reports and Tests*

A. Owner's duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. Paragraph 4.02 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of subsurface conditions and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

8.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 5.

8.07 *Change Orders*

A. Owner is obligated to execute Change Orders as indicated in Paragraph 10.03.

8.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 13.03.B.

8.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

8.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 4.06.

8.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents.

8.12 *Compliance with Safety Program*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed pursuant to Paragraph 6.13.D.

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract Documents.

9.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or

continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.03 *Project Representative*

A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

9.04 *Authorized Variations in Work*

A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

A. Engineer will have authority to reject Work which Engineer believes to be defective, or that Engineer believes will not produce a completed Project that conforms to the Contract Documents or that will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Engineer will also have authority to require special inspection or testing of the Work as provided in Paragraph 13.04, whether or not the Work is fabricated, installed, or completed.

9.06 *Shop Drawings, Change Orders and Payments*

A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.

B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.

C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.

D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

9.08 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.

B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believes that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.

C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.

D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not

exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

9.10 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Engineer has been informed pursuant to Paragraph 6.13.D.

ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.D.

10.03 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:

1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;

2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.04 *Notification to Surety*

A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

10.05 *Claims*

A. *Engineer's Decision Required*: All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.

B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data

shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

C. *Engineer's Action*: Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:

1. deny the Claim in whole or in part;

2. approve the Claim; or

3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.

D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.

F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

ARTICLE 11 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

11.01 *Cost of the Work*

A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 11.01.B, and shall include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

    a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

    b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

    c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of

said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

B. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not

limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A.

C. *Contractor's Fee:* When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.

D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. *Cash Allowances:*

1. Contractor agrees that:

a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. *Contingency Allowance:*

1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

11.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to

the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

2. there is no corresponding adjustment with respect to any other item of Work; and

3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12 – CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).

C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

   a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;

   b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;

   c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 12.01.C.2.a and 12.01.C.2.b is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

   d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;

   e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

   f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.03 *Delays*

A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or

neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.

D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

ARTICLE 13 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

13.01 *Notice of Defects*

A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor. Defective Work may be rejected, corrected, or accepted as provided in this Article 13.

13.02 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

13.03 *Tests and Inspections*

A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in Paragraph 13.04.C; and

3. as otherwise specifically provided in the Contract Documents.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation.

F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.

B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.

C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.

D. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

13.06 *Correction or Removal of Defective Work*

A. Promptly after receipt of written notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair such defective land or areas; or

2. correct such defective Work; or

3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and

4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.

C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner (and, prior to Engineer's recommendation of final payment, Engineer) prefers to accept it, Owner may do so. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness) and for the diminished value of the Work to the extent not otherwise paid by Contractor pursuant to this sentence. If any such acceptance occurs prior to Engineer's recommendation of final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05. If the acceptance occurs after such recommendation, an appropriate amount will be paid by Contractor to Owner.

13.09 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct, or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.

C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.02 *Progress Payments*

A. *Applications for Payments:*

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an

Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens and evidence that the materials and equipment are covered by appropriate property insurance or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

B. *Review of Applications:*

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

   a. the Work has progressed to the point indicated;

   b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and any other qualifications stated in the recommendation); and

   c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

   a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or

involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or

b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

   a. to supervise, direct, or control the Work, or

   b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

   c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

   d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or

   e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:

   a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;

   b. the Contract Price has been reduced by Change Orders;

   c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or

   d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. *Payment Becomes Due:*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor.

D. *Reduction in Payment:*

1. Owner may refuse to make payment of the full amount recommended by Engineer because:

   a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;

   b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;

   c. there are other items entitling Owner to a set-off against the amount recommended; or

   d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.

2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor remedies the reasons for such action.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1 and subject to interest as provided in the Agreement.

14.03 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment covered by any Application for Payment, whether incorporated in the Project or not, will pass to Owner no later than the time of payment free and clear of all Liens.

14.04 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before

final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the tentative certificate to Owner, notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will, within said 14 days, execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.

E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the tentative list.

14.05 *Partial Utilization*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 14.04.A through D for that part of the Work.

2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

14.06 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

14.07 *Final Payment*

A. *Application for Payment:*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.6;

   b. consent of the surety, if any, to final payment;

   c. a list of all Claims against Owner that Contractor believes are unsettled; and

   d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

B. *Engineer's Review of Application and Acceptance:*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying

documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Payment Becomes Due:*

1. Thirty days after the presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is entitled to set off against Engineer's recommendation, including but not limited to liquidated damages, will become due and will be paid by Owner to Contractor.

14.08 *Final Completion Delayed*

A. If, through no fault of Contractor, final completion of the Work is significantly delayed, and if Engineer so confirms, Owner shall, upon receipt of Contractor's final Application for Payment (for Work fully completed and accepted) and recommendation of Engineer, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed and accepted. If the remaining balance to be held by Owner for Work not fully completed or corrected is less than the retainage stipulated in the Agreement, and if bonds have been furnished as required in Paragraph 5.01, the written consent of the surety to the payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by Contractor to Engineer with the Application for such payment. Such payment shall be made under the terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

14.09 *Waiver of Claims*

A. The making and acceptance of final payment will constitute:

1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and

2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);

2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;

3. Contractor's repeated disregard of the authority of Engineer; or

4. Contractor's violation in any substantial way of any provisions of the Contract Documents.

B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:

1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);

2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere; and

3. complete the Work as Owner may deem expedient.

C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when

so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.

E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.

F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B and 15.02.C.

15.03 *Owner May Terminate For Convenience*

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;

3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and

4. reasonable expenses directly attributable to termination.

B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days

to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 – DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions; or

2. agrees with the other party to submit the Claim to another dispute resolution process; or

3. gives written notice to the other party of the intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 – MISCELLANEOUS

17.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended; or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

A. When any period of time is referred to in the Contract Documents by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

17.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract Documents. The provisions of this Paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

17.04 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

17.05 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

17.06 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

SECTION 00 73 01

SUPPLEMENTARY CONDITIONS

SCOPE. These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (No. C-700, 2007 Edition) and other provisions of the Contract Documents as indicated herein. All provisions which are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions will have the meanings indicated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings indicted herein, which are applicable to both the singular and plural thereof.

SC-1. DEFINITIONS AND TERMINOLOGY. Amend the following defined terms as indicated:

Add the following new definitions to paragraph 1.01:

"52. Final Completion – The time when all work is complete, including all punch list items, and all documents required for occupancy of the facility are completed and submitted to the Owner. These documents include, but are not limited to, Certificate of Occupancy, Letters of Approval from various regulatory agencies, inspection certificates, and all other items as required in paragraph 14.07."

"53. General Contractor – The person, firm, or corporation with whom Owner has entered into an Agreement for work, general trades, or complete work less a part of the work."

"54. Without exception – The term "without exception", when used in the Contract Documents following the name of a Supplier or a proprietary item of equipment, product, or material, shall mean that the sources of the product are limited to the listed Suppliers or products and that no like, equivalent, or "or-equal" item and no substitution will be considered."

"55. Written Notice – Notice to any party which is in writing and which shall be considered delivered and the service thereof completed once posted by certified or registered mail to the party to whom the notice is sent at its last given address or delivered in person to said party or its authorized representative on the work."

Delete 1.02.E in its entirety and replace with the following:

"SC-1.02.E The words "furnish", "furnish and install", "install", and "provide" or words with similar meaning shall be interpreted, unless otherwise specifically stated, to mean "furnish and install complete in place and ready for service"."

Add the following paragraphs G and H:

"G. Imperative Mood. These specifications are written to the Bidder before the award of the Contract and to the Contractor after award of the Contract. The sentences that direct the Contractor to perform work are mostly written as commands. For example, a requirement to provide cold-weather protection would be expressed as, 'Provide cold-weather protection for concrete,' rather than 'The Contractor shall provide cold-weather protection for concrete.' In the imperative mood, the subject "the Bidder" or "the Contractor" is understood."

"H. The terms used in these Supplementary Conditions which are defined in the Standard General Conditions of the Construction Contract (EJCDC C-700, 2007 Edition) have the meanings assigned to them in the General Conditions."

SC-2. PRELIMINARY MATTERS.

Add the following:

"SC-2.00. Execution of Agreement.

A. At least four counterparts of the Agreement will be executed and delivered by the Contractor to the Owner within fifteen (15) days of the Notice of Award and receipt of Contract Documents by the Contractor for execution; and Owner will execute and deliver one counterpart to Contractor within fifteen (15) days of receipt of the executed Agreement from Contractor.**"**

Replaced SC-2.01.B in its entirety and replace with:

"B. Replace "Before any Work at the Site is started, Contractor and Owner shall each deliver to the other" with "When Contractor delivers the executed counterparts of the Agreement to the Owner, Contractor shall deliver to the Owner", and replace "and Owner respectively are" with "is"."

SC-2.02. Copies of Documents. Delete paragraph 2.02.A and insert the following in its place:

"Two (2) sets of contract drawings and specifications will be furnished the Contractor without charge. Additional sets will be furnished upon request at the cost of reproduction. The Contractor shall keep one (1) set of approved plans and specifications on the site of the work. This set shall be kept current by addition of all approved changes, addenda and amendments thereto. One set of as-built plans shall be returned to the Owner after the project is complete.

The plans and specifications are intended to be complementary; but should any discrepancy appear or any misunderstanding arise as to the import of anything contained in either, the decision of the District shall be final and binding on the Contractor. The District may make any corrections of errors or omissions in the drawings and specifications when such corrections are necessary for the proper fulfillment of their intention as construed by the District.

All work or materials shown on the plans and not mentioned in the specifications or any work specified and not shown on the plans, shall be furnished, performed and done by the Contractor as if the same were both mentioned in the specifications and shown on the plans.

Should the Contractor in preparing its bid find anything necessary for the work that is not mentioned in the specifications or shown on the plans, or any discrepancy, it shall notify the District so that such items may be included. Should the Contractor fail to notify the District of such items, it will be assumed that its bid included everything necessary for the complete construction in the spirit and intent of the designs shown.

In case of discrepancy, figure dimensions shall govern over scale dimensions, large-scale details shall govern over small-scale drawings, plans shall govern over specifications, detailed technical specifications shall govern over general specifications, and the more restrictive specifications shall prevail."

SC-2.03. Commencement of Contract Times; Notice to Proceed. Delete the paragraph and insert in its place:

"A. The Contract Times will commence to run on the day indicated in the Notice to Proceed. The date for the Contract Times may be extended by mutual agreement between the Owner and the Contractor."

SC-2.06. Preconstruction Conference; Designation of Authorized Representatives. Delete paragraph 2.06.A in its entirety and insert the following new paragraph in its place:

"If requested by Owner, within 20 days after the Contract Times start to run, but before any work at the Site is started, a conference attended by Contractor, Owner, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in paragraph 2.05.A procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records."

SC-3. CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE.

SC-3.01. Intent. Add the following new paragraph:

"D. The Contract Drawings may be supplemented from time to time with additional Drawings by the Engineer as may be required to illustrate the work or, as the work progresses, with additional Drawings, by the Contractor, subject to the approval of the Engineer. Supplementary Drawings, when issued by the Engineer or by the Contractor, after approval by the Engineer, shall be furnished in sufficient quantity to all those who, in the opinion of the Engineer, are affected by such Drawings."

SC-4. AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS; REFERENCE POINTS.

SC-4.02. Subsurface and Physical Conditions. Delete Paragraph 4.02.A in its entirety and insert the following new paragraph in its place:

A. *Reports and Drawings*: No reports of explorations and tests of subsurface conditions at or contiguous to the Site have been prepared, and no drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site are available.

SC-4.03. Differing Subsurface or Physical Conditions.

Replace paragraph 4.03.A with the following:

"A. Notice: If Contractor believes that any subsurface or physical condition at or contiguous to the Site that is uncovered or revealed either:

1. Is of such nature as to require a change in the Contract Documents; or

2. Differs materially from that shown or indicated in the Contract Documents; or

3. Is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent on work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any work in connection therewith (except in an emergency as required by paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any work in connection therewith (except as aforesaid) until receipt of written order to do so."

SC-4.04. Underground Facilities.

Add the following new paragraph 4.04.A.3 through 4.04.A.7 immediately after paragraph 4.04.A.2:

"3. Location of Subsurface Utilities.

a. The location of subsurface utilities is shown on the plans from information furnished by the utility Owners.

b. The Contractor shall, no later than 2 working days, excluding Saturdays, Sundays, and legal holidays, prior to construction in the area of the subsurface utility, notify the subsurface utility Owner and Engineer in writing, by telephone, or in person. The marking or locating shall be coordinated to stay approximately 2 days ahead of the planned construction.

c. The Contractor shall alert immediately the occupants of nearby premises as to any emergency that it may create or discover at or near such premises.

d. The Contractor shall have full responsibility for coordination of the work with Owners of such underground facilities during construction, for the safety and protection thereof as provided in paragraph 6.13 and repairing any damage thereto resulting from the work, the cost of all of which will be considered as having been included in the Contract Price.

4. Where existing utilities and structures are indicated as being in the line of the proposed improvement, the Contractor shall expose them sufficiently in advance of the construction operations to permit adjustments in line or grade, if required, to eliminate interferences.

5. Existing pipes or conduits crossing a trench, or otherwise exposed, shall be adequately braced and supported to prevent movement during construction.

6. Broken Utility Services.

a. Utility services broken or damaged shall be repaired at once to avoid inconvenience to customers and utility Owners.

b. Temporary arrangements, as approved by the Engineer, may be used until any damaged items can be permanently repaired.

c. All items damaged or destroyed by construction and subsequently repaired must be properly maintained by the Contractor.

d. Contractor must work 24 hours a day until service is restored to a damaged utility.

7. Existing Utility Relocation.

a. Where it is necessary to relocate an existing utility or structure, the work shall be done in such manner as is necessary to restore it to a condition equal to that of the original utility or structure.

b. No such relocation shall be done until approval is received from the authority responsible for the utility or structure being changed."

Add the following:

"4.04.B.3 The Owner, Engineer, and Engineer's Consultants shall not be liable to Contractor for any claims, costs, losses or damages incurred or sustained by Contractor on or in connection with any other work or anticipated work."

SC-4.06 Hazardous Environmental Conditions at Site.

Delete paragraph 4.06.A. in its entirety and substitute the following paragraph therefore:

"A. The following reports and drawings related to Hazardous Environmental Conditions identified at the Site are known to Owner: (None)."

Amend paragraph 4.06.B second sentence by deleting "Supplementary Conditions" and substituting "Specifications and Contract Drawings" in its place.

Amend paragraph 4.06.C by adding the words "that is created by, or" immediately after the words "a Hazardous Environmental Condition" in the fourth line.

Amend paragraph 4.06.G by deleting all words following the words "Hazardous Environmental Condition" in the seventh line and substituting therefore the following words: "was created by Owner or by anyone for whom Owner is responsible, other than Contractor and all persons, subcontractors and entities for which Contractor is responsible."

SC-5. BONDS AND INSURANCE.

SC-5.02. Licensed Sureties and Insurers. Add the following new sentence at the end of paragraph 5.02.A:

"The surety company shall be rated "A" by AM BEST."

SC-5.03. Certificates of Insurance. Add the following new sentence at the end of paragraph 5.03.A:

"Contractor shall deliver to Owner properly completed certificates of insurance prior to the start of any Work at the Site, on the forms included in the Contract Documents."

SC-5.04. Contractor's Insurance.

Add the following new paragraphs immediately after paragraph 5.04.A.6:

"7. Claims arising out of pollution and excluded from the Contractor's general liability and comprehensive automobile liability policies. This insurance shall be coordinated with the Contractor's general liability policy and shall provide bodily injury and property damage coverage similar to the Contractor's general liability policy. Coverage shall include contractual liability."

Add the following new paragraphs immediately after paragraph 5.04.B.6:

"7. contain a cross liability or severability of interest clause or endorsement. Insurance covering the specified additional insureds shall be primary insurance, and all other insurance carried by the additional insureds shall be excess insurance;

8. with respect to workers' compensation and employers' liability, comprehensive automobile liability, commercial general liability, and umbrella liability insurance, and all other liability insurance specified herein to be provided by Contractor, Contractor shall require its insurance carriers to waive all rights of

subrogation against Owner, Engineer, and their respective officers, directors, partners, employees, and agents."

Add the following new paragraphs immediately after paragraph 5.04.B:

"C. The insurance required by paragraph 5.04 shall include coverage as necessary for the benefits provided under the United States Longshoremen's and Harbor Workers' Act and the Jones Act. This policy shall include an "all states" endorsement.

D. The limits of liability for the insurance required by paragraph 5.04 of the General Conditions shall provide coverage for not less than the following amounts but shall provide coverage in greater amounts where required by Laws and Regulations. This coverage may be primary or a combination of primary and umbrella excess liability.

1. Workers' Compensation, and related coverage under paragraphs 5.04.A.1 and 5.04.A.2 of the General Conditions:

a.	State	Statutory
b.	Applicable Federal (e.g., Longshoreman's)	Statutory
b.	Employer's Liability	$1,000,000 each occurrence

2. Commercial General Liability under paragraphs 5.04.A.3 through 5.04.A.6 of the General Conditions shall be occurrence type, written in comprehensive form, and shall protect Contractor, Owner, and Engineer as additional insureds, against claims arising from injuries, sickness, disease, or death of any person or damage to property arising out of performance of the Work. The policy shall also include a per work aggregate limit endorsement, personal injury liability coverage, contractual liability coverage for blasting, explosion, collapse of buildings, and damage to underground property.

a.	General Aggregate	$1,000,000
b.	Products – Completed Operations Aggregate	$1,000,000
c.	Personal and Advertising Injury	$1,000,000
d.	Each Occurrence (Bodily Injury and Property Damage)	$1,000,000

e. Property Damage liability insurance will provide Explosion, Collapse and Underground coverage's where applicable.

3. Automobile Liability under paragraph 5.04.A.6 of the General Conditions shall be occurrence type, written in comprehensive form, and shall protect Contractor, Owner, and Engineer as additional insureds, against all claims for

injuries to members of the public and damage to property of others arising from the use of motor vehicles, either on or off the work site whether they are owned, nonowned, or hired. The liability limit shall be not less than:

a.	Bodily Injury	
	Each Person	$1,000,000
	Each Accident	$1,000,000
b.	Property Damage	
	Each Accident	$1,000,000
c.	Combined Single Limit	$1,000,000

4. Umbrella Liability Insurance shall protect Contractor, Owner, and Engineer as additional insureds, against claims in excess of the limits provided under workers' compensation and employers' liability, comprehensive automobile liability, and commercial general liability policies. The umbrella policy shall follow the forms of the primary insurance, including the application of the primary limits. The liability limits shall be not less than:

Bodily injury and Property damage	$4,000,000 combined single limit for each occurrence
	$4,000,000 general aggregate"

SC-5.05. Owner's Liability Insurance. Delete paragraph 5.05 in its entirety and insert the following new paragraph in its place:

"5.05. *Owner's Liability Insurance*. This insurance shall be obtained by Contractor and issued in the name of Owner, and shall protect and defend Owner against claims arising as a result of the operations of Contractor or Contractor's Subcontractors. The liability limits shall be not less than:

a.	Bodily Injury	
	Each Occurrence	$1,000,000
	General Aggregate	$1,000,000
b.	Property Damage	
	Each Occurrence	$1,000,000
	General Aggregate	$1,000,000"

SC-5.06. Property Insurance. Delete paragraph 5.06 in its entirety and insert the following new paragraphs in their place:

"5.06. *Property Insurance*

A. Contractor shall purchase and maintain property insurance coverage upon the Work at the Site in the amount of the full replacement cost thereof. This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, Engineer, Engineer's Consultants, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an additional insured;

2. be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, false work, and materials and equipment, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, flood, damage caused by frost and freezing, and such other perils or causes of loss as may be specifically required by the Supplementary Conditions;

3. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment accepted by Owner;

4. include expenses incurred in the repair or replacement of any insured property (including, but not limited to, fees and charges of engineers and architects);

5. allow for partial utilization of the Work by Owner;

6. include testing and startup; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer, with 30 days' written notice to each other additional insured to whom a certificate of insurance has been issued.

B. Contractor shall be responsible for any deductible or self-insured retention.

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with paragraph 5.06 shall contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with paragraph 5.07.

D. If Owner requests in writing that other special insurance be included in the property insurance policies provided under paragraph 5.06, Contractor shall, if possible, include such insurance, and the cost thereof will be charged to Owner by appropriate Change Order or Written Amendment. Prior to commencement of the Work at the Site, Contractor shall in writing advise Owner whether or not Contractor has procured such other special insurance."

SC-6. CONTRACTOR'S RESPONSIBILITIES.

SC-6.02. Labor; Working Hours. Delete the last sentence of paragraph 6.02.B and replace with the following:

"Contractor will not permit the performance of Work on a Sunday or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer and Owner. Work may be performed on Saturdays from 9:00 a.m. through 3:00 p.m. as a regular procedure with the permission of Owner; such permission, however, may be revoked at any time by Owner if Contractor fails to maintain adequate equipment and supervision for the proper prosecution and control of the weekend Work."

Add the following new paragraphs immediately after paragraph 6.02.B:

"C. No Work shall be done between 6:00 p.m. and 7:00 a.m. Monday through Friday without permission of Owner. However, emergency work including weekends may be done without prior permission."

SC-6.05. Substitutes and "Or-Equals". Add the following new paragraph after paragraph 6.05.A.2.d:

"e. If a proposed substitute item is accepted, all incidental costs associated with the use of the substitute including, but not limited to, redesign, claims of other Contractors, changes to electrical supply equipment, additional equipment or material required for the installation, etc., shall be at the expense of the Contractor proposing the substitute unless otherwise agreed to by the Owner."

SC-6.06. Concerning Subcontractors, Suppliers, and Others. Delete paragraph 6.06.B in its entirety and insert the following new paragraph in its place:

"B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity without an increase in the Contract Price. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work."

SC-6.07 Patent Fees and Royalties:

Delete 6.07.A, 6.07.B, and 6.07.C in their entirety and substitute the following:

"A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work of any invention, design, process, products or device which is the subject of patent rights or copyrights held by others. Contractor shall indemnify and hold harmless Owner and Engineer and anyone directly or indirectly employed by either of them from and against all claims, damages, losses and expenses, including attorney's fees, arising out of any infringement of patent rights or copyrights incident to the use in the performance of the Work or furnished by him in fulfillment of the requirements of this Contract. In the event of any claim or action by law on account of such patents or fees, it is agreed that the Owner may retain out of the monies which are or which may become due the Contractor under this Contract, a sum of money sufficient to protect itself against loss, and to retain the same until said claims are paid or are satisfactorily adjusted."

SC-6.09. Laws and Regulations. Delete 6.09.B in its entirety and substitute the following:

"B. If Contractor observes that the Specifications or Drawings are at variance with any Laws or Regulations, Contractor shall give Engineer prompt written notice thereof. If Contractor performs any Work knowing it to be contrary to such Laws or Regulations, and without such notice to Engineer, Contractor shall bear all costs arising therefrom. The Contractor shall, at all times, observe and comply with and shall cause all agents and employees and all Subcontractors to observe and comply with all such existing Laws or Regulations, and shall protect and indemnify the Owner and the Engineer and the municipalities in which work is being performed, and their officers and agents against any claim, civil penalty, fine or liability arising from or based on the violation of any such Law or Regulation, whether by the Contractor or any Subcontractors."

SC-6.10. Taxes. Add the following new paragraph immediately after Paragraph 6.10.A of the General Conditions:

"B. Portions of this project may be exempt from taxes. It is the Contractor's responsibility to determine the exemptions for this."

SC-6.16. Emergencies. Add the following new paragraph immediately after paragraph 6.16.A:

"B. The Contractor understands and agrees that during the performance of the Contract, it shall maintain a presence within such proximity of the Work Site which will allow it to respond to an emergency at the Work Site within one hour of receiving notice of an emergency, including emergencies occurring during non-working hours. The Contractor shall provide a list of emergency phone numbers for such purposes. If the Contractor does not have such a presence, it may satisfy this requirement by sub-contracting with a sub-contractor that does have such a presence, provided that any such sub-contractor must be approved by the Owner, in its sole discretion, prior to the pre-construction meeting."

SC-6.19. Contractor's General Warranty and Guarantee. Delete paragraph 6.19.C.7 and insert the following new paragraph in its place:

"8. any correction of defective Work by Owner; or

9. any expiration of a correction period."

SC-6.20 Indemnification:

A. Third sentence, after "…claims, costs" add the following: ", civil penalties, fines,"

C. Add the following:

"3. Nothing in the Contract Documents shall create or give to third parties any claim or right of action against the Contractor, the Owner or the Engineer beyond such as may legally exist irrespective of the Contract."

SC-7. OTHER WORK AT THE SITE. No Modifications.

SC-8. OWNER'S RESPONSIBILITIES.

SC-8.06 Insurance.

A. Delete in its entirety.

SC-8.11 Evidence of Financial Arrangements.

A. Delete in its entirety.

SC-9. ENGINEER'S STATUS DURING CONSTRUCTION.

SC-9.02. Visits to Site. Delete paragraph 9.02.A in its entirety and insert the following new paragraph in its place:

"A. Engineer may make visits to the Site as Owner deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, at the request and benefit of Owner, may determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will advise Owner of the progress of the Work and will endeavor to guard Owner against defective Work."

SC-10. CHANGES IN THE WORK; CLAIMS. No Modifications.

SC-11. COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK.

11.01.A.4. Delete in its entirety.

11.01.A.5.a. Delete in its entirety.

11.01.A.5.c. Add the following before last sentence of paragraph:

"These rates shall include all fuel, lubricants, insurance, etc. Equipment rental charges shall not exceed the prorated monthly rental rates listed in the current edition of the 'Compilation' of Rental Rates for Construction Equipment" as published by the Associated Equipment Distributors. Charges per hour shall be determined by dividing the monthly rates by 176."

11.01.A.5.f. Delete in its entirety.

11.01.A.5.g. Delete in its entirety.

11.01.A.5.h. Delete in its entirety.

SC-12. CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES.

SC-12.01. Change of Contract Price. Delete paragraph 12.01.A in its entirety and insert the following new paragraph in its place:

"A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by Contractor to Owner in accordance with the provisions of paragraph 10.05."

SC-12.02. Change of Contract Times. Delete paragraph 12.02.A in its entirety and insert the following new paragraph in its place:

"A. The Contract Times (or Milestones) may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times (or Milestones) shall be based on written notice submitted by Contractor to owner in accordance with the provisions of paragraph 10.05."

SC-12.03. Delays. Insert the following new sentence following the first sentence of paragraph 12.03.A:

"This extension shall be Contractor's sole and exclusive remedy for such delay."

Delete paragraph 12.03.C in its entirety and replace with the following:

"C. The Contractor shall not be entitled to an equitable adjustment in Contract Times even if the Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of the Owner, or other causes not the fault of and beyond control of Owner and Contractor. Since the North Reservoir will need to be ready to place back into service no later than the date specified in the Contract Documents, the Contractor shall not have any expectations from the Owner to authorize time extensions beyond the Substantial Completion Date indicated in the Contract Documents, particularly those associated with weather conditions impacting the Work."

Insert the following new paragraph 12.03.F immediately after paragraph 12.03.E:

"F. In no event shall Owner be liable to Contractor, any Subcontractor, any Supplier, or any other person or organization, or to any surety for or employee or agent of any of them, for damages (including acceleration costs) arising out of or resulting from any delay."

SC-13. TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK.

SC-13.02. Access to Work. Add the following new paragraph immediately after paragraph 13.02.A:

"B. Authorized representatives of the U.S. Environmental Protection Agency and the Kentucky Division of Water shall have access to the Work wherever it is in preparation or progress. Contractor shall provide proper facilities for such access and inspection."

SC-13.07. Correction Period. Add the following new paragraph after paragraph 13.07.D:

"Nothing in Article 13 concerning the correction period shall establish a period of limitation with respect to any other obligation which Contractor has under the Contract Documents. The establishment of time periods relates only to the specific obligations of Contractor to correct the Work, and has no relationship to the time within which Contractor's obligations under the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish Contractor's liability with respect to Contractor's obligations other than to specifically correct the Work.

All machinery, piping, materials, equipment, fittings, and restoration of every kind furnished under this Contract by the Contractor shall be free from defects of manufacture and/or workmanship. The Contractor agrees to replace materials, workmanship, and restoration, which includes all roadway pavement work, shoulder and ditch restoration and repairs, which are found to be defective within twenty four (24) months after issuance of the "Certificate of Substantial Completion". In cases where such defects shall be caused by forces beyond the Contractor's control, as judged by the Owner, the replacements will not have to be made by the Contractor."

SC-14. PAYMENTS TO CONTRACTOR AND COMPLETION.

SC-14.02. Progress Payments. Add the following new paragraphs immediately after paragraph 14.02.A.3:

"4. Contractor's Applications for Payment shall be accompanied by the documentation specified herein.

5. Payments for stored materials and equipment shall be based only upon the actual cost to Contractor of the materials and equipment and shall not include any overhead or profit to Contractor. Partial payments will not be made for undelivered materials or equipment.

6. During the progress of the Work, each Application for Payment shall be accompanied by Contractor's updated schedule of operations, or progress report, with such shop drawings schedules, procurement schedules, value of material on hand included in application, and other data specified in Division 1 or reasonably required by Owner."

Delete paragraphs 14.02.C in its entirety and insert the following new paragraphs in its place:

"C. *Payment Becomes Due*

1. Twenty-five days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended will (subject to the provisions of paragraph 14.02.D) become due, and when due will be paid by Owner to Contractor."

Add the following:

"SC-14.02.D.

4. Nothing shall prevent the Owner from withholding payment to the Contractor in addition to the amounts identified herein for unsatisfactory job progress, defective construction not remedied, disputed work, or third-party claims filed against the Owner or reasonable evidence that a third-party claim will be filed."

SC-14.04. Substantial Completion. Add the following new paragraphs following paragraph 14.04.A:

"Substantial Completion shall be the removal of the estimated volume for the reservoir and the reservoir being able to be placed back into service. Portions of the Work not essential to operation, which can be completed without interruption of the Owner's operation, may be completed after the Work is accepted as substantially complete, and may include the following items: seeding and sodding."

SC-14.07. Final Application for Payment. Add the following new sentence immediately after the last sentence of paragraph 14.07.A.2:

"Consent of the surety, signed by an agent, must be accompanied by a certified copy of such agent's authority to act for the surety. The Contractor shall be responsible for providing all of the documents identified in this paragraph."

SC-15. SUSPENSION OF WORK AND TERMINATION.

SC-15.02. Owner May Terminate for Cause. Amend paragraph 15.02.B by deleting the fifth sentence of the paragraph, in its entirety, which begins: "Such Claims, costs, losses, and damages incurred…".

A.2. Add the following to the end of first sentence after "jurisdiction": "(including those governing employee safety)"

D. Delete in its entirety.

Add the following:

"SC-15.05 Assignment of Contract:

A. Contractor shall not assign, transfer, convey or otherwise dispose of the Contract, or of its legal right, title, or interest in or to the same or to any part thereof, without the prior written consent of the Owner. Contractor shall not assign by power of attorney or otherwise any monies due him and payable under this Contract without the prior written consent of the Owner. Such consent, if given, will in no way relieve the Contractor from any of the obligations of this Contract. Owner shall not be bound to abide by or observe the requirements of any such assignment."

SC-16. DISPUTE RESOLUTION.

Delete Article 16 in its entirety and insert the following new article in its place:

"ARTICLE 16 - DISPUTES.

Arbitration will not be acceptable as a means for settling claims, disputes, and other matters."

SC-17. MISCELLANEOUS.

17.01 Giving Notice:

Add the following:

"B. No oral statement of any person whomsoever shall in any manner or degree modify or otherwise affect the terms of this Contract. Any notice to the Contractor, from Owner and Engineer, relative to any part of this Contract shall be in writing."

SC-17.04. Survival of Obligations. Add the following new paragraph immediately after paragraph 17.04.A:

"B. Contractor shall obtain from all Suppliers and manufacturers any and all warranties and guarantees of such Suppliers and manufacturers, whether or not specifically require by the Specifications, and shall assign such warranties and guarantees to Owner. With respect thereto, Contractor shall render reasonable assistance to Owner when requested, in order to enable Owner to enforce such warranties and guarantees. The assignment of any warranties or guarantees shall not affect the Correction Period or any other provisions of these Contract Documents."

End of Section

NOTICE OF AWARD

To: _____

_____

_____

Description of Work: Furnish and install two belt filter presses to replace two existing units, replace existing belt conveyor with new screw conveyor system, replace existing dry polymer and pumping components with new dry polymer system, install new monorail hoist system, and add two transfer pumps. Conduct temporary sludge dewatering as necessary during equipment improvements. Piping, electrical, lighting, instrumentation, and control upgrades, along with temporary dewatering during the dewatering facility modifications, are also included in the project scope.

The Owner represented by the undersigned has considered the Bid submitted by you on _____ for the above described work in response to its Invitation to Bid and Instructions to Bidders.

It appearing that it is to the best interest of said Owner to accept your Bid in the amount of

_____

you are hereby notified that your Bid has been accepted for the above referenced project. You are required by the Notice and Instructions to Bidders to execute the formal Agreement with the undersigned Owner and to furnish the required Contractor's Performance and Payment Bond and proper Insurance Certificate within fifteen (15) days from the date of delivery of this Notice to you.

You are required to return an acknowledged copy of this Notice of Award and all copies of the signed Agreement (leave dates blank) to the Owner for execution.

If you fail to execute said Agreement and to furnish said bonds and certificates within 15 days from the date of delivery of this Notice, said Owner will be entitled to consider all your rights arising out of the Owner's acceptance of your Bid as abandoned and as a forfeiture of your Bid Security. The Owner will be entitled to such other rights as may be granted by law and to award the work covered by your Bid to another, or to re-advertise the work or otherwise dispose thereof as the Owner may see fit.

Dated this ___ day of _____, 20___.

Owner
Northern Kentucky Water District

By:_____
Amy Kramer, V.P. of Engineering, Production & Distribution

ACCEPTANCE OF NOTICE
Receipt of the above Notice of
Award is hereby acknowledged this

_____day of _____,20___.

By: _____

_____ Title

SECTION 01 11 00

SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **General.** Provide all labor, materials, tools, and equipment necessary to construct the project in accordance with the contract drawings and as specified herein.

B. **The project generally consists of** furnishing and installing two belt filter presses to replace two existing units, replacing existing belt conveyor with new screw conveyor system, replacing existing dry polymer and pumping components with new dry polymer system, and adding two transfer pumps. Piping, electrical, lighting, instrumentation, video surveillance, and control upgrades, along with coordinating temporary dewatering sludge disposal during the dewatering facility modifications, are also included in the project scope.

1.3 QUALITY ASSURANCE

A. **Codes and Standards**. Perform all work in compliance with all federal, state, and local codes.

1.4 SUBMITTALS

A. **Submittal Requirements**. See other Division 1 sections for required submittals and for procedures necessary for transmittal of submittals.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

Not used.

1.7 SPECIAL WARRANTY

A. **Warranty Requirements.** Provide as specified in Divisions 40 and 44.

1.8 **OWNER FURNISHED ITEMS**

A. **General**. The Owner will provide control system and existing utility coordination.

PART 2 – PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 **SEQUENCE OF CONSTRUCTION AND OPERATION**

A. **Maintain dewatering** operations with current, temporary, or new equipment as the existing components are demolished and the new equipment is installed.

B. **During temporary operations,** sludge quality produced by the Contractor shall meet the minimum 20-percent solids content NKWD staff normally supplies to the Hauling Contractor. If through routine NKWD staff grab sampling testing the solids content is verified to be below 20-percent, then Contractor shall pay the additional cost charged by the Hauling Contractor to dispose of the additional quantity or weight of dewatered sludge below 20-percent solids content. Contractor shall perform temporary operations at a frequency as not to allow solids from overflowing the weirs in the two existing thickeners. Current dewatering operations by NKWD staff are performed approximately 72 hours per week.

B. **Maintain dewatered sludge disposal** operations with Hauling Contractor, including scheduling dumpster delivery and removal directly with the Owner. The Owner's agreement stipulates that orders for dumpster pickup received before 4:00 p.m. on weekdays shall be picked up by Hauling Contractor within three hours of the Hauling Contractor's receipt of notice from the Owner. Orders placed after 4:00 p.m. shall be picked up by Hauling Contractor by 8:30 a.m. on the next business day, and all removals shall be made between the hours of 7:00 a.m. and 7:00 p.m. local time on weekdays, unless otherwise requested by the Owner. Contractor's personnel shall be fully equipped and capable of performing all necessary removal operations without assistance from the District or its employees. An empty dumpster must be provided at the same time to replace the one being picked up.

C. **Both existing thickeners and belt filter press feed pumps shall be maintained** throughout the project (regardless of how solids are being dewatered).

D. **Belt filter presses, polymer system, and dewatered solids conveyance system** replacement shall be sequenced by Contractor.

E. **Temporary dewatering facilities** shall be maintained until the new dewatering system components are installed, tested, and accepted by the Owner.

F. **Electrical and control upgrades** shall be made concurrently with process equipment upgrades.

G. **Protect dewatering building interior** and sky lights throughout project. Both existing skylights can be removed temporarily for demolition of existing components and installation of new equipment, but must be replaced periodically over its roof opening to protect building interior from rain, snow, and any other possible intrusions. Following completion of tasks requiring roof access, both sky lights shall be reinstalled per current installation, with flashing and weatherproofing for a permanently-sealed installation.

H. **Scheduled Operations/Maintenance.** Twice a year (once in the spring and once in the fall), the sedimentation basins are cleaned. This results in an approximately 4-week period of increased solids removal. Coordinate this and other periodic operations/maintenance and ongoing projects with the Owner.

I. **Backwash Tank Access.** The Contractor's access within the backwash tank will be limited. The backwash tank can be taken out of operation for a maximum of 72 consecutive hours per week. Contractor shall coordinate with Owner's required tank operation for access within the tank. The Owner will clean and dewater the backwash tank for the Contractor's initial access. If additional access within the tank is required, the Contractor shall be responsible for dewatering, cleaning, and coordinating access with the Owner. Contractor will be allowed access within the tank during tank operation for work activities performed at and above tank water surface operating levels. Due to limited access time within the fully dewatered tank, Contractor will be allowed extended work day hours. All work performed by the Contractor after typical work day hours shall be subject all local noise ordinance codes.

END OF SECTION

SECTION 01 22 13

BASIS OF MEASUREMENT AND PAYMENT - LUMP SUM

PART 1 - GENERAL

1.01 DESCRIPTION OF REQUIREMENTS

A. **The Contractor shall furnish** all necessary labor, machinery, tools, apparatus, equipment, materials, service and other necessary supplies and perform all Work shown on the Drawings and described in the Specifications and Contract Documents at the lump sum price as indicated by the Bidder in the Bid Form.

B. **The Bidder declares that it has examined the site** of the Work and informed itself fully in regard to all conditions pertaining to the place where the Work is to be done; that it has examined the Drawing, Specification, and Contract Documents for the Work, and has read all special provisions (such as temporary dewatering operations) furnished prior to the opening of bids; and that it has further satisfied itself relative to the Work to be performed.

C. **All excavation required of the work** shall be done as part of the total price for the complete project. All excavation shall be unclassified.

1.02 PAY ITEMS

A. **The items listed hereinbefore** refer to and are the same items listed in the Bid and constitute all of the pay items in this Contract. Any other items of Work listed in the Specifications or shown on the Drawings shall be considered incidental to the above items.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 01 31 13

PROJECT REQUIREMENTS

1. GENERAL DESCRIPTION OF WORK. The Work to be performed under these Contract Documents is generally includes furnishing all materials, equipment, supplies, labor and transportation, including fuel, power, water, (except any materials, equipment, utility, or service, if any, specified herein to be furnished by the District), and performing all work required in the scope of work in the Contract, in strict accordance with the specifications, schedules, and drawings, all of which are made a part hereof and including such detail drawings as may be furnished by the District from time to time during the prosecution of the work in explanation of said drawings.

2. COORDINATION. Contractor shall plan, schedule, and coordinate its operations in a manner which will facilitate the simultaneous progress of the work included under other contracts outside the scope of these Contract Documents if applicable.

3. MATERIALS TO BE FURNISHED BY OWNER. If the Owner is supplying some of the materials for this project, it shall be indicated on the bid item unit price sheet and Basis of Measurement and Payment, Section 00 22 13. Items will be available at the Owner's storage yard unless other provisions have been made.

4. RESPONSIBILITY FOR MATERIALS AND EQUIPMENT.

4.01. Items Furnished by Owner. Contractor's responsibility for materials and equipment furnished by Owner shall begin at the point of delivery on acceptance by Contractor. Contractor shall carefully examine each shipment prior to acceptance and shall reject all defective items. Owner reserves the right, however, to accept items rejected by Contractor and to authorize their installation in the Work.

Defective materials and equipment discovered after installation and prior to final acceptance of the Work, where the defect is of a nature not detectable by visual examination and other appropriate field inspection methods, shall be replaced by Owner, together with such additional materials and supplies as may be necessary for their replacement. Contractor shall furnish all necessary tools, equipment, and appliances, and perform all necessary labor, for the removal and replacement of such defective items in a manner acceptable to Owner; adjustment to the Contract Price for the costs of the removal and replacement shall be made in accordance with Article 11 of the General Conditions.

All materials and equipment furnished by Owner which disappear or are damaged after their acceptance by Contractor shall be replaced by and at the expense of Contractor. Replacements shall conform to the original procurement specifications.

Contractor shall be responsible for all unloading, reloading, transporting to the site, storage if necessary, re-handling, and installation.

All items shall be unloaded promptly after arrival. All charges for demurrage due to negligence or delay by Contractor shall be paid by Contractor. Equipment and materials shall be handled by methods which will prevent damage.

Equipment and materials shall be protected from exposure to the elements. All equipment shall be stored in accordance with the General Equipment Stipulations.

Contractor shall accept the risk of any delay in delivery of equipment or materials furnished by Owner, and if the Work is delayed, Contractor shall have no claim for damages or contract adjustment other than an extension of time and the waiving of liquidated damages occasioned by the delay.

All equipment shall be arranged and installed as indicated on the Drawings, and in conformity with installation drawings and instructions furnished to Owner by the manufacturer of the equipment.

4.02. Items Furnished by Contractor. Contractor shall be fully responsible for all materials and equipment which it has furnished.

5. OFFSITE STORAGE. Offsite storage arrangement shall be approved by Owner for all materials and equipment not incorporated into the Work but included in Applications for Payment. Such offsite storage arrangement shall be presented in writing and shall afford adequate and satisfactory security and protection. Offsite storage facilities shall be accessible to Owner.

6. SUBSTITUTES AND "OR-EQUAL" ITEMS. Provisions for evaluation of substitutes and "or-equal" items of materials and equipment are covered in Paragraph 6.05 of the General Conditions. Requests for review of equivalency will not be accepted by Owner from anyone except Contractor, and such requests will not be considered until after the Contract has been awarded.

7. PREPARATION FOR SHIPMENT. All materials shall be suitably packaged to facilitate handling and protect against damage during transit and storage. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Owner.

Each item, package, or bundle of material shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

8. SALVAGE OF MATERIALS AND EQUIPMENT. Existing materials and equipment removed, and not reused as a part of the Work, shall become Contractor's property, except the following items which shall remain Owner's property: Fire Hydrants, temporary plugs, and any unused materials supplied by the Owner. The Owner shall also take possession of the removed sludge transfer pump, the pump variable frequency drive, the polymer tank, and the polymer mixer. The Owner shall have the right of first refusal for all equipment and material to be removed, but the Contractor shall assume the Contractor is responsible for the disposal cost associated with all items, for bidding purposes.

Contractor shall carefully remove, in a manner to prevent damage, all materials and equipment specified or indicated to be salvaged and reused or to remain the property of Owner. Contractor shall store and protect salvaged items specified or indicated to be reused in the Work.

Salvaged items not to be reused in the Work, but to remain Owner's property, shall be delivered by Contractor in good condition to Owner’s storage yard.

Any items damaged in removal, storage, or handling through carelessness or improper procedures shall be replaced by Contractor in kind or with new items.

Contractor may furnish and install new items instead of those specified or indicated to be salvaged and reused, in which case such removed items will become Contractor's property.

Existing materials and equipment removed by Contractor shall not be reused in the Work except where so specified or indicated.

9. EASEMENTS AND RIGHTS-OF-WAY. The easements and rights-of-way for the pipelines will be provided by Owner. Contractor shall confine its construction operations within the limits indicated on the Drawings. Contractor shall use due care in placing construction tools, equipment, excavated materials, and pipeline materials and supplies in order to avoid damage to property and interference with traffic.

9.01. On Private Property. Easements across private property are indicated on the Drawings. Contractor shall set stakes to mark the boundaries of construction easements across private property. The stakes shall be protected and maintained until completion of construction and cleanup.

Contractor shall not enter any private property outside the designated construction easement boundaries without written permission from the owner of the property.

Whenever the easement is occupied by crops which will be damaged by construction operations, Contractor shall notify the owner sufficiently in advance so that the crops may be removed before excavation or trenching is started. Contractor shall be responsible for all damage to crops outside the easement and shall make satisfactory settlement for the damage directly with the owner.

Where the line crosses fields which are leveled for irrigation or terraced, Contractor shall relevel irrigated fields and replace all terraces to their original or better condition, and to the satisfaction of the owner.

9.02. Work Within Highway and Railroad Rights-of-Way. Permits shall be obtained by Owner. All Work performed and all operations of Contractor, its employees, or Subcontractors within the limits of railroad and highway rights-of-way shall be in conformity with the requirements and be under the control (through Owner) of the railroad or highway authority owning, or having jurisdiction over and control of, the right-of-way in each case.

10. OPERATION OF EXISTING FACILITIES. The existing water transmission and distribution system must be kept in continuous operation throughout the construction period. No interruption will be permitted which adversely affects the degree of service provided. Provided permission is obtained from Owner in advance, portions of the existing facilities may be taken out of service for short periods corresponding with periods of minimum service demands. This may facilitate work at night or weekends which is considered incidental to the project.

Contractor shall provide temporary facilities and make temporary modifications as necessary to keep the existing facilities in operation during the construction period.

11. NOTICES TO OWNERS AND AUTHORITIES. Contractor shall, as provided in the General Conditions, notify owners of adjacent property and utilities when prosecution of the Work may affect them.

When it is necessary to temporarily deny access to property, or when any utility service connection must be interrupted, Contractor shall give notices sufficiently in advance to enable the affected persons to provide for their needs. Notices shall conform to any applicable local ordinance and, whether delivered orally or in writing, shall include appropriate information concerning the interruption and instructions on how to limit inconvenience caused thereby.

Utilities and other concerned agencies shall be notified at least 24 hours prior to cutting or closing streets or other traffic areas or excavating near underground utilities or pole lines.

12. LINES AND GRADES. All Work shall be done to the lines, grades, and elevations indicated on the Drawings.

Basic horizontal and vertical control points will be established or designated by Owner to be used as datums for the Work. All additional survey, layout, and measurement work shall be performed by Contractor as a part of the Work.

Contractor shall provide an experienced instrument person, competent assistants, and such instruments, tools, stakes, and other materials required to complete the survey, layout, and measurement work. In addition, Contractor shall furnish, without charge, competent persons and such tools, stakes, and other materials as Owner may require in establishing or designating control points, or in checking survey, layout, and measurement work performed by Contractor.

Contractor shall keep Owner informed, a reasonable time in advance, of the times and places at which it wishes to do Work, so that horizontal and vertical control points may be established and any checking deemed necessary by Owner may be done with minimum inconvenience to Owner and minimum delay to Contractor.

Contractor shall remove and reconstruct work which is improperly located.

13. CONNECTIONS TO EXISTING FACILITIES. Unless otherwise specified or indicated, Contractor shall make all necessary connections to existing facilities, including structures, drain lines, and utilities such as water, sewer, gas, telephone, and electric. In each case, Contractor shall receive permission from Owner or the owning utility prior to undertaking connections. Contractor shall protect facilities against deleterious substances and damage.

Connections to existing facilities which are in service shall be thoroughly planned in advance, and all required equipment, materials, and labor shall be on hand at the time of undertaking the connections. Work shall proceed continuously (around the clock) if necessary to complete connections in the minimum time. Operation of valves or other appurtenances on existing utilities, when required, shall be by or under the direct supervision of the owning utility.

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

15. CUTTING AND PATCHING. As provided in General Conditions, Contractor shall perform all cutting and patching required for the Work and as may be necessary in connection with uncovering Work for inspection or for the correction of defective Work.

Contractor shall perform all cutting and patching required for and in connection with the Work, including but not limited to the following:

Removal of improperly timed Work.
Removal of samples of installed materials for testing.
Alteration of existing facilities.
Installation of new Work in existing facilities.

Contractor shall provide all shoring, bracing, supports, and protective devices necessary to safeguard all Work and existing facilities during cutting and patching operations. Contractor shall not undertake any cutting or demolition which may affect the structural stability of the Work or existing facilities without Owner's concurrence.

Materials shall be cut and removed to the extent indicated on the Drawings or as required to complete the Work. Materials shall be removed in a careful manner, with no damage to adjacent facilities or materials. Materials which are not salvable shall be removed from the site by Contractor.

All Work and existing facilities affected by cutting operations shall be restored with new materials, or with salvaged materials acceptable to Owner, to obtain a finished installation with the strength, appearance, and functional capacity required. If necessary, entire surfaces shall be patched and refinished.

16. ASBESTOS REMOVAL. If, during the progress of the Work, suspected asbestos-containing products are identified, Contractor shall stop work in the affected area and engage an asbestos removal Subcontractor to verify the materials and, if necessary, encapsulate, enclose, or remove and dispose of all asbestos in accordance with current regulations of the Environmental Protection Agency and the U. S. Department of Labor - Occupational Safety and Health Administration, the state asbestos regulating agency, and any local government agency. Payment for such work will be made by Change Order.

16.01. Subcontractor's Qualifications. The Subcontractor for asbestos removal shall be regularly engaged in this type of activity and shall be familiar with the regulations which govern this work. The Subcontractor shall demonstrate to the satisfaction of Owner that it has successfully completed at least three asbestos removal projects, that it has the necessary staff and equipment to perform the work, and that it has an approved site for disposal of the asbestos. The Subcontractor shall carry insurance as specified in the Supplementary Conditions.

16.02. Removal Methods. The asbestos removal Subcontractor shall submit a work plan of its proposed removal procedure to Owner before beginning work and shall certify that the methods are in full compliance with the governing regulations. The work plan shall cover all aspects of the removal, including health and safety of employees and building occupants, hygiene facilities, employee certification, clearance criteria, transportation and disposal, enclosure techniques, and other techniques appropriate for the proposed work.

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

Construction materials, such as concrete forms and scaffolding, shall be neatly stacked by Contractor when not in use. Contractor shall promptly remove splattered concrete, asphalt, oil, paint, corrosive liquids, and cleaning solutions from surfaces to prevent marring or other damage.

Volatile wastes shall be properly stored in covered metal containers and removed daily.

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

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

18. APPLICABLE CODES. References in the Contract Documents to local codes mean the following:

Kentucky Building Code
National Electric Code

Other standard codes which apply to the Work are designated in the Specifications.

19. PRECONSTRUCTION CONFERENCE. Prior to the commencement of Work at the site, a pre-construction conference will be held at a mutually agreed time and place. The conference shall be attended by:

Contractor and its superintendent.
Principal Subcontractors.
Representatives of principal Suppliers and manufacturers as appropriate.
Representatives of Owner.
Government representatives as appropriate.
Others as requested by Contractor or Owner.

Unless previously submitted to Owner, Contractor shall bring to the conference a preliminary schedule for each of the following:

Progress.
Procurement.
Values for progress payment purposes.
Shop Drawings and other submittals.

The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The agenda will include:

Contractor's preliminary schedules.
Transmittal, review, and distribution of Contractor's submittals.
Processing Applications for Payment.
Maintaining record documents.
Critical Work sequencing.
Field decisions and Change Orders.
Use of premises, office and storage areas, security, housekeeping, and Owner's needs.
Contractor's assignments for safety and first aid.

Owner will preside at the conference and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.

20. PROGRESS MEETINGS. Contractor shall schedule and hold regular progress meetings at least monthly and at other times as requested by Owner or required by progress of the Work. Contractor, Owner, and all Subcontractors active on the site shall be represented at each meeting. Contractor may at its discretion request attendance by representatives of its Suppliers, manufacturers, and other Subcontractors.

Contractor shall preside at the meetings. Meeting minutes will be prepared and distributed by Contractor. The purpose of the meetings will be to review the progress of the Work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop.

End of Section

SECTION 01 32 00

SUBMITTALS

1. PROGRESS SCHEDULE. After the preconstruction conference and before Work is started, Contractor shall submit to Owner for review a schedule of the proposed construction operations. Owner shall cooperate with Contractor in arrangements for continuity of service and operation of valves and other control facilities. The progress schedule shall indicate the sequence of the Work, the time of starting and completion of each part, and the time for making connections to existing piping, structures, or facilities.

2. PROGRESS REPORTS. A progress report shall be furnished to Owner with each Application for Payment. If the Work falls behind schedule, Contractor shall submit additional progress reports at such intervals as Owner may request. Each progress report shall include sufficient narrative to describe current and anticipated delaying factors, their effect on the progress schedule, and proposed corrective actions. Any Work reported complete, but which is not readily apparent to Owner, must be substantiated with satisfactory evidence.

3. SURVEY DATA. All field books, notes, and other data developed by Contractor in performing surveys required as part of the Work shall be available to Owner for examination throughout the construction period. All such data shall be submitted to Owner with the other documentation required for final acceptance of the Work.

4. SHOP DRAWINGS AND ENGINEERING DATA.

4.01. General. Shop Drawings and engineering data (submittals) covering all equipment and fabricated and building materials which will become a permanent part of the Work under this Contract shall be submitted to Owner, at the Owner's address given in the Agreement. Submittals shall verify compliance with the Contract Documents, and shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and operation of component materials and devices; the external connections, anchorages, and supports required; performance characteristics; and dimensions needed for installation and correlation with other materials and equipment. When an item consists of components from several sources, Contractor shall submit a complete initial submittal including all components.

All submittals, regardless of origin, shall be stamped with the approval of Contractor and identified with the name and number of this Contract, Contractor's name, and references to applicable specification paragraphs and Contract Drawings. Each submittal shall indicate the intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified and inapplicable data crossed out. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.

Contractor shall be solely responsible for the completeness of each submission. Contractor's stamp of approval is a representation to Owner that Contractor accepts sole responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, and that Contractor has reviewed and coordinated each submittal with the requirements of the Work and the Contract Documents.

All deviations from the Contract Documents shall be identified as deviations on each submittal and shall be tabulated in Contractor's letter of transmittal. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by Contractor.

One copy of each drawing and necessary data shall be submitted to Owner for its record. The Owner intends to use this for information only. If requested by Contractor, up to three additional copies may be submitted for review and approval by Owner. Owner will return marked copies (or one marked reproducible copy) to Contractor. Owner will not accept submittals from anyone but Contractor. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.

4.02. Owner's Review of Submittals. Owner's review of submittals will cover only general conformity to the Drawings and Specifications, external connections, and dimensions which affect the layout. Owner's review does not indicate a thorough review of all dimensions, quantities, and details of the material, equipment, device, or item shown. Owner's review shall not relieve Contractor of Contractor's sole responsibility for errors, omissions, or deviations in the drawings and data, nor of Contractor's sole responsibility for compliance with the Contract Documents.

If Contractor requests a review and response, Owner's submittal review period shall be 14 consecutive calendar days in length and shall commence on the first calendar day immediately following the date of arrival of the submittal or resubmittal in Owner's office. The time required to mail the submittal or resubmittal back to Contractor shall not be considered a part of the submittal review period.

When the drawings and data are returned marked "NOT ACCEPTABLE" or "RETURNED FOR CORRECTION", the corrections shall be made as noted thereon and as instructed by Owner and corrected copies (or one corrected reproducible copy) resubmitted. When the drawings and data are returned marked "EXCEPTIONS NOTED", "NO EXCEPTIONS NOTED", or "RECORD COPY", no additional copies need be furnished unless requested by Owner at time of review.

4.03. Resubmittal of Drawings and Data. Contractor shall accept full responsibility for the completeness of each resubmittal. Contractor shall verify that all corrected data and additional information previously requested by Owner are provided on the resubmittal.

When corrected copies are resubmitted, Contractor shall in writing direct specific attention to all revisions and shall list separately any revisions made other than those called for by Owner on previous submissions. Requirements specified for initial submittals shall also apply to resubmittals. Resubmittals shall bear the number of the first submittal followed by a letter (A, B, and so on) to indicate the sequence of the resubmittal.

Re-submittals shall be made within 30 days of the date of the letter returning the material to be modified or corrected, unless within 14 days Contractor submits an acceptable request for an extension of the stipulated time period, listing the reasons the resubmittal cannot be completed within that time.

Any need for more than one resubmission, or any other delay in obtaining Owner's review of submittals, will not entitle Contractor to extension of the Contract Times unless delay of the Work is directly caused by a change in the Work authorized by a Change Order.

End of Section

SECTION 01 40 00

QUALITY CONTROL

1. TESTING SERVICES. All tests to determine compliance with the Contract Documents shall be performed by an independent commercial testing firm acceptable to Owner. The testing firm's laboratory shall be staffed with experienced technicians, properly equipped and fully qualified to perform the tests in accordance with the specified standards.

Testing services provided by Owner are for the sole benefit of Owner; however, test results shall be available to Contractor. Testing necessary to satisfy Contractor's internal quality control procedures shall be the sole responsibility of Contractor.

1.01. Testing Services Furnished by Contractor. Unless otherwise specified, Contractor shall provide all testing services in connection with the following:

a. Concrete materials and mix designs.
b. Asphaltic concrete materials and mix designs.
c. Embedment, fill and backfill materials.
d. All other tests and engineering data required for Owner's review of materials and equipment proposed to be used in the Work.

Contractor shall obtain Owner's acceptance of the testing firm before having services performed, and shall pay all costs for these testing services.

1.02. Testing Services Furnished by Owner. Unless otherwise specified, Owner shall provide for tests made on the following materials and equipment:

a. Concrete.
b. Asphaltic concrete.
c. Moisture-density and relative density tests on embedment, fill, and backfill materials.
d. In-place field density tests on embedments, fills, and backfill.
e. Dewatered cake solids content during temporary dewatering operation.
f. Other materials and equipment at the discretion of Owner.

Testing, including sampling, will be performed by Owner or the testing firm's laboratory personnel, in the general manner indicated in the Specifications. Owner shall determine the exact time, location, and number of tests, including samples.

Arrangements for delivery of samples and test specimens to the testing firm's laboratory will be made by Owner. The testing firm's laboratory shall perform all laboratory tests within a reasonable time consistent with the specified standards and shall furnish a written report of each test.

Contractor shall furnish all sample materials and cooperate in the testing activities, including sampling. Contractor shall interrupt the Work when necessary to allow testing, including sampling, to be performed. Contractor shall have no claim for an increase in Contract Price or Contract Times due to such interruption. When testing activities, including sampling, are performed in the field by Owner or the testing firm's laboratory personnel, Contractor shall furnish personnel and facilities to assist in the activities.

If testing shows workmanship and/or materials does not meet established requirements, the Contractor shall be responsible for all additional testing cost to ensure compliance.

1.03. Transmittal of Test Reports. Written reports of tests and engineering data furnished by Contractor for Owner's review of materials and equipment proposed to be used in the Work shall be submitted as specified for Shop Drawings.

End of Section

SECTION 01 42 13

ABBREVIATIONS OF TERMS AND ORGANIZATIONS

1. LIST OF ABBREVIATIONS. Reference to standards and organizations in the Specifications shall be indicated by the following abbreviated letter designations:

AA	Aluminum Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AFBMA	Antifriction Bearing Manufacturers Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
APA	American Plywood Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWG	American Wire Gage
AWPA	American Wood-Preservers' Association
AWPB	American Wood Preservers Bureau
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
CDA	Copper Development Association
CISPI	Cast Iron Soil Pipe Institute
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard (U.S. Department of Commerce)
DIPRA	Ductile Iron Pipe Research Association
EEI	Edison Electric Institute
EJCDC	Engineers' Joint Contract Documents Committee
EPA	Environmental Protection Agency
Fed Spec	Federal Specification
FHWA	Federal Highway Administration
FIA	Factory Insurance Association
FM	Factory Mutual
IEEE	Institute of Electrical and Electronics Engineers
IFI	Industrial Fasteners Institute
IRI	Industrial Risk Insurers

MIL	Military Specification
MSS	Manufacturers Standardization Society of Valve and Fitting Industry
NBS	National Bureau of Standards
NCSPA	National Corrugated Steel Pipe Association
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NPC	National Plumbing Code
NPT	National Pipe Thread
NRMCA	National Ready Mixed Concrete Association
NSC	National Safety Council
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PS	Product Standard
SAE	Society of Automotive Engineers
SI	Système International des Unitès (International System of Units)
SPFA	Steel Plate Fabricators Association
SSI	Scaffolding and Shoring Institute
SSPC	Steel Structures Painting Council
UL	Underwriters' Laboratories

End of Section

SECTION 01 50 00

TEMPORARY FACILITIES

1. PRESENCE IN THE AREA. The Contractor understands and agrees that during the performance of the Contract, it shall maintain a presence within such proximity of the Work Site which will allow it to respond to an emergency at the Work Site within one hour of receiving notice of an emergency, including emergencies occurring during non-working hours. The Contractor shall provide a list of emergency phone numbers for such purposes. If the Contractor does not have such a presence, it may satisfy this requirement by sub-contracting with a sub-contractor that does have such a presence, provided that any such sub-contractor must be approved by the Owner, in its sole discretion, prior to the project pre-construction meeting.

2. DEWATERING. During temporary dewatering operation (defined as period between removing existing equipment and commissioning new equipment) Contractor shall provide all necessary dewatering, polymer, and conveyance equipment necessary to dewater solids produced on a weekly basis, and dispose of the dewatered sludge per requirements in Temporary Services, Section 01 51 00.

3. WATER. Water in reasonable amounts required for and in connection with the Work to be performed will be furnished at existing fire hydrants by Owner without charge to Contractor. All water used in testing and disinfection of mains will be furnished by the Owner for the first test only. Contractor shall furnish necessary pipe, hose, nozzles, and tools and shall perform all necessary labor. Contractor shall make arrangements with Owner (who will determine the time, rate, and duration of each withdrawal from the distribution system) as to the amount of water required and the time when the water will be needed. Unnecessary waste of water will not be tolerated. Special hydrant wrenches shall be used for opening and closing fire hydrants. In no case shall pipe wrenches be used for this purpose.

4. POWER. Contractor shall provide all power for heating, lighting, operation of Contractor's plant or equipment, or for any other use by Contractor.

5. TELEPHONE SERVICE. Contractor shall make all necessary arrangements and pay all installation charges for telephone lines in its offices at the Site and shall provide all telephone instruments.

6. RESTROOMS / SANITARY FACILITIES. Contractor shall furnish temporary sanitary facilities at the Site, as provided herein, for the needs of all construction workers and others performing work or furnishing services on the Project. Sanitary facilities shall be of reasonable capacity, properly maintained throughout the construction period, and obscured from public view to the greatest practical extent. If toilets of the chemically treated type are used, at least one toilet will be furnished for each 20 persons. Provide self-contained single-occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material. Contractor shall enforce the use of such sanitary facilities by all personnel at the Site. Use of existing restroom facilities inside buildings at the Treatment Plant is prohibited. No construction workers or others performing work or furnishing services on the Project shall be permitted to use existing facilities inside of buildings used by the Owner's Staff.

Comply with regulations and health codes for the type, number, location, operation, and maintenance of fixtures and facilities. Install where facilities will best serve the project's needs. Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Provide covered waste containers for used material. Install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up for a healthy and sanitary condition. Dispose of drainage properly. Supply cleaning compounds appropriate for each condition. Provide bottled-water-type drinking water units.

7. MAINTENANCE OF TRAFFIC. Contractor shall conduct his work to interfere as little as possible with public travel, whether vehicular or pedestrian. Whenever it is necessary to cross, obstruct, or close roads, driveways, and walks, whether public or private, Contractor shall provide and maintain suitable and safe bridges, detours, or other temporary expedients for the accommodation of public and private travel, and shall give reasonable notice to owners of private drives before interfering with them. Such maintenance of traffic will not be required when Contractor has obtained permission from the owner and tenant of private property, or from the authority having jurisdiction over public property involved, to obstruct traffic at the designated point.

In making open cut street crossings, Contractor shall not block more than one-half of the street at a time. Whenever possible, Contractor shall widen the shoulder on the opposite side to facilitate traffic flow. Temporary surfacing shall be provided as necessary on shoulders.

The Contractor shall wherever necessary or as required by the Owner or the authority having jurisdiction provide, erect and maintain proper lights, signs, barricades, temporary guardrail, other traffic control devices, and furnish watchmen and flagmen as may be necessary to maintain safe traffic conditions in accordance with the Manual of Uniform Traffic Control Devices.

The Contractor shall be liable for and hold the Owner free and harmless from all damages occasioned in any way by its actions or neglect or those of its agents, employees, or workmen.

Work that requires the Contractor to shut down the road on weekends or at nights is considered an incidental to the project.

The Contractor at all times shall conduct the work in such manner as to cause as little interference as possible with private business or with private and public travel on the public highway. All damage (other than that resulting from normal wear and tear) to existing roads or pavements shall be repaired to withstand traffic in a safe condition.

Where the Contractor finds it necessary to remove excavated material to some other location, care should be taken not to overload trucks, which would in turn spill material out upon highways. Any such material spilled upon highways shall be immediately cleaned up from the location and properly disposed of per applicable regulation.

Where it is necessary and is agreeable with public and private property owners, excavated materials may be temporarily piled in the streets or roadways, however, one lane of traffic must be maintained at all times.

After excavated materials have been removed, all hard surface streets or roadways shall be thoroughly cleaned and left free of dirt, gravel and dust. Streets or roadways, which do not have hard surfaces, must be restored to their original condition at the expense of the Contractor. Streets and roadways shall be kept in a safe and passable condition at all times.

7.01. Temporary Bridges. Contractor shall construct substantial bridges at all points where it is necessary to maintain traffic across pipeline construction. Bridges in public streets, roads, and highways shall be acceptable to the authority having jurisdiction thereover. Bridges erected in private roads and driveways shall be adequate for the service to which they will be subjected. Bridges shall be provided with substantial guardrails and with suitably protected approaches. Footbridges shall be at least 4 feet wide, provided with handrails and uprights of dressed lumber. Bridges shall be maintained in place as long as the conditions of the Work require their use for safety of the public. When necessary for the

proper prosecution of the Work in the immediate vicinity of a bridge, the bridge may be relocated or temporarily removed for such period as Owner may permit.

7.02. Detours. Where required by the authority having jurisdiction thereover that traffic be maintained over any construction work in a public street, road, or highway, and the traffic cannot be maintained on the alignment of the original roadbed or pavement, Contractor shall, at its own expense, construct and maintain a detour around the construction work. Each detour shall include a bridge across the pipe trench and all necessary barricades, guardrails, approaches, lights, signals, signs, and other devices and precautions necessary for protection of the Work and safety of the public.

8. BARRICADES AND LIGHTS. All streets, roads, highways, and other public thoroughfares, which are closed to traffic, shall be protected by effective barricades on which shall be placed acceptable warning signs. Barricades shall be located at the nearest intersecting public highway or street on each side of the blocked section.

All open trenches and other excavations shall have suitable barricades, signs, and lights to provide adequate protection to the public. Obstructions, such as material piles and equipment, shall be provided with similar warning signs and lights.

All barricades and obstructions shall be illuminated with warning lights from sunset to sunrise. Material storage and conduct of the Work on or alongside public streets and highways shall cause the minimum obstruction and inconvenience to the traveling public.

All barricades, signs, lights, and other protective devices shall be installed and maintained in conformity with applicable statutory requirements and, where within railroad and highway rights-of-way, as required by the authority having jurisdiction thereover.

9. TRAFFIC CONTROL. In addition to the requirements of the maintenance of traffic and barricades and lights paragraphs in this section, traffic control shall be as set forth herein.

During periods of inclement weather, rush-hour traffic, or during periods of unusually heavy traffic, the Owner may require the Contractor to cease operations in order to adequately handle the traffic. The Owner reserves the right to require the suspension or delay of certain operations, or the expediting of other operations, at no additional cost to the Owner, to provide a proper sequence of operations which will promote the satisfactory movement of traffic. The Owner may require additional barricades, lights, or flagmen at any time or at any place necessary for proper protection of traffic, but approval by the Owner of the Contractor's method of operation shall not relieve the Contractor of his responsibility to protect traffic.

The use and duration of using heavy steel plates to convey traffic across open excavations shall be kept to a minimum. Steel plates shall be secured in an appropriate manner to prevent them from moving. The purpose of this requirement is to minimize the sound to the residents, institutions, commercial establishments, etc. The Owner reserves the right, at no additional cost to the Owner, to require the Contractor to complete certain operations and street re-paving so steel plates are not required.

The use of heavy steel plates during should be keep to a minimum. The Contractor shall place traffic cones behind the curb or other visible location to help identify the beginning and termination of the steel plates. Special precautions shall be taken by the Contractor if steel plates are used during inclement weather. The Contractor shall be responsible for notifying the authority having jurisdiction over the roadway maintenance (snow removal) with the locations of the steel plates prior to each inclement weather event. The Contractor shall maintain the traffic cones and steel plates.

Contractor shall take extra precautions to provide and maintain emergency access on all streets and roads and to all residential, commercial, and other properties for police and fire departments and emergency medical service throughout the construction operations.

Contractor shall maintain the use of existing walks for pedestrians at all times. Additional requirements are specified in the temporary bridge subparagraph in this section.

10. TRAFFIC CONTROL PLAN. To obtain a permit to work within public rights-of-way, Contractor may be required to prepare and submit to the appropriate agencies, a traffic control plan in conformance with the requirements of the authority having jurisdiction thereover.

11. FENCES. All existing fences affected by the Work shall be maintained by Contractor until completion of the Work. Fences which interfere with construction operations shall not be relocated or dismantled until written permission is obtained from the owner of the fence, and the period the fence may be left relocated or dismantled has been agreed upon. A copy of all written permissions shall be submitted to Owner. Where fences must be maintained across the construction easement, adequate gates shall be installed. Gates shall be kept closed and locked at all times when not in use.

On completion of the Work across any tract of land, Contractor shall restore all fences to their original or to a better condition and to their original location.

12. PROTECTION OF PUBLIC AND PRIVATE PROPERTY, DAMAGE TO EXISTING PROPERTY. Contractor shall protect, shore, brace, support, and maintain all underground pipes, conduits, drains, and other underground construction uncovered or otherwise affected by his construction operations. All pavement, surfacing, driveways, curbs, walks, buildings, utility poles, guy wires, fences, and other surface structures affected by construction operations, together with all sod, shrubs, trees in yards, parkways, and medians shall be restored to their original or better condition, whether within or outside the easement. Unless otherwise specified, all replacements shall be made with new materials.

Sodded and landscaped areas on improved property (yards) shall be disturbed only to the extent required to permit construction. Such areas shall not be used as storage sites for construction supplies and, insofar as practicable, shall be kept free from stockpiles or excavated materials.

No trees shall be removed outside the permanent easement, except where authorized by Owner. Hand excavation shall be employed as necessary to prevent injury to trees. Trees left standing shall be adequately protected against damage from construction operations.

Contractor shall be responsible for all damage to streets, curbs/gutters, roads, sidewalks, shoulders, ditches, embankments, culverts, bridges, traffic loops and other public or private property, regardless of location or character, which may be caused by transporting equipment, materials, or workers to or from the Work or any part or site thereof, whether by him or his Subcontractors. Contractor shall make satisfactory and acceptable arrangements with the owner of, or the agency or authority having jurisdiction over, the damaged property concerning its repair or replacement or payment of costs incurred in connection with the damage and shall furnish a written verification of all agreements.

Should the Contractor's operations damage any existing underground or aboveground utility, installation, structure, or other construction, Contractor shall immediately notify the authority owning or having jurisdiction over and control of the utility, installation, structure, or other construction, and make a report of such damage. A copy of the report shall be submitted to the Owner. The damaged item shall be repaired immediately by and at the expense of the Contractor unless otherwise specified or acceptable to the authority or owner having jurisdiction over, or to the Owner.

The utility, installation, structure, or other structures damaged by Contractor's operations shall be repaired, replaced, or otherwise restored in accordance with the local ordinances, standards, and requirements of the applicable authority or owner having jurisdiction thereover and shall be subject to acceptance by the Owner. Special precaution shall be taken by the Contractor to avoid damage to existing overhead and underground utilities owned and operated by the Owner or other public or private utility companies.

With particular respect to existing underground utilities, all available information concerning their location has been shown on the drawings. While it is believed that the locations shown are reasonably correct, the Owner cannot guarantee the accuracy or adequacy of this information.

Before proceeding with the work, the Contractor shall confer with all public or private companies, agencies, property owners, or departments that own and operate utilities in the vicinity of the construction work. The purpose of this conference or conferences shall be to notify said companies, agencies or departments of the proposed construction schedule, verify the location of and possible interference with the existing utilities, fire protection systems, lawn irrigation systems, etc., that are shown on the plans, arrange for necessary suspensions of service, and make arrangements to locate and avoid interference with all other utilities (including house connections) that are not shown on the plans. The Owner has no objection to the Contractor arranging for said utility companies, agencies, or departments to locate and uncover their own utilities, however, insofar as the Owner is concerned, the Contractor shall bear entire responsibility for locating and avoiding or repairing damage to said existing utilities.

Where existing utilities or other underground structures are encountered, they shall not be displaced or molested unless necessary, and in such case they shall be replaced in as good or better condition than found as quickly as possible. All such utilities that are so damaged or molested shall be replaced at the Contractor's expense unless in the opinion of the Owner such damage was caused through no fault or action of the Contractor.

It is expected that the Contractor will be diligent in its efforts and use every possible means to locate existing utilities. Any claims for unavoidable damage based on improper or unknown locations will be thoroughly examined in the light of the Contractor's efforts to locate the said utilities or obstructions prior to beginning.

When construction is completed, the private property owner's facilities and grounds shall be restored to as good or better condition than found and as quickly as possible at the Contractor's expense.

All water mains and water service connections damaged by Contract's operations will be repaired by the Owner at the expense of the Contractor unless other arrangements are made. Customer irrigation piping damaged by Contractor's operations shall be repaired by and at the cost of the Contractor.

All fire hydrants and water control valves shall be kept free from obstruction and available for use at all times.

13. TREE AND PLANT PROTECTION. Tree and plant protection is of prime importance. Except where otherwise authorized, indicated, or specified, no trees or plants shall be removed. Activities near trees that are to be protected shall be kept to a minimum. Tree protection shall also include trimming, when necessary, to prevent damage by construction equipment.

Trees and plants to be removed shall be removed in such a manner as to avoid injury to surrounding trees and plants. Contractor shall be responsible for disposal of all trees and plants removed or damaged.

14. HAUL ROUTES. Contractor shall obtain and pay for all necessary permits from the applicable authority having jurisdiction thereover to allow use of public streets to transport equipment and material to and from

the Site. At such time the Contractor shall request the agency having jurisdiction to establish the haul routes. A copy of the permit and designated haul routes shall be provided to the Owner prior to commencement of Work in that area.

15. PARKING. Contractor shall provide and maintain suitable parking areas for the use of all construction workers and others performing work or furnishing services in connection with the Project, as required to avoid any need for parking personal vehicles where they may interfere with public traffic, Owner's operations, or construction activities.

Contractor shall clean up all parking areas used and return them to their original state.

The location of the Contractor's parking areas shall be acceptable to Owner, and the owner and tenant of private property or to the authority having jurisdiction over public property upon which the parking area will be located.

16. RESIDENTIAL PARKING. Contractor shall provide appropriate areas for residents to park their vehicles during the construction operations adjacent to their properties, if required. This shall include making the appropriate areas available to the residents by not storing construction materials or equipment in these areas and providing signs and other notification methods acceptable to the Owner for instructing the residents on the location of the temporary parking and its intended use.

Additional requirements for notifying property owners and tenants of available temporary parking are covered in the project requirements section.

17. ACCESS ROADS. Contractor shall establish and maintain temporary access roads to various parts of the Site as required to complete the Project. Such roads shall be available for the use of all others performing work or furnishing services in connection with the Project.

18. NOISE CONTROL. Contractor shall take reasonable measures to avoid unnecessary noise. Such measures shall be appropriate for the normal ambient sound levels in the area during working hours. All construction machinery and vehicles shall be equipped with practical sound-muffling devices, and operated in a manner to cause the least noise consistent with efficient performance of the Work.

During construction activities on or adjacent to occupied buildings, and when appropriate, Contractor shall erect screens or barriers effective in reducing noise in the building and shall conduct his operations to avoid unnecessary noise which might interfere with the activities of building occupants.

19. DUST CONTROL. Contractor shall take reasonable measures to prevent unnecessary dust. Earth surfaces subject to dusting shall be kept moist with water or by application of a chemical dust suppressant. When practicable, dusty materials in piles or in transit shall be covered to prevent blowing dust.

Buildings or operating facilities, which may be affected adversely by dust, shall be adequately protected from dust. Existing or new machinery, motors, instrument panels, or similar equipment shall be protected by suitable dust screens. Proper ventilation shall be included with dust screens.

20. STORM WATER EROSION AND PREVENTION. The following is to be used as a guideline in conjunction with the plans for temporary drainage provisions, erosion control and pollution control as required by a Sanitation District #1 Permit and Kentucky Pollution Discharge Elimination System (KPDES). Reference “Kentucky Best Management Practices for Controlling Erosion, Sediment, and Pollutant Runoff from Construction Sites” and the “Northern Kentucky Sanitation District No. 1 Storm Water Permitting Guide”.

20.01. GRADING PERMIT, NOTICE of INTENT and NOTICE of TERMINATION. The owner will be responsible for acquiring a Grading Permit from Sanitation District #1 and filing a Notice of Intent/Notice of Termination with the KPDES. A Grading Permit is necessary when the square footage of the pervious and impervious areas are equal to or greater than one acre.

A. Projects less than one acre:
   - Best Management Practices that are shown on the plans and specifications are a minimum. Contractors are responsible for providing the minimum, and, if necessary will provide additional BMP's to satisfy the situation and the regulating authority.

B. Projects greater than one acre:
   - Best Management Practices that are shown on the plans and specifications are a minimum. Contractors are responsible for providing the minimum, and, if necessary will provide additional BMP's to satisfy the situation and the regulating authority.
   - Sanitation District #1 must be contacted at least 72 hours prior to any construction activity. (Andy Amen @ 859-578-6880)
   - Site stabilization shall begin within 14 days where construction activity has permanently ceased.
   - Site stabilization shall begin within 21 days where construction activity has temporarily ceased.
   - BMP'S shall be checked a minimum of every 7 days and within 24 hours after a 0.5" rainfall. Contractor shall keep a maintenance log book that records the date, weather event, reason for inspection and signature. The maintenance log book shall be turned over to the Owner at the end of the project.

20.02. TEMPORARY DRAINAGE PROVISIONS. Contractor shall provide for the drainage of storm water and such water as may be applied or discharged on the Site in performance of the Work. Drainage facilities shall be adequate to prevent damage to the Work, the Site, and adjacent property.

Existing drainage channels and conduits shall be cleaned, enlarged, or supplemented as necessary to carry all increased runoff attributable to Contractor's operations. Dikes shall be constructed as necessary to divert increased runoff from entering adjacent property (except in natural channels), to protect Owner's facilities and the Work, and to direct water to drainage channels or conduits. Ponding shall be provided as necessary to prevent downstream flooding.

20.03. EROSION CONTROL. Contractor shall prevent erosion of soil on the Site and adjacent property resulting from it's construction activities. Effective measures shall be initiated prior to the commencement of clearing, grading, excavation, or other operation that will disturb the natural protection.

Work shall be scheduled to expose areas subject to erosion for the shortest possible time, and natural vegetation shall be preserved to the greatest extent practicable. Temporary storage and construction buildings shall be located, and construction traffic routed, to minimize erosion. Temporary fast-growing vegetation or other suitable ground cover shall be provided as necessary to control runoff.

21. POLLUTION CONTROL. Contractor shall prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities. No sanitary wastes will be permitted to enter any drain or watercourse other than sanitary sewers. No sediment, debris, or other substance will be permitted to enter sanitary sewers, and reasonable measures shall be taken to prevent such materials from entering any drain or watercourse.

22. CUSTOMER NOTIFICATION. The Contractor after approval by the Owner's representative shall notify all affected Owner customers a minimum of 48 hours prior to interrupting water service. Notification shall be made by the Contractor using the Northern Kentucky Water District "Interruption of Service Notice". All Owner customers shall be notified prior to having their water turned-off to have ample time to draw water for use until service is restored. Under no circumstance shall a customer of the Owner be without water service overnight. If water service or existing water system cannot be interrupted during normal daytime hours due to water needs or high demands, the contractor may be required to conduct the work at night or on the weekend. This work is considered an incidental to the project.

It is the Contractor's responsibility to post "No Parking" signs twenty-four (24) hours in advance of starting work in designated parking zones. Said signs shall be removed upon completion of work. Signs shall not be left posted over weekends or holidays.

23. UNSAFE CONDITIONS. The Owner reserves the right to take whatever action necessary to correct an unsafe condition created by the Contractor at the Contractor's expense.

24. SECURITY. CONTRACTOR shall be responsible for protection of the Site, and all the Work, materials, equipment, and existing facilities thereon, against vandals and other unauthorized persons.

No Claim shall be made against OWNER by reason of any act of an employee or trespasser, and CONTRACTOR shall make good all damage to OWNER's property resulting from CONTRACTOR's failure to provide security measures as specified.
Security measures shall be at least equal to those usually provided by OWNER to protect OWNER's existing facilities during normal operation, but shall also include such additional security fencing, barricades, lighting, and other measures as required to protect the Site.

25. TEMPORARY LIGHTING. Contractor shall provide all temporary lighting required to complete work, for security, or for any other use by Contractor.

26. TEMPORARY HEAT. Contractor shall provide all temporary heat required to complete work, for curing or drying of completed installations, for protection of installed construction from adverse effects of low temperatures or high humidity, or for any other use by Contractor. Select safe equipment that will not have a harmful effect on completed installations, elements being used, or personnel. Coordinate ventilation requirements.

27. FIELD OFFICE. Contractor shall provide an insulated, weathertight, heated, or air-conditioned temporary office of sufficient size to accommodate required office personnel at the project site.
The Contractor shall provide, either as a part of its field office or as a separate facility, a room of not less than 240 square feet (sf) for project meetings. Furnish the room with a conference table, eight folding chairs, and a tackboard. Keep the office clean and orderly.

28. STORAGE AND FABRICATION SHEDS. Contractor shall provide storage and fabrication sheds, sized, furnished, and equipped to accommodate materials and equipment including temporary utility service. Sheds may be open shelters or fully enclosed spaces on the site.

29. PROJECT IDENTIFICATION AND TEMPORARY SIGNS. Contractor shall provide temporary signage per Owner requirements. This includes project identification signs and temporary signs. Prepare signs to provide directional information to construction personnel and visitors. Support on posts or framing of preservative-treated wood or steel. Do not permit installation of unauthorized signs. Install exterior yard and sign lights so that signs are visible when work is being performed.

30. COLLECTION AND DISPOSAL OF WASTE. See Section 01 74 23 “Cleaning”.

31. TEMPORARY FIRE PROTECTION. Until fire protection needs are supplied by permanent facilities, Contractor shall install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 10, "Standard for Portable Fire Extinguishers," and NFPA 241, "Standard for Safeguarding Construction, Alterations and Demolition Operations." Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell. Store combustible materials in containers in fire safe locations. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways, and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.

32. BARRICADES, WARNING SIGNS, AND LIGHTS. Contractor shall comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to warn personnel and the public of the hazard. Where needed, provide lighting including flashing lights.

End of Section

SECTION 01 51 00

TEMPORARY SERVICES

1. TEMPORARY SERVICE PLAN. The Contractor shall furnish the District a detailed plan for installation and connection of temporary pipes necessary to maintain dewatering operations. This plan shall be submitted to the District a minimum of two weeks prior to beginning any construction of this project. This plan must show, in detail, all temporary pipes to be used, location of feed for temporary pipes, and the approximate location of the temporary pipes with respect to the roadways and sidewalks. Any alterations required by the District to the submitted plan to conform to the requirements of these specifications will be accomplished as a part of the lump sum proposal.

2. INSTALLATION OF TEMPORARY PIPES. The Contractor shall furnish, install, and maintain all temporary pipe, appurtenances, and equipment during the temporary dewatering operations. The Contractor shall perform all connecting and disconnecting of the temporary pipe to new or existing permanent piping. All temporary service pipes crossing streets, driveways, and sidewalks must use ramps to prevent a traffic/pedestrian hazard. When rubber ramps are used the Contractor shall be responsible for the maintenance of the temporary ramping method and repairing any damages. Plastic temporary piping will be allowed if properly placed so as to prevent its damage by traffic. All temporary sidewalk crossings must be painted with orange fluorescent paint with a flashing light barricade maintained by the Contractor.

3. OPERATION OF TEMPORARY PIPES. The Contractor shall maintain the temporary pipe in safe and operative condition at all times.

4. REMOVAL OF TEMPORARY PIPE. Upon restoring to service water mains the Contractor shall remove any corresponding section of temporary pipes and shall leave the streets, sidewalks and adjacent property in a neat and orderly condition and in every respect equal to if not better than their original condition.

5. DISPOSAL OF DEWATERED SLUDGE DURING TEMPORARY OPERATIONS. During temporary dewatering operations, Contractor shall coordinate sludge disposal operations with NKWD's Hauling Contractor, including scheduling dumpster delivery and removal directly with the Owner. The Owner's agreement stipulates that orders for dumpster pickup received before 4:00 p.m. on weekdays shall be picked up by Hauling Contractor within three hours of the Hauling Contractor's receipt of notice from the Owner. Orders placed after 4:00 p.m. shall be picked up by Hauling Contractor by 8:30 a.m. on the next business day, and all removals shall be made between the hours of 7:00 a.m. and 7:00 p.m. local time on weekdays, unless otherwise requested by the Owner. Contractor's personnel shall be fully equipped and capable of performing all necessary removal operations without assistance from the District or its employees. An empty dumpster must be provided at the same time to replace the dumpster being picked up. Sludge quality produced by the Contractor shall meet the minimum 20-percent solids content NKWD staff normally supplies to the Hauling Contractor. If through routine NKWD staff grab sampling testing the solids content is verified to be below 20-percent, then Contractor shall pay the additional cost charged by the Hauling Contractor to dispose of the additional quantity or weight of dewatered sludge below 20-percent solids content.

6. PAYMENT. Payment for all work covered under this section and all costs in connection therewith shall be included and paid as part of the lump sum in the cost proposal.

End of Section

SECTION 01 60 00

MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Transport and handle materials and equipment in accordance with the manufacturer's recommendations and requirements of Contract Documents. Make all arrangements for transportation, delivery, storage, and handling of equipment and materials required for prosecution and completion of the work.

1.3 QUALITY ASSURANCE

Not used.

1.4 SUBMITTALS

Not used.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery**. Deliver shipments of materials and equipment to the site only during regular working hours. Shipments shall be addressed and consigned to the proper party giving name of Contract, street number, and city. Shipments shall not be delivered to the Owner or Owner's Representative, except as otherwise directed. Transportation shall be in accordance with Part 3 of this section.

B. **Storage and Handling**

1. Store, handle, and protect materials in accordance with the manufacturer's recommendations and the requirements of Part 3 of this section.
2. Maintain equipment in an undeteriorated and fully serviceable condition and as specified in Part 3 of this section.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 **TRANSPORTATION**

A. **General**. Arrange deliveries of products in accordance with the construction schedule and in ample time to facilitate inspection prior to installation.

B. **Coordination**

1. Coordinate deliveries to avoid conflict with work and conditions at site and to accommodate the following:

   a. Work of other contractors.
   b. Limitations of storage space.
   c. Availability of equipment and personnel for handling products.
   d. Owner's use of premises.

2. Do not have products delivered to project site until related shop drawings have been approved.
3. Do not have products delivered to site until required storage facilities have been provided.
4. Have products delivered to site in manufacturer's original, unopened, labeled containers. Keep Engineer/Architect informed of delivery of all equipment to be incorporated in the work.

C. **Inspection**

1. Immediately upon delivery, inspect shipment to ensure that:

   a. Product complies with requirements of Contract Documents and reviewed submittals.
   b. Quantities are correct.
   c. Containers and packages are intact and labels are legible.
   d. Products are properly protected and undamaged.

3.2 **HANDLING**

A. **Methods**

1. Provide equipment and personnel necessary to handle products without soiling or damaging products or packaging.
2. Lift heavy components only at designated lifting points.

3. Handle materials and equipment at all times in a safe manner and as recommended by manufacturer or supplier so that no damage will occur to them.
4. Do not drop, roll, or skid products off delivery vehicles. Hand carry or use suitable materials handling equipment.
5. Keep interiors completely free of dirt and foreign matter.

3.3 STORAGE AND PROTECTION

A. General

1. Make all arrangements and provisions necessary for the storage of materials and equipment.
2. Place all excavated materials, construction equipment, and materials and equipment to be incorporated into the work so as not to damage anything.
3. Keep materials and equipment neatly and compactly stored in locations that will cause a minimum of inconvenience to other contractors, public travel, adjoining owners, tenants, and occupants.
4. Arrange storage in a manner to provide easy access for inspection.

B. Storage Areas

1. Areas available on the construction site for storage of material and equipment shall be as shown on the drawings or otherwise approved by the Engineer/Architect.
2. Store materials and equipment which are to become the property of the Owner in a way to facilitate their inspection and ensure preservation of the quality and fitness of the work, including proper protection against damage by freezing and moisture.
3. Lawns or other private property shall not be used for storage purposes without written permission of the Owner in control of such premises.
4. Restore all storage areas to their original condition.

C. Storage Methods

1. Do not open manufacturer's containers until the time of installation unless recommended by the manufacturer or otherwise specified.
2. Do not store products in the structures being constructed unless approved in writing.
3. The following types of materials may be stored out-of-doors and on wood blocking so there is no contact with the ground.

    a. Masonry units.
    b. Reinforcing steel.
    c. Structural steel.
    d. Piping.
    e. Precast concrete items.
    f. Castings.
    g. Handrailing.

4. The following types of materials may be stored out-of-doors if covered with material impervious to water and sunlight. Store materials on wood blocking and tie down covers with rope and slope to prevent accumulation of water on covers.

    a. Construction lumber.
    b. Wood for formwork.
    c. Fiberglass and plastic materials which are not ultraviolet (UV) protected.

5. Store all products not listed above in buildings or trailers which have a concrete or wooden floor, a roof, and fully closed walls on all sides.
6. Provide heated storage space for materials that would be damaged by freezing.
7. Protect mechanical and electrical equipment from contamination by dust, dirt, and moisture.
8. Maintain humidity at levels recommended by manufacturers for electrical and electronic equipment.

D. **Inspection**

1. Regularly inspect stored products to ensure that:

    a. State of storage facilities is adequate to provide required conditions.
    b. Required environmental conditions are maintained on continuous basis.
    c. Products exposed to elements are not adversely affected.

2. Be fully responsible for loss or damage to stored materials and equipment.

3.4 MAINTENANCE

A. **Maintenance Log**. Prepare a maintenance log for all equipment.

1. This log shall include a list of required maintenance services and inspections, as provided by the manufacturer.
2. The log shall include checklists for the periodic services and inspections required.
3. Initial and date the checklist upon completion of the individual servicing or inspection.
4. Locate the maintenance log in the field office and have it available for review until it is submitted for record purposes upon completion of the work and the start of the warranty period.

B. **Preparation**

1. Before removing an item from storage, review the installation location. Protection and services at the installed location must meet the equipment storage requirements.
2. Before moving equipment to the installed location, have materials available for temporary shelter or services required to establish the proper storage environment.

C. **Performance of Maintenance**

1. Perform all storage and preventive maintenance and inspections required by the manufacturer at the specified intervals from the time of delivery until completion of the work.
2. When notified by the Owner or Owner's Representative of a maintenance deficiency, perform corrective maintenance. Corrective maintenance will be performed per the manufacturer.
3. Reestablish storage maintenance in the event an item or equipment is removed from service.

END OF SECTION

SECTION 01 74 23

CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Throughout the construction period, maintain all areas of the existing buildings and site affected by the work of the Contract in a standard of cleanliness as described in this section.

B. **Related Work Described Elsewhere**. In addition to standards described in this section, comply with all requirements for cleaning up as described in various other sections of these specifications.

1.3 QUALITY ASSURANCE

A. **Inspection**. Conduct daily inspections, and more often if necessary, to verify that requirements of cleanliness are being met.

B. **Codes and Standards**. In addition to the standards described in this section, comply with all pertinent requirements of governmental agencies having jurisdiction and comply with Occupational Safety and Health Administration (OSHA) Housekeeping Standards, Subpart C, Section 1926.25.

1.4 SUBMITTALS

Not used.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

Not used.

1.7 SPECIAL WARRANTY

Not used.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. **Provide all required personnel, equipment, and materials** needed to maintain the specified standard of cleanliness.

2.2 COMPATIBILITY

A. **Use only the cleaning materials** and equipment which are compatible with the surface being cleaned, as recommended by the manufacturer of the material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **General**

1. Retain all stored items in an orderly arrangement allowing maximum access, not impeding drainage or traffic, and providing the required protection of materials.
2. Do not allow the accumulation of scrap, debris, waste material, and other items not required for construction of the work.
3. At least twice each month, and more often if necessary, completely remove all scrap, debris, and waste material from the job site.
4. Comply with OSHA Section 1926-252 of Subpart H of Part 1926, Disposal of Waste Materials.
5. Provide adequate storage for all items awaiting removal from job site, observing all requirements for fire and environment protection.
6. Do not bury waste materials within the project site.

B. **Site**

1. Daily, and more often if necessary, inspect the site and pick up all scrap, debris, and waste material.
2. Weekly, and more often if necessary, inspect all arrangements of materials stored on the site; restack, tidy, or otherwise service all arrangements to meet the requirements of Paragraph 3.1 A of this section.
3. Maintain the site in a neat and orderly condition at all times and comply with OSHA Housekeeping Standards, Subpart C, Section 1926.25.

C. **Structures**

1. Weekly, and more often if necessary, inspect the structures, pick up all scrap, debris, and waste material.
2. Weekly, and more often if necessary, sweep all interior spaces clean. Interpret "Clean" (for the purpose of this subparagraph) as meaning free from dust and other material capable of being removed by use of reasonable effort and hand-held broom, except that vacuum cleaning shall also be employed if dust accumulates on surfaces above floor.

3. As required preparatory to installation of succeeding materials, clean the structures or pertinent portions thereof to the degree of cleanliness recommended by the manufacturer of the succeeding material, using all equipment and materials required to achieve the required cleanliness.
4. Following the installation of finish floor materials, clean finish floor daily (and more often if necessary) while work is being performed in the space. Interpret "clean" (for the purpose of this subparagraph) as meaning free from all foreign material which may be damaging to the finish floor material.

3.2 FINAL CLEANING

A. **Definition**. Except as otherwise specifically provided, interpret "clean" (for the purpose of this paragraph) as meaning the level of cleanliness generally provided by skilled cleaners using commercial-quality building maintenance materials.

B. **General**. Prior to completion of the work, remove from the job site all tools, surplus materials, equipment, scrap, debris, and waste. Conduct final cleaning as described in paragraph 3.1 of this section.

C. **Site**. Unless otherwise directed, broom-clean all paved areas on the site and all public paved areas directly adjacent to the site. Completely remove all debris.

D. **Structures**

1. Exterior.
   a. Visually inspect all exterior surfaces and remove all traces of soil, waste material, smudges, and other foreign matter.
   b. Remove all traces of splashed materials from adjacent surfaces.
   c. If necessary to achieve a uniform degree of exterior cleanliness, hose and brush down the exterior of the structure.
   d. In the event of stubborn stains not removable with water, lightly sandblast to remove the stain.

2. Interior.
   a. Visually inspect all interior surfaces and remove all traces of soil, waste material, smudges, and other foreign matter.
   b. Remove all traces of splashed materials from adjacent surfaces.
   c. Remove all paint droppings, spots, stains, and dirt from finished surfaces.
   d. Sweep, vacuum, and hand-dust all areas, including concealed surfaces and overhead spaces, to remove all dust.

3. Glass. Clean all glass inside and outside.
4. Polished surfaces. To all surfaces requiring the routine application of buffed polish, apply the polish recommended by the manufacturer of the material being polished.

END OF SECTION

SECTION 01 79 00

START-UP, DEMONSTRATION, AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. This section includes general requirements for start-up, training, and operational demonstration as required by the specifications.

1.3 QUALITY ASSURANCE

A. **Test Instruments**. Provide all instruments required for testing. Calibrate all test instruments to within appropriate test standards as established by American Society for Testing and Materials (ASTM) or the governing technical standard. Retain calibration data at the Contractor's site office for Owner or Owner's Representative's review.

1.4 SUBMITTALS

Not used.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

Not used.

1.7 SPECIAL WARRANTY

Not used.

1.8 DEFINITIONS

A. **Operational Demonstration**. An activity performed by the Contractor wherein the Owner operates and the Contractor maintains a fully functional component, system, unit process, or entire upgraded residuals handling for a minimum period of continuous calendar days after start-up has been completed and stable operation has been achieved. Specifically for this project:

1. The two new belt filter presses shall function intermittently for 14 days prior to acceptance of the upgraded dewatering facility components, which include the polymer system and sludge conveyance system in

addition to the two belt filter press systems. Each belt filter press shall be operated at least 5 days over that two-week period, for a minimum of 6 hours per day. Accordingly, if that 30-hour period is not met in the initial 14-day period (regardless of reason, either directly related to each belt filter press itself or indirectly, because of a polymer feed or sludge conveyance problem), that period shall be extended until the demonstration period is completed to the satisfaction of the Owner's operations staff.

B. **Field Testing**. Testing performed on-site by the Contractor to satisfy requirements of the manufacturer and Contract Documents.

1. Dry Testing. Dry testing is performed by the Contractor without introducing either process material or other test material into the component, system, or unit process. Under certain circumstances, dry testing may consist of functional testing using potable water.
2. Wet Testing. Wet testing is performed by the Contractor utilizing test material in the component, system, or unit process. Process tankage shall be filled with test material to operating level.
3. Performance Testing. Performance testing is performed by the Contractor to demonstrate system performance in accordance with specification requirements.

C. **Start-Up**. An activity performed by the manufacturer's representative with the Contractor immediately after equipment or system is completed to verify the installation.

1. Check the installation for conformance with the plans and specifications.
2. Check the installation for conformance with the shop drawings and manufacturer's data.
3. Verify quantities and data with the operation and maintenance (O&M) manuals.
4. Verify that equipment is ready for operation.
5. Place component, system, or unit process on-line.
6. Perform all required field testing.
7. Prepare and submit a manufacturer's representative's report including certification, recommendations, and conclusions.

D. **Training**. To educate Owner's personnel to become qualified and proficient in the operation, maintenance, and repair of the complete system. Training shall include:

1. Classroom instruction.
2. In-plant, on-site demonstration.
3. Equipment demonstration.
4. Actual hands-on operation by the Owner's staff.

E. **Adjusting**. To install or change setting, parameters, calibrations, flows, and processes so that the equipment or system operates in a logical or more efficient state.

F. **Balancing**. To make equipment or subsystems operate in harmony or equilibrium by adjusting, altering, or modifying parts of the system.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 START-UP EXECUTION

A. Start-Up Preparation

1. Prior to beginning a start-up, inspect the systems and equipment to verify their readiness to begin with the manufacturer's representative
2. Correct hazardous conditions to equipment or personnel prior to start-up of equipment.
3. Do not proceed with start-up operations using temporary power or temporary instrumentation and control wiring unless approved. All electrical and control connections shall be permanent and complete, and all such electrical components and equipment fully functional.
4. Design, fabricate, and install all necessary testing and monitoring equipment before commencing the test.

    a. Quality. Use materials and equipment of good quality and suitable for the intended service. The use of miscellaneous items found at the job site is not acceptable.
    b. Maximum Gauge Readings. Select capacity or range of test equipment to provide meaningful test results. Select pressure or differential pressure gauges so that test pressure is 50 percent to 75 percent of maximum gauge reading.
    c. Temporary Equipment. Fabricate, as necessary, any temporary equipment used in testing. This equipment shall remain the property of the Contractor who will remove it from the site upon substantial completion.

5. Manufacturer's representatives shall be present for the initial start-up of all systems or equipment.
6. Request permission to start up equipment, including electrical gear, and notify the Engineer/Architect of the start-up.

    a. Submit the start-up request a minimum of 72 hours before the scheduled start-up. Make requests in writing during normal working hours.
    b. Start-up request shall be in accordance with Section 01 33 00 "Submittals."
    c. The Owner and/or Engineer/Architect shall have the right to reject the use of an individual for facility start-up.
    d. Approval of the request is based solely on impact on plant operations. Approval does not relieve the Contractor of any responsibility for plant and personnel safety.

e. Coordinate the start-up of each piece of equipment with the Owner and the Engineer/Architect so that operation does not interfere with the normal operation of the facility.

7. Normal installation checks, such as for rotation, are not considered start-ups and do not require start-up notification. Clearly mark all electrical apparatus which is energized.

B. **Conduct of Start-Up**

1. Equipment Adjustments. Make all adjustments, corrections, and calibrations to set points, process parameters, etc., necessary to achieve normal, stable operation of systems.
2. Equipment Failure. Consider any failures of equipment or systems as deficiencies and correct them. Stop testing and the start-up until all deficiencies have been corrected.
3. System Failure.

   a. When there appears to be a system failure and the system is composed of separate but functionally codependent individual pieces of equipment and check-out of each piece of equipment by its respective manufacturer's representative verifies that the equipment is functioning properly, then the Contractor's remains responsible for overall system operation.
   b. Verify compatibility of equipment during the submittal process to minimize overall system operating problems.
   c. Reconfigure, repair, modify, or replace parts or all the equipment in order to provide a system that shall perform as specified at no additional cost to the Owner.

4. Dry Testing.

   a. Test, adjust, align, lubricate, and balance all equipment and systems in accordance with the manufacturer's instructions prior to testing.
   b. Test individual components prior to testing the system of which they are a part.

5. Wet Testing.

   a. After dry testing, wet test all equipment and systems for a minimum of 72 hours under the design operating conditions utilizing a test material similar to or same as the process material.
   b. All costs, including materials and equipment, for delivery of the test material shall be at the Contractor's expense. Test each component or item of equipment to demonstrate compliance with the design criteria and operating range specified.
   c. Suspend or secure all tests in the event that test failures or hazardous conditions occur. Make repairs, replacements, or adjustments and restart test in its entirety.

d. Dispose of the test material at no additional cost to the Owner.
e. Clean all equipment systems and structures upon conclusion of testing at no additional cost to the Owner.
f. Comply with any performance testing requirements specified.

6. Retesting. Repeat tests if results fail to meet test criteria, whether the failure is identified during field testing or through reviewing the test report later.
7. Performance Testing. Verify operating ranges, capacities, low and high limits, efficiencies, temperatures, speeds, pressures, sequences, etc., of each piece of equipment being tested. Check monitors, indicators, alarms, and fail-safe devices.
8. Do not use repair parts during start-up operations unless approved.
9. Furnish all lubrication and operating fluids per the manufacturer's instructions.
10. Field-verify initial copy of O&M manual according to Section 01 33 00 "Submittals."

C. **Start-Up Conclusion**

1. Submit manufacturer's representative's report within 48 hours of conclusion of each start-up. Report shall be in accordance with Section 01 33 00 "Submittals."

3.2 OPERATIONAL DEMONSTRATION EXECUTION

A. **Operational Demonstration Preparation**. Prior to the operational demonstration beginning:

1. Complete start-up procedures including submitting all reports for all parts of the work designated for the operational demonstration.
2. Complete all required construction activities, including any activities by any entity that would interrupt the normal operations of the demonstration.
3. Ensure that adequate parts and supplies for routine maintenance and replacement are on hand to support system operation through the demonstration period.
4. Deliver all repair parts to the Owner.
5. Submit an operational demonstration request according to Section 01 33 00 "Submittals," at least 48 hours prior to start of operational demonstration.

B. **Conduct of Operational Demonstration**

1. During the operational demonstration and at other times, the work will be on-line and an integral part of the plant operations and process. The Owner maintains control of plant operations and processes at all times. Therefore:

a. Do not commence, resume, modify, terminate, or suspend the operations without the permission of the Owner and only in a

sequence and manner suitable to the Owner except in the case of an emergency.

b. The operation of the work shall be in strict accordance with the operational orders of the Owner.

c. Adjust or repair immediately, on a 24-hour-per-day, 7-day-per-week basis, any malfunction in the work which in the opinion of the Owner jeopardizes or may jeopardize the proper operation of the total facility.

2. Perform operational demonstrations of the entire work. With approval, individual systems may be independently demonstrated as long as their complete range of operation and performance can be shown without the rest of the facility.

3. Update. Keep the log on-site during the operational demonstration and updated on a regular basis. The log shall be available for review by the Owner or Owner's Representative at all times during the operational demonstration.

4. Maintenance. Perform all required maintenance and servicing during the operational demonstration at the specified intervals and as necessary. Note all maintenance and servicing in the operational demonstration log.

5. Time.

a. The operational demonstration shall last for a period of 7 consecutive days.

b. All equipment and systems shall remain totally operational during this period.

c. Upon successful completion of the operational demonstration, the work is considered to be ready for its intended use, and the Contractor may make recommendation for substantial completion.

d. Outages.

1) Note all outages of equipment, systems, or the plant in the operational demonstration log.

2) Plant power outages such as power failure, process failure or existing equipment, and planned outages of existing systems for cleaning, maintenance, or repair are considered a part of normal plant operation and will not invalidate the operational demonstration.

3) Be responsible for the safe and orderly shutdown and restart of equipment as necessary in the event of an outage.

4) Do not include outage time in the demonstration time period.

e. Do not count activities such as filling, draining, purging, heating or cooling to temperature, stabilizing, adjusting, testing, or other start-up activity time as operational demonstration time.

f. Failed Operational Demonstration.

1) If, during the operational demonstration, any part of the work fails to fully conform to the requirements of the Contract Documents, consider the operational demonstration to have failed, and the work not to be substantially complete.
2) Upon failure of the operational demonstration, promptly remedy any defects in the work and promptly reschedule and restart the complete operational demonstration time period. No operational demonstration time will be considered to have accrued to any part of the work by reason of a failed operational demonstration.

g. Suspension of Operational Demonstration.

1) During the operational demonstration, the Owner may require or permit the operational demonstration to be suspended upon the written request of the Contractor to correct or adjust the work, when in the judgement of the Owner or Owner's Representative such required correction or adjustment is insufficient to deem the operational demonstration to have failed.
2) If an operational demonstration is suspended for any reason except failure, operational demonstration time shall accrue to the work from the time of the beginning of the operational demonstration to the time of the suspension. No operational demonstration time shall accrue during the period of suspension.
3) If an operational demonstration is suspended at the request of the Contractor, continue operation and maintenance of the work without additional charges to the Owner, according to all provisions of this section of the specifications, and to the extent required by the Owner.

6. O&M Manuals. Start-up and operation of the system and all associated equipment shall be in accordance with the O&M manuals. If deviations from the manuals are necessary, note these in the operational demonstration log, and subsequently submit as revisions to the O&M manuals.
7. Personnel and Consumables.

a. Have sufficient personnel available during the entire demonstration to ensure proper maintenance, adjusting, troubleshooting, and any and all repairs to equipment, controls, etc., to maintain and keep the entire facility operating intermittently over a two-week demonstration period.
b. The Owner will remain in control of the facility processes and provide the manpower to operate the facility.

c. The Owner will furnish power required for the 14-day complete facility operational demonstration.
d. Contractor's Supervision. When Owner personnel are operating systems or equipment under supervision of the Contractor during operational demonstration, make available, at all times, persons knowledgeable about the systems or equipment to direct the Owner personnel in its operation.

8. To the extent possible, operate all equipment or individual components throughout their range during this period.

C. **Operational Demonstration Completion**

1. Within 2 weeks of the termination or completion of the operational demonstration, submit for approval:

a. Any changes to O&M Instructions.
b. The completed operational demonstration logs according to Section 01 33 00 "Submittals."

2. The Owner will not assume full responsibility for operation and maintenance of the system and equipment until successful completion of the operational demonstration and all conditions for substantial completion have been satisfied and both the Contractor and Owner have accepted the Certificate of Substantial Completion.

3.3 TRAINING EXECUTION

A. **Training Preparation**. Coordinate and verify to ensure that, prior to the scheduled training times:

1. The equipment is ready for operation and has completed its start-up.
2. That all associated construction required to operate the equipment in all normal and anticipated operating modes is complete.
3. That the equipment area is safe, well lit, and unobstructed, so that all training class attendees may access, hear, view, and participate in the training.
4. That the equipment area is free of construction activities that could present a hazard to training class participants.
5. That adequate training materials, as required, are on hand for use during the training session.
6. Any representatives of interfacing Prime Contractors, subcontractors or equipment suppliers needed to perform supporting operations allowing demonstration of equipment operation, have been notified and will be available.
7. Schedule training sessions through Owner and the Engineer/Architect. Cooperate with the Owner in scheduling all required training sessions.
8. Verify that the training materials are compatible with this equipment. Provide other audio/visual equipment and training aids as needed.
9. The approved O&M manuals shall be available and frequent reference shall be made to the equipment O&M manuals.

10. The instructor's qualifications, the training schedule, the lesson plan, and any instructional materials have been submitted and approved before training begins. Submittals shall be in accordance with Section 01 33 00 "Submittals."
11. Training schedules should be submitted far enough in advance that the Owner can adjust work schedules so that all participants are available for the training sessions.

B. **Conduct of Training**

1. Provide at least one copy of instructional materials used for training at the time of the first training session for each attendee.
2. Before the training is complete, have all training session attendees sign an attendance sheet.
3. Discuss all items of the approved lesson plan in the classroom or the field, in complete and sufficient detail to allow the Owner's operating personnel to knowledgeably operate and maintain the equipment in accordance with manufacturer's recommended procedures and safety considerations during all anticipated operational and maintenance situations. Operating staff training shall be conducted as part of the performance demonstration period. One day each week of the two-week period shall be dedicated to training NKWD operations staff.
4. Address safety concerns and features intended to enhance safety.
5. Address tasks required to maintain the warranty. Maintenance training for the belt filter press shall be conducted during the performance demonstration period (when the presses are not operating). One day minimum shall be allotted during this two-week period to train NKWD maintenance staff.
6. The Owner reserves the right to record the training session for the future use in training employees.
7. Address all questions and comments as they are raised by the training session participants to the maximum extent practicable. If questions or comments cannot be addressed during the training session, additional materials and/or training may be required.
8. O&M material and instructional material shall not conflict.

C. **Training Conclusion**. Within two weeks of the training being completed:

1. Correct, revise, and update the O&M manuals as necessary to agree with training.
2. Submit completed sign-in sheet in accordance with Section 01 33 00 "Submittals."

END OF SECTION

SECTION 01 89 19

LEAKAGE TEST AND DISINFECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. The Contractor shall provide the labor, tools, equipment, and materials necessary to perform the leakage tests and disinfection of pipes, equipment, and tanks in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work to provide leakage tests and disinfection in compliance with all federal, state, local codes and regulatory agencies.

B. **Standards**. Materials and workmanship shall be in accordance with the following standards as referenced herein:

1. AWWA – American Water Works Association.
2. ASTM – American Society for Testing and Materials.
3. ACI – American Concrete Institute.

1.4 SUBMITTALS

Not used.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

Not used.

1.7 SPECIAL WARRANTY

Not used.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Site Verification of Conditions**. Examine conditions under which the pipe test section, facility, or part of a facility is to be tested or disinfected and verify that conditions are satisfactory and ready for the test to proceed.

3.2 PREPARATION

A. **Protection**. Protect adjacent equipment, materials, piping, and valving against drainage from testing and/or disinfection.

B. **Notification**. The Engineer/Architect shall be notified at least 24 hours prior to any testing and/or disinfecting. The Owner shall be notified at least 48 hours prior to any disinfecting. Notify the Engineer/Architect immediately of all unsatisfactory or nonconforming conditions.

C. **Responsibility**. Beginning the test means the Contractor accepts all the existing surfaces and conditions.

3.3 PRESSURE MAIN AND PROCESS PIPING LEAKAGE TESTING

A. **Description**. The Contractor shall provide the leakage tests as directed by the Engineer/Architect and as specified herein. Gauges for the tests shall be furnished by the Contractor with the most recent gauge calibration test report available for the Engineer/Architect's review on-site.

B. **Leakage Allowances** (unless noted otherwise)

1. Process Piping. No leakage is acceptable for sludge, water, and chemical lines.

C. **Test Procedure**

1. Each pressure main or process piping section shall be slowly filled with water to the specified test pressure in a manner satisfactory to the Engineer/Architect.
2. Before applying the specified test pressure, all air shall be expelled from the pipe.
3. The test water pressure shall be maintained for at least 2 hours.
4. Leakage will be determined by measuring the quantity of water added to the main to maintain the specified test pressure.
5. Unless noted otherwise, minimum test water pressure shall be the greater of 1.5 times the working pressure or the following:

    a. Mains or process piping carrying water – 150 pounds per square inch (psi).
    b. Force mains – 100 psi.
    c. Other pressure mains – 100 psi.

3.4 DISINFECTION

A. General

1. Pipes, tanks, and equipment designed to carry water for domestic consumption shall be thoroughly cleaned, flushed, and disinfected.
2. Engineer/Architect shall confirm that the item to be disinfected is thoroughly cleaned and flushed prior to disinfection.
3. Disinfection shall be done by the addition of suitable amounts of chlorine in the form of liquid chlorine or high-test hypochlorite of lime.
4. The application shall be as approved by the Owner and in accordance with the appropriate AWWA standard listed below.

    a. Water mains are under AWWA C651.
    b. Water storage tanks are under AWWA C652.
    c. Water treatment plants are under AWWA C653.

5. Tests for efficacy of disinfection, and repeated disinfection and tests shall be carried out by the Contractor, at no cost to the Owner.
6. Disposal of heavily chlorinated water shall be in accordance with AWWA C651 and AWWA C651 Appendix B, and shall not be disposed to a sanitary sewer or the environment unless dechlorinated sufficiently to not interfere with treatment of sanitary sewage or the environment.

3.5 STORAGE TANK LEAKAGE TESTING

A. **Description**. All liquid storage tanks shall be leakage tested in accordance with ACI 350.1, "Tightness Testing of Environmental Engineering Concrete Structures."

3.6 FIELD QUALITY CONTROL

A. Field Tests

1. All test materials, equipment, chemicals, and water required for testing or disinfection shall be provided by the Contractor at no additional cost to the Owner.
2. Testing shall be done according to the methods described in this section.

B. Witness

1. All tests performed for each section to be tested shall be witnessed and approved by the Engineer/Architect before acceptance.
2. In the event the Contractor performs any test without witness by the Engineer/Architect, the Contractor may be required by the Engineer/Architect to test the section again in conformance with this specification at no cost to the Owner.

3.7 ADJUSTING

A. Test Results

1. If the field tests show excessive leakage, the Contractor shall repair, adjust, modify, or replace the noncomplying sections until the tests are successfully completed.
2. If the field tests show noncompliance with the disinfection requirements, the Contractor shall repeat the disinfection procedure until the tests are successfully completed.
3. This shall be done at no additional cost to the Owner.

3.8 CLEANING AND DISPOSAL

A. **Disposal**. The Contractor is responsible for the removal from the job site and, if necessary, safe disposal of all excess material and debris as a result of the work completed under this section, including testing procedures.

3.9 PROTECTION

A. Requirements

1. The Contractor shall be responsible for provisions to protect the sections tested and approved, but prior to acceptance by the Owner.
2. Protection of the tested and approved piping sections shall include provisions during installation and testing of nearby piping, valving, or other adjacent equipment.
3. The Contractor shall remove all protective measures installed at completion and acceptance of the project.

END OF SECTION

SECTION 02 41 00

DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, and equipment necessary to remove and salvage or dispose of the structures or portions thereof as shown on the drawings and specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all demolition and disposal work in compliance with all federal, state, and local codes and regulatory agencies.

B. **Protection**. Ensure safe passage of persons and vehicles around area of demolition. Conduct operations to prevent damage to adjacent buildings, structures, and other facilities and injury to persons.

1.4 SUBMITTALS

A. **Schedule of Demolition**. Submit to the Owner a proposed schedule of demolition for the purposes of coordinating shutoff, capping, and continuation of utility services as required to operate the facility.

B. **Photographs**. Submit photographs of adjacent areas and structures affected by this demolition.

1.5 JOB CONDITIONS

A. **Beginning Work**. Structures to be demolished will be vacated and their use discontinued prior to start of work.

B. **Protection**

1. Structural. Prior to the removal of any wall, beam, or column, or cutting of any openings, examine the existing structure and, when required, protect the structure by shoring, bracing, or underpinning.
2. Equipment and Tanks. Protect all equipment and tanks from dust, dirt, debris, and damage by covering with planking and tarpaulins during demolition.

C. **Explosives**. Do not use explosives.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **General**. Handle, store, and protect items removed and stored or reset in accordance with Section 01 60 00 "Materials and Equipment" and the manufacturer's instructions.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 **EXAMINATION**

A. **Site Verification**. Verify the actual areas, structures or parts of structures, pipes, or other items to be demolished in the presence of the Owner and Engineer/Architect.

3.2 **PREPARATION**

A. **Equipment and Manpower**. Have all required equipment and manpower available at the job site prior to beginning of demolition. This includes any special equipment to permit continued uninterrupted Owner operations as required.

B. **Coordination**. Provide adequate but no less than 48 hours of notice when any Owner operations are affected by demolition.

3.3 **DEMOLITION**

A. **Demolition Schedule**. Perform demolition work in accordance with the final approved schedule of demolition.

B. **Salvage**

1. Material and Equipment. Remove with care, clean, and store at the site in an approved area all material and equipment designated to be salvaged and store onsite at direction of Owner. See Specification Section 01 31 13 for details on what materials and equipment shall remain the property of the Owner.

C. **Openings**

1. Concrete. Close concrete openings using a non-shrink, nonmetallic grout.
2. New. Neatly cut or drill new openings to prevent face chipping or spalling. Repair all damaged areas to a condition equivalent to that which existed prior to the start of work.

D. **Patching Concrete**

1. Repair all concrete that has been marred, damaged, or defaced as a result of demolition. See concrete repair requirements in Section 03 30 00, "Cast-in-Place Concrete".
2. Procedure. Repair concrete surfaces as follows:

    a. Saw cut and remove concrete to a depth of not less than 1 inch.
    b. Remove exposed reinforcing where noted.
    c. Apply an approved bonding agent to the cut surface.
    d. Patch with a non-shrink, nonmetallic grout finished to match the existing surface unless noted otherwise.

E. **Anchors**. Cut all embedded anchors of removed items flush with the existing surface and grind metal 1 inch minimum below surface below patching.

F. **Pipe**. Plug all abandoned pipe at each end.

G. **Cleanup**. Remove from the site all debris, rubble, unusable materials, and items not salvaged.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Furnish and install cast-in-place concrete in accordance with the drawings and specifications.

B. **This section specifies** cast-in-place concrete, including formwork, reinforcing, mix design, accessories, placement procedures, joints, embedments, finishes, curing, supports for equipment and piping, and grout toppings for tanks.

C. **Other specification sections** may reference this section for other cast-in-place concrete items.

1.3 QUALITY ASSURANCE

A. **Standards**. Comply with the provisions of the following standards:

1. ACI – American Concrete Institute.
2. ASTM – American Society for Testing and Materials.
3. CRSI – Concrete Reinforcing Steel Institute.
4. AASHTO – American Association of State Highway and Transportation Officials.

B. **Concrete Testing Service**. Engage an acceptable laboratory to perform material evaluation tests and to design concrete mixes.

C. **Testing**. Materials and installed work may require testing and retesting at any time during progress of work. Retesting of rejected materials or installed work shall be done at Contractor's expense.

D. **Concrete Conference**. Prior to submittal of design mixes, conduct conference at project site to comply with the following:

1. Review detailed requirements for preparing concrete design mixes.
2. Determine procedures for satisfactory concrete operations.
3. Review requirements for submittals, status of coordinating work, and availability of materials.
4. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications.

5. Request that representatives of each entity directly concerned with cast-in-place concrete attend conference, including, but not limited to, the following:

    a. Contractor's superintendent.
    b. Laboratory responsible for concrete mix design.
    c. Laboratory responsible for field quality control.
    d. Ready-Mix concrete supplier.
    e. Concrete subcontractor.
    f. Primary admixture manufacturers.
    g. Engineer/Architect or Owner's Representative.

6. Concrete conference may be waived by the Engineer/Architect or Owner's Representative.

1.4 SUBMITTALS

A. **Submit all submittals** in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. **Submittal Package No. 1 – Shop Drawings and Product Data**

1. Product data for materials and items, such as cement, reinforcement, embedded forming accessories, admixtures, patching compounds, waterstops, joint systems, and curing compounds.
2. Reinforcement shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI SP-66 (88), "ACI Detailing Manual," showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures, and dowel reinforcement for masonry.
3. Concrete mix designs for each class of concrete to be used on the project including specifics regarding admixtures proposed for each mix design. Include concrete test reports to substantiate trial batch mixes or previous performance of the same mix design.
4. Materials Certificates.

    a. Submit with the concrete mix design.
    b. Signed by manufacturer certifying that each material item complies with or exceeds specified requirements.
    c. Provide certification from admixture manufacturers that chloride content complies with specification requirements.
    d. For Ground Granulated Blast-furnace Slag (GGBS), provide certifications as given paragraph 12 of ASTM C989 listed below:

        1) Manufacture’s report stating the results of tests made on samples.
        2) Test data on chlorine ion content of the GGBS.

5. Construction joint locations which clearly show where construction joints are intended to be placed in walls, slabs, columns, beams, at stairwells, etc.

   a. Box Outs. Proposed locations.

6. Testing Laboratories. Submit the names of the testing laboratories proposed for use to perform the material evaluation tests and also to perform the field quality control testing. An ACI certified technician shall perform all concrete testing.

C. **Submittal Package No. 2 – Batch Tickets**

1. Submit batch tickets for each load of concrete used on the job that indicate the design mix, the project name, the date, the time of batching, and the truck number.

D. **Submittal Package No. 3 – Test Reports**

1. The concrete testing laboratory shall submit two copies of all concrete test reports directly.

1.5 JOB CONDITIONS

A. **Coordination**. Coordinate installation of joint materials, embedded items, vapor retarders, etc., with placement of forms and reinforcing steel to prevent delays, errors, or omissions.

B. **Reference Material**. Provide a copy of ACI SP-15, Field Reference Manual, in the field office at all times during concrete construction.

C. **Climatic Conditions**. Perform placement and curing of concrete under various weather conditions in accordance with ACI 301, "Specifications for Structural Concrete for Buildings," ACI 305, "Hot Weather Concreting," and ACI 306, "Cold Weather Concreting," except as modified herein.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Comply with ACI 304**, "Recommended Practice for Measuring, Mixing, and Placing Concrete."

PART 2 – PRODUCTS

2.1 MATERIALS

A. **Forms**

1. Exposed finish concrete forms shall be plywood, metal, metal framed plywood faced, or other acceptable panel type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest

practicable sizes to minimize number of joints and to conform to joint system shown.

2. Unexposed finish concrete forms shall be plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit.
3. Cylindrical column and support forms shall be metal, fiberglass reinforced plastic, or paper or fiber tubes.

    a. When used, provide paper or fiber tubes of laminated plies with water resistant adhesive and wax impregnated exterior for weather and moisture protection.
    b. Provide sufficient wall thickness to resist wet concrete loads without deformation.

B. **Form coatings**. Commercial formulation form coating compounds with a maximum volatile organic compound (VOC) of 350 milligrams per liter (mg/l) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

C. **Form ties**. Factory-fabricated, adjustable length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal.

1. Provide units that will leave no metal closer than 1 inch to exposed surface.
2. Provide ties that, when removed, will leave holes not larger than 1-1/2 inch diameter in concrete surface.

D. **Reinforcing Materials**

1. Reinforcing Bars. ASTM A 615, A 616, including Supplemental Requirement S1, or A 617; Grade 60, deformed.
2. Epoxy Coated Reinforcing Bars. ASTM A 775.
3. Welded Wire Fabric. ASTM A 185, welded steel wire fabric, provided in flat sheets.
4. Supports for Reinforcement. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use steel bar supports or precast concrete bar supports complying with CRSI specifications.

    a. For slabs on grade, use steel bar supports with sand plates or horizontal runners or precast concrete bar supports where base material will not support chair legs.
    b. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are plastic protected (CRSI, Class 1) or stainless steel (CRSI, Class 2).

E. **Concrete Materials**

1. Portland Cement. ASTM C 150, Type I or Type II in areas where alkali-aggregate reaction is a problem. Use one brand of cement throughout project.
2. Fly Ash. ASTM C 618, Type C or Type F including supplementary optional physical requirements, except loss on ignition shall not exceed 3 percent.
3. Ground Granulated Blast-furnace Slag (GGBS). ASTM C989, grade 100 or grade 120.
4. Normal Weight Aggregates. ASTM C 33 and as herein specified.

    a. For exposed concrete, provide aggregates from a single source.
    b. For exterior exposed surfaces, do not use fine or coarse aggregates containing deleterious substances which might cause spalling.
    c. Fine Aggregate.

        1) Fine aggregate shall consist of natural sand or manufactured sand.
        2) Maximum loss during an AASHTO T104 5-cycle sulfate soundness test shall be 10 percent.

    d. Coarse Aggregate.

        1) Coarse aggregate shall consist of crushed rock, gravel, or crushed gravel.
        2) Grading. The coarse aggregate shall conform to requirements for Size 57, unless otherwise approved.
        3) Deleterious substances shall not exceed the percentages for Class 4S.
        4) Maximum loss during an AASHTO T104 5-cycle sulfate soundness test shall be 15 percent.
        5) Maximum wear during an AASHTO T-96 Los Angeles abrasion test shall be 40 percent.

5. Water. Potable.
6. Admixtures.

    a. Air-Entraining Admixture.

        1) ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
        2) Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

            a) Darex II or Daravair, W.R. Grace & Co.
            b) MB-VR or Micro-Air, Master Builders, Inc.
            c) Sika AER, Sika Corp.

d) AEA-92 or Air Mix 200, Euclid Chemical Co.

b. Water-Reducing Admixture.

1) ASTM C 494, Type A.
2) Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a) Eucon WR-75 or WR-89, Euclid Chemical Co.
b) WRDA with Hycol, or Daracem-55, W.R. Grace & Co.
c) Pozzolith 220-N, Pozzolith 322-N, or Polyheed, Master Builders, Inc.
d) Plastokrete 161, Sika Corp.

c. High-Range Water-Reducing (HRWR) Admixture (Super Plasticizer).

1) ASTM C 494, Type F or Type G.
2) Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a) Eucon 37, Euclid Chemical Co.
b) Daracem 19, Daracem ML330, or Daracem ML500, W.R. Grace & Co.
c) Rheobuild, Master Builders, Inc.
d) Sikament 300, Sika Corp.

d. Noncorrosive, Nonchloride Accelerating Admixture.

1) ASTM C 494, Type C or E.
2) Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a) Accelguard 80, Euclid Chemical Co.
b) Polarset, W.R. Grace & Co.
c) Pozzutec 20, Master Builders, Inc.

e. Water-Reducing, Retarding Admixture.

1) ASTM C 494, Type D.
2) Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a) Eucon Retarder 75, Euclid Chemical Co.
b) Daratard-17, W.R. Grace & Co.

c) Pozzolith R, Master Builders, Inc.
d) Plastiment, Sika Corporation.

f. Crystalline Waterproofing Admixture. Subject to compliance with requirements, products that may be incorporated in the work include the following:

1) Penetron ADMIX.
2) Aquafin-IC.
3) Kryton KIM.
4) Xypex ADMX C-Series.
5) BASF Rheomac 300D.

2.2 ACCESSORIES

A. **Reglets**. Where resilient or elastomeric sheet flashing or bituminous membranes are terminated in reglets, provide reglets of not less than 0.0217 inch thick (26 gauge) galvanized sheet steel. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

B. **Polyvinyl (PVC) Chloride Waterstops.** Corps of Engineers CRD-C 572.

1. Waterstops for construction joints shall be serrated type without center bulb and at least 3/8 inch thick and 6 inches wide.
2. Waterstop for expansion joints shall be serrated type with center bulb and at least 3/8 inch thick and 9 inches wide.
3. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

a. Greenstreak Plastic Products Co.
b. DuraJoint.
c. BoMetals, Inc.

C. **Bitumen Waterstops**

1. Provide a single component self-sealing plastic adhesive type waterstop which is nonoxidizing, nonevaporating, nonexpanding, nonshrinking, and resistant to water, chemicals, and saturated hydrogen sulfide.
2. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:

a. Synko-Flex, Synko-Flex Products.
b. Seal-Tite, DuraJoint.

D. **Sand Cushion**. Clean, manufactured or natural sand conforming to ASTM C 33 or C 144.

E. **Vapor Retarder.** ASTM E 1745 Class A Compliant with a permeance of 0.01 before and after mandatory conditioning as required by (ASTM E 1745 Section 7.1 and Sub-paragraphs 7.1.1 – 7.1.5).

1. Provide vapor retarder cover over prepared base material where indicated below slabs on grade.
2. Subject to compliance with these specifications, the vapor retarder may be one of the following:

    a. Stego Wrap 15 mil by Stego Industries, LLC
    b. Vapor Flex by Layfield
    c. Moistop Ultra 15 by Fortifiber Industries

F. **Chemical Hardener**. Colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than 2 pounds of fluosilicates per gallon.

1. Use hardener on existing concrete where noted.
2. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

    a. Surfhard, Euclid Chemical Co.
    b. Lapidolith, Sonneborn-Rexnord.
    c. Burk-O-Lith, The Burke Co.
    d. Fluohard, L&M Construction Chemical, Inc.

G. **Sealer/Dustproofer**

1. Floor hardener compound for new concrete shall be an acrylic containing not less than 14 percent solids.
2. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

    a. Super Diamond Clear VOX, Euclid Chemical Company.
    b. Dress and Seal WB30, L&M Construction Chemicals, Inc.

H. **Absorptive Cover**. Burlap cloth made from jute or kenaf, weighing approximately 9 ounces per square yard, complying with AASHTO M 182, Class 2.

I. **Moisture-Retaining Cover**. One of the following complying with ASTM C 171.

1. Waterproof paper.
2. Polyethylene film.
3. Polyethylene coated burlap.

J. **Curing Compound.** Clear styrene acrylate type, 30 percent solids content minimum.

1. Submit test data from an independent testing laboratory indicating a maximum moisture loss of 0.55 kilograms (kg) per square meter when applied at a coverage rate of 200 square feet per gallon.
2. Verify compatibility of curing compound with finishes to be used.
3. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

    a. Super Diamond Clear VOX, Euclid Chemical Company.
    b. Dress and Seal WB30, L&M Construction Chemicals, Inc.

K. **Evaporation-Control Compound**

1. Monomolecular film-forming compound applied to exposed concrete slab surfaces for temporary protection from rapid moisture loss.
2. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

    a. Aquafilm, Conspec Marketing and Mfg. Co.
    b. Eucobar, Euclid Chemical Co.
    c. E-Con, L&M Construction Chemicals, Inc.
    d. Confilm, Master Builders, Inc.

L. **Bonding Compound**

1. Polyvinyl acetate or acrylic base.
2. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

    a. Polyvinyl Acetate (Interior Only).

        1) Superior Concrete Bonder, Dayton Superior Corp.
        2) Euco Weld, Euclid Chemical Co.
        3) Weld-Crete, Larsen Products Corp.
        4) Everweld, L&M Construction Chemicals, Inc.

    b. Acrylic or Styrene Butadiene.

        1) SBR Latex, Euclid Chemical Co.
        2) Daraweld C, W.R. Grace & Co.
        3) Acryl-Set, Master Builders, Inc.
        4) Stonlock LB2, Stonhard, Inc.

M. **Epoxy Adhesive**

1. ASTM C 881, two-component material suitable for use on dry or damp surfaces.
2. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a. Euco Epoxy System #452 or #620, Euclid Chemical Co.
b. Epabond, L&M Construction Chemicals, Inc.
c. Concresive 1001, Master Builders, Inc.
d. Sikadur 32 Hi-Mod, Sika Corp.

N. **Expansion Joint and Isolation Joint Material**. Use one of the following unless noted otherwise.

1. Self-expanding cork conforming to ASTM D 1752, Type III.
2. Cellular fiber-asphalt conforming to ASTM D 1751.
3. Neoprene/SBR polymer conforming to ASTM D 1056-67.

2.3 MIXES

A. General

1. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301.
2. If trial batch method used, retain an acceptable independent testing facility for preparing and reporting proposed mix designs.
3. The testing facility shall not be the same as used for field quality control testing.
4. Submit mix designs of each proposed mix for each class of concrete at least 15 days prior to start of work.
5. Do not begin concrete production until proposed mix designs have been reviewed.
6. Chloride Ion content. Provide cement, fly ash, GGBS and admixtures that contain a maximum of 0.05 percent chloride ions by weight of cement when tested in accordance with AASHTO T260. Certificate from manufacturers of the above materials shall be provided prior to mix design approval.
7. Where the concrete alkali aggregate reaction resistance and/or sulfate resistance is noted on the drawings the concrete shall conform to the following:

    a. Where alkali aggregate reaction resistance is required, the concrete shall contain less than 20 percent fly ash by weight.
    b. Where sulfate resistance is required, the concrete shall contain less than 40 percent GGBS by weight.

8. Limit use of fly ash to 20 percent of cement content by weight.

    a. When used, fly ash shall replace cement at a 1:1 ratio for Class C fly ash and a 1.25:1 ratio for Class F fly ash (Class F fly ash to cement).
    b. Adjust weights of concrete materials to provide the correct yield.

9. Limit use of GGBS not to exceed 50 percent of cement content by weight.

10. When GGBS and fly ash are both used in the concrete mix, the combination shall not exceed 50 percent of cement content by weight. Fly ash shall not exceed 25 percent of the cement content by weight in the combination.

B. **Design Mixes**. Provide normal weight concrete with the following properties, unless otherwise indicated. Tolerance for air content shall be ±1 percent.

1. Class A. 4,000 pounds per square inch (psi), 28 day compressive strength.

   a. Water/Cementitious Product (w/c) ratio, 0.45 maximum; minimum cementitious material, 611 pounds per cubic yard (cy).
   b. 6 percent air.

2. Class B. 3,000 psi, 28 day compressive strength.

   a. w/c ratio, 0.50 maximum; minimum cementitious material, 541 pounds per cy.
   b. 6 percent air.

3. Class C. 2,000 psi, 28 day compressive strength.

   a. w/c ratio, 0.6 maximum; minimum cementitious material, 376 pounds per cy.
   b. 6 percent air.

4. Class D.

   a. w/c ratio, 0.45 maximum; minimum cementitious material, 846 pounds per cy.
   b. Fine aggregate to cement ratio shall not exceed 3.0 by weight.
   c. The maximum size course aggregate shall not exceed 1/3 the minimum concrete placement thickness.
   d. 6 percent air.

5. Class S. 4,500 psi, 28 day compressive strength.

   a. w/c ratio, 0.42 maximum; minimum cementitious material, 564 pounds per cy.
   b. 6 percent air.

6. Class W. In accordance with Class S, except:

   a. Contains crystalline waterproofing admixture in accordance with paragraph 2.1 C.5.g.
   b. Dose in accordance with admixture manufacturer's recommendations.

C. **Slump Limits**. Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Ramps and sloping surfaces. Less than 3 inches.
2. Reinforced foundation systems. 2 to 4 inches.
3. Concrete containing HRWR admixture (Superplasticizer). Less than 8 inches after addition of HRWR to site verified 2 inch to 3 inch slump concrete without HRWR.
4. Other concrete. Less than 4 inches for slabs and less than 5 inches for walls, curbs, bases, and other miscellaneous concrete.

D. **Chloride Content**. The maximum water-soluble chloride ion content, expressed as a percent by weight of cement contributed by all ingredients of the concrete mix shall not exceed 0.10 percent.

E. **Controlled Density Fill or Controlled Low-Strength Material**. The fine aggregates shall be fine enough to stay in suspension in the mixture to the extent required for proper flow. Provide with the following properties, unless otherwise indicated:

1. 100 psi, 28 day compressive strength.

    a. Cement, 100 pounds.
    b. Fly Ash, 250 pounds.
    c. Fine Aggregate, Saturated Surface Dry, 2,800 pounds.
    d. Water, 500 pounds maximum.

2. It is necessary for bleed water to appear on the surface immediately after the fill is struck off.

    a. A delay in bleeding indicates there are too many fines in the mixture, so reduce the fly ash quantity in increments of 50 pounds until mixture is bleeding freely.
    b. Add approximately 60 pounds of sand to replace each 50-pound increment of fly ash to maintain the original yield.

F. **Dry Pack Mortar**. Mix dry pack, consisting of one part portland cement to 2 1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.

G. **Cement Mortar**. A mixture of sand, cement, and water in the same proportions used for the concrete being placed, but omit all coarse aggregate.

H. **Adjustment to Concrete and Mixes**. Request mix design adjustments when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as approved. Submit laboratory test data for revised mix design and strength results for acceptance before using in work.

I. **Admixtures**. Use of Admixtures.

1. Use water-reducing admixture for placement and workability in all classes of concrete unless noted otherwise.
2. A noncorrosive nonchloride accelerating admixture may be used in concrete slabs placed at ambient temperatures below 50 degrees F when approved.
3. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content as indicated in the design mix.

J. **Concrete Mixing.** Ready Mix Concrete. Comply with requirements of ASTM C 94 and as specified.

1. When air temperature is between 85 degrees F and 90 degrees F, mixing and delivery time shall not exceed 75 minutes.
2. When air temperature is above 90 degrees F, mixing and delivery time shall not exceed 60 minutes unless approved otherwise.

PART 3 – EXECUTION

3.1 EXAMINATION

A. **Tolerances**. Unless otherwise specified, tolerances shall be in accordance with ACI 117 and ACI 301.

B. **Inspection**

1. Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in.
2. Notify other trades to permit installation of their work; cooperate with other trades in setting such work.
3. Verify that all wood, dirt, foreign objects, and all other debris have been removed from inside the formwork.
4. Verify that reinforcing steel is spaced to provide the proper coverage against forms and against earth for slabs on grade.
5. When requested, provide documentation of inspection prior to placing concrete.

C. **Site and Weather Conditions**. Do not place concrete when site conditions exist such as standing water, extreme heat or cold, etc., unless the proper precautions have been taken to properly place and protect concrete as recommended by ACI and as acceptable. Do not place concrete on frozen ground.

3.2 PREPARATION

A. **Forms**

1. General. Design, erect, support, brace, and maintain formwork to support vertical and lateral, static and dynamic loads that might be

applied until concrete structure can support such loads. Maintain formwork construction tolerances complying with ACI 347.

2. Forms.

   a. Construct forms to sizes, shapes, lines, position, elevation, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures.
   b. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work.
   c. Use selected materials to obtain required finishes.
   d. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.

3. Fabrication of Forms.

   a. Fabricate forms for easy removal without hammering or prying against concrete surfaces.
   b. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.
   c. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only.
   d. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

4. Openings.

   a. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete.
   b. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar.
   c. Locate temporary openings in forms at inconspicuous locations.

5. Exposed Corners and Edges. Chamfer exposed corners and edges using wood, metal, PVC, or rubber chamfer strips to produce uniform smooth lines and tight edge joints.
6. Provisions for Other Trades.

   a. Provide openings in concrete formwork to accommodate work of other trades.
   b. Determine size and location of openings, recesses, and chases from trades providing such items.
   c. Accurately place and securely support items built into forms.

7. Cleaning and Tightening.

    a. Thoroughly clean forms and adjacent surfaces to receive concrete.
    b. Remove wood, sawdust, dirt, or other debris just before concrete is placed.
    c. Retighten forms and bracing before concrete placement as required to prevent mortar leaks and maintain proper alignment.

8. Form Coatings. Coat contact surfaces of forms with an approved, nonresidual, low VOC, form coating compound before reinforcement is placed.

    a. Do not allow excess form coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
    b. Coat steel forms with a nonstaining, rust preventative material. Rust stained steel formwork is not acceptable.
    c. Form coatings for use in water treatment plants shall be nontoxic after 30 days from the date the forms are removed.

B. **Reuse of Forms**

1. Clean and repair surfaces of all forms to be reused in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces.
2. Apply form coating compound as specified for new formwork.
3. Successive Reuse.

    a. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints.
    b. Align and secure joint to avoid offsets.
    c. Do not use "patched" forms for exposed concrete surfaces except as approved.

3.3 INSTALLATION

A. **Vapor Retarder Installation**

1. Install vapor retarder where shown per ASTM E/643-10.
2. Following leveling and tamping of granular base for slabs on grade, place vapor retarder sheeting with longest dimension parallel with direction of pour.
3. Lap joints 6 inches and seal vapor barrier joints with manufacturer's recommended mastic and/or pressure sensitive tape.

B. **Placing Reinforcement**

1. Comply with CRSI's recommended practice for "Placing Reinforcing Bars" for details and methods of reinforcement placement and supports and as herein specified.
2. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.
3. Installation.

    a. Accurately position, support, and secure reinforcement against displacement.
    b. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as approved.
    c. Place reinforcement to obtain at least minimum coverages for concrete protection as noted in ACI 301.
    d. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations.
    e. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
    f. Install welded wire fabric in lengths as long as practicable.
    g. Lap adjoining pieces at least one full mesh plus 2 inches or 8 inches and lace splices with wire.
    h. Offset laps of adjoining widths to prevent continuous laps in either direction.
    i. Avoid cutting or puncturing vapor retarder barrier during reinforcement placement and concreting operations.

C. **Joints**

1. Construction Joints. Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure.

    a. Provide keyways 1-1/2 inches deep in construction joints in walls and slabs and between walls and footings. Accepted bulkheads designed for this purpose may be used for slabs.
    b. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as otherwise indicated.
    c. The maximum length of wall pours shall not exceed 40 feet, and slab pours shall not exceed 40 feet in length or width.
    d. Bond fresh concrete to hardened new concrete as follows:

        1) For horizontal joints, place new concrete on a 1 inch layer of cement mortar evenly spread over the previously placed concrete. Thoroughly clean and remove laitance of previously placed concrete.
        2) For vertical joints, thoroughly clean the surface of the hardened concrete and remove all laitance prior to placing new concrete.

e. If noted, prior to placement of new concrete against old existing concrete, apply bonding agent to surface of old concrete, if accessible, immediately before placement of new concrete.
f. Make provisions to support and protect exposed waterstops during progress of work. Field-fabricate joints in waterstops in accordance with manufacturer's printed instructions. Provide continuous waterstops in construction joints as follows:

1) Liquid-bearing walls and slabs.
2) Walls or slabs subject to groundwater and/or in contact with ground.
3) Elsewhere as indicated.

2. Isolation Joints in Slabs-on-Ground. Construct isolation joints as indicated in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as shown. Fill joints where noted with sealant specified in Division 7 sections of these specifications.
3. Contraction (Control) Joints in Slabs-on-Ground.

a. Construct contraction joints in slabs-on-ground to form panels of patterns as shown.
b. Use saw cuts 1/8 inch wide by 1/4 slab depth or insert premolded plastic, hardboard, or fiberboard strip into fresh concrete until top surface of strip is flush with slab surface unless otherwise indicated.
c. Tool slab edges round on each side of insert.
d. After concrete has cured, remove inserts and clean groove of loose debris.

1) Saw-cut as soon as possible after slab finishing without dislodging aggregate.
2) If joint pattern not shown, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).
3) Provide joint, filler, and sealant materials where shown.

4. Control Joints in Retaining Wall.

a. Provide control joints at 32 feet on center maximum unless otherwise shown.
b. Provide 1-1/2 inch deep by 1/3 wall thickness vertical keyway.
c. Horizontal reinforcing shall not pass through joint.
d. Joints need not be provided in retaining wall footings.

5. Expansion Joints. Construct expansion joints where shown. If not shown, provide expansion joints at interval not to exceed the following:

a. Retaining Walls. 96 feet (not required in footings).

6. Waterstop. Provide waterstops in all joints shown and listed in this specification.

a. Provide PVC waterstops in all joints unless noted otherwise.
b. Properly support and wire all waterstops to reinforcing to remain straight and true. Heat-splice all joints per manufacturer's recommendations.
c. Provide bitumen waterstop in joint between new and existing concrete.
d. Provide factory made waterstop fabrications for all changes in direction, intersections, and transitions leaving only butt-joint splicing for the field.
e. Provide hog rings spaced at 12 inches on center along the length of the waterstop to provide attachment to rebar without puncturing waterstop for proper positioning.

D. **Installation of Embedded Items**

1. Set and build into the work, anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by other prime Contractors and suppliers of items to be attached thereto.
2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.
3. Set edge forms, bulkheads, and intermediate screed strips for slabs to obtain required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting type screeds.

E. **Concrete Placement**

1. Location. Provide concrete as specified in the table below unless otherwise indicated.

Location	Design Mix
All reinforced concrete and nonreinforced fillets	4,000 psi Class A
Nonreinforced concrete not designated as Class A, C, or D	3,000 psi Class B
Nonreinforced so designated	2,000 psi Class C
Grout fill or topping as designated	Class D
Reinforced concrete so designated	Class W

2. General. Comply with ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete," and as specified herein.

   a. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness, or to be resistant to the penetration of a vibrator.
   b. If a section cannot be placed continuously, provide construction joints as specified herein.
   c. Deposit concrete to avoid segregation at its final location.

3. Placing Concrete in Forms. Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints.

   a. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
   b. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   c. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
   d. Do not use vibrators to transport concrete inside forms.
   e. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine.
   f. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer.
   g. Do not insert vibrators into lower layers of concrete that have begun to set.
   h. At each insertion, limit duration of vibration to time necessary to consolidate concrete around reinforcement and other embedded items without causing segregation of mix.

4. Placing Concrete Slabs. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

   a. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   b. When epoxy-coated reinforced steel is used, vibrators shall have nonmetallic heads.
   c. Bring slab surfaces to correct level with straightedge and strike off. Use highway straightedge, bull floats, darbies, or other means to obtain a smooth surface which is free of humps or hollows and that conforms to the required flatness and levelness.
   d. Do not disturb slab surfaces prior to beginning finishing operations.

e. Maintain reinforcing in proper position during concrete placement.

5. Protection for Slab Construction. Ensure that the concrete floor moisture levels do not exceed flooring manufacturer's recommended moisture level.

   a. Be responsible for controlling the moisture content of interior concrete slabs. Achieve each respective flooring manufacturer's specifications prior to installation. Conduct calcium chloride absorption rate tests in sufficient number to properly substantiate compliance. No additional construction time or extra costs will be approved for failure to satisfy this requirement.
   b. Follow construction practices that will help control the moisture in the slabs (i.e., a low water-to-cement ratio, careful installation of the vapor barrier, properly compacted subgrade free of standing water or mud, surface protection for completed slabs, proper temporary heating and ventilation).
   c. Once the building is enclosed, control the humidity level in spaces (dew point temperature should be 20 degrees below the surface temperature of the slab). If necessary, include the use of desiccant dehumidifiers.

6. Cold Weather Placing. Comply with provisions of ACI 306 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

   a. When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature between 50 degrees F and 80 degrees F at point of placement.
   b. Do not use frozen materials or materials containing ice or snow.
   c. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   d. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

7. Hot Weather Placing. When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

   a. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F. Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is included in the total amount of mixing water. Liquid nitrogen to cool concrete is allowed.

b. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
c. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
d. Use water reducing retarding admixture when required by high temperatures or other adverse placing conditions, when acceptable.
e. Use evaporation control compound in accordance with manufacturer's recommendations or fogging.

8. Adjusting Concrete Slump at Job Site.

a. Slump Greater than Specified. Do not use concrete with slump greater than specified.
b. Slump Less than Specified. If on arrival at the job site, the slump of the concrete is less than specified, the following remedies may be used.

1) Add water only if the maximum specified w/c ratio is not exceeded.
2) Accompany additional water by a quantity of cement sufficient to maintain the specified w/c ratio.
3) Add an approved water reducing admixture.

F. **Controlled Density Fill or Controlled Low-Strength Material Placement**

1. General. Unless noted otherwise, place controlled density fill in overexcavated areas under slabs, in utility trenches within roadways, and as directed.
2. Mixing Equipment. Provide sufficient mixing capacity to permit fill to be placed without interruption.
3. Placing Fill.

a. Discharge flowable fill from the mixer by any reasonable means into the space to be filled.
b. Bring up the fill material uniformly to the fill line shown or as directed.
c. Placing of any material over low strength fill may commence as soon as the surface water is gone or as directed.

G. **Finish of Formed Surfaces**. Classify inside face of covered basins, clear wells and reservoirs, filters below the media line, open tanks and flumes below water or flow lines, and the outside of structures below finish grade lines as not exposed to view.

1. Finish. Finish formed concrete surfaces in accordance with the schedule below.

Location	Type of Finish
Concrete surfaces not exposed to view or surfaces to be covered with a coating material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or other similar system	Smooth form finish
Concrete exposed to view including surfaces which will be painted	Smooth rubbed finish or grout-cleaned finish

2. Smooth Form Finish. This is an as-cast concrete surface obtained with selected form facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch defective areas with fins and other projections completely removed and smoothed.
3. Smooth Rubbed Finish.

    a. Provide smooth-rubbed finish not later than 1 day after form removal.
    b. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced.
    c. Do not apply cement grout other than that created by the rubbing process.

4. Grout-Cleaned Finish.

    a. Mix one part portland cement and 1-1/2 parts fine sand with sufficient water to produce a grout with the consistency of thick paint.
    b. Substitute white portland cement for a part of the gray portland cement in order to produce a color matching the color of the surrounding concrete, as determined by a trial patch.
    c. Wet the surface of the concrete sufficiently to prevent absorption of water from the grout and apply the grout uniformly with brushes or a spray gun.
    d. Immediately after applying the grout, scrub the surface with a cork float or stone to coat the surface and fill all air bubbles and holes.
    e. While the grout is still plastic, remove all excess grout by working the surface with a rubber float, burlap, or other means.
    f. After the surface whitens from drying, rub with clean burlap.
    g. Keep the finish damp for at least 36 hours after final rubbing.

5. Related Unformed Surfaces. At tops of walls, horizontal offsets, and similar unformed surfaces occurring 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.

H. **Slab Finishes**

1. Finish. Finish slab surfaces in accordance with the schedule below unless shown otherwise.

Location	Type of Finish
Slabs to receive grout topping	Rough finish
Slabs to receive concrete topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material	Scratch finish
Slabs to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo	Float finish
Slabs of tanks, flumes, channels, wet wells, etc., which are submerged including grout toppings	Trowel finish after float finishing
Slabs to be exposed to view or covered with resilient flooring, carpet, ceramic or quarry tile, paint or other thin film finish coating system	Trowel finish after float finishing
Slabs to be covered with ceramic quarry tile installed with thin set mortar	Float finish followed by trowel and fine broom finish
Exterior concrete platforms, steps, ramps	Float finish followed by nonslip broom finish

2. Floor Levelness, General. Floor levelness requirements below do not apply to sloped slabs or unshored slabs on metal deck.
3. Scratch Finish.

   a. After placing slabs, plane surface to tolerances for floor flatness (Ff) of 20 and floor levelness (Fl) of 17.
   b. Slope surfaces uniformly to drains where required.
   c. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

4. Float Finish.

   a. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating.
   b. Begin floating, using float blades or float shoes only, when surface water has disappeared, and/or when concrete has stiffened sufficiently to permit operation of power driven floats.
   c. Consolidate surface with power driven floats or by hand floating if area is small or inaccessible to power units.
   d. Check and level surface plane to tolerances of Ff 25 - Fl 20.

e. Cut down high spots and fill low spots.
f. Uniformly slope surfaces to drains.
g. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

5. Trowel Finish.

a. After floating, begin first trowel finish operation using a power driven trowel.
b. Begin final troweling when surface produces a ringing sound as trowel is moved over surface.
c. Consolidate concrete surface by final hand troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of Ff 50 - Fl 35.
d. Grind smooth surface defects that would telegraph through applied floor covering system.

6. Trowel and Fine Broom Finish. Apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.
7. Nonslip Broom Finish. Immediately after float finishing, slightly roughen concrete surface by brooming with stiff fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer/Architect before application.
8. Rough Finish. The bottom of concrete tanks which are to receive grout topping shall receive a rough finish for maximum adhesion. The surface to receive the grout topping shall be intentionally roughened to a minimum amplitude of 1/4 inch.
9. Chemical Hardener. Apply chemical hardener to existing interior concrete floors where indicated.

a. Clean floors and allow to dry before applying hardener.
b. Apply proprietary chemical hardeners, in accordance with manufacturer's printed instructions.
c. After final coat of chemical hardener solution is applied and dried, remove surplus hardener by scrubbing and mopping with water.

10. Sealer/Dustproofer Finish.

a. Coat all exposed surfaces and floors within buildings which will be subject to pedestrian or vehicular traffic under normal operation.
b. Accomplish this by applying a liquid sealer/dustproofer in three applications in accordance with the manufacturer's directions.
c. Apply the sealer/dustproofer as late as possible and just prior to completion of construction.

I. **Placing Grout Toppings**. Grout toppings shall be Class D concrete mix design unless noted otherwise.

1. Prior to placement of the structurally bonded topping, remove all laitance, debris, and loose and foreign material from the base slab. Use water-blasting, sandblasting, or other acceptable methods.
2. Thoroughly wet the base slab before placing the grout topping. Remove all standing water from the surface prior to placing neat cement grout.
3. Brush in neat cement grout as a bonding agent immediately before application of grout topping. Do not allow neat cement grout to set prior to placing grout topping.
4. Where recommended by manufacturer, use the tank mechanism to screed the grout on the tank floor as it is placed. Screed in accordance with the manufacturer's instructions.
5. Trowel finish topping as specified above.
6. Moisture cure grout toppings as specified herein.

J. **Miscellaneous Concrete Items**

1. Filling In Holes and Openings.

   a. Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place.
   b. Mix, place, and cure concrete as herein specified, to blend with in-place construction.
   c. Provide other miscellaneous concrete filling shown or required to complete work.

2. Equipment Bases and Foundations. Provide machine and equipment bases and foundations as shown. Set anchor rods for machines and equipment complying with diagrams or templates of manufacturer furnishing machines and equipment.

3.4 CONCRETE SURFACE REPAIRS

A. **Patching Defective Areas**. Repair and patch defective areas and plug form tie holes with cement mortar immediately after removal of forms, when acceptable.

1. Cut out honeycomb, rock pockets, and voids over 1/4 inch in any dimension down to solid concrete but in no case to a depth of less than 1 inch.

   a. Make edges of cuts perpendicular to the concrete surface.
   b. Thoroughly clean, dampen with water, and brush coat the area to be patched with specified bonding compound.
   c. Place patching mortar before bonding compound has dried.

2. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surrounding.

a. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching.
b. Compact mortar in place and strike-off slightly higher than surrounding surface.
c. After shrinkage has occurred, grind surface until flush.

B. **Repair of Formed Surfaces**. Remove and replace concrete having defective surfaces if defects cannot be repaired satisfactorily. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on surface, and stains and other discolorations that cannot be removed by cleaning.

C. **Repair of Unformed Surfaces**. Repair or replace supported slabs that fail to meet the specified finish requirements.

1. Correct levelness and flatness, and low and high areas as herein specified.
2. For slabs on grade, remove slab between control joints and replace with concrete slab meeting floor finish and tolerances.
3. For all other unformed surfaces, repair as follows:

a. Repair surface defects that affect the durability of the concrete. These include crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
b. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14 days.
c. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with patching compound.
d. Finish repaired areas to blend into adjacent concrete.
e. Underlayment compounds may be used when acceptable.
f. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete.

1) Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4 inch clearance all around.
2) Dampen concrete surfaces in contact with patching concrete and apply bonding compound.
3) Mix patching concrete of same materials to provide concrete of same type or class as original concrete.
4) Place, compact, and finish to blend with adjacent finished concrete.
5) Cure in same manner as adjacent concrete.

D. **Miscellaneous Repairs**. Repair isolated random cracks and single holes not over 1 inch in diameter by dry pack method.

1. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles.
2. Dampen cleaned concrete surfaces and apply bonding compound.
3. Place dry pack mortar before bonding compound has dried.
4. Compact dry pack mixture in place and finish to match adjacent concrete.
5. Keep patched area continuously moist for not less than 72 hours.

E. **Approval**. Perform structural repairs with prior approval for method and procedure, using specified epoxy adhesive and mortar.

F. **Alternative Repair Methods**. Repair methods not specified above may be used, subject to acceptance.

3.5 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. **General**

1. Employ an approved testing laboratory to perform tests and submit test reports.
2. ACI Grade 1 certified technician employed by the testing laboratory shall be present during the placing of all concrete.
3. The concrete testing laboratory shall submit two copies of all test reports directly to the Engineer/Architect.

B. **Sampling Fresh Concrete**. Sample concrete in accordance with ASTM C 172, except modified for slump to comply with ASTM C 94.

1. Slump. Perform slump tests at the point of truck discharge prior to adding plasticizers in accordance with ASTM C 143.

   a. For each class of concrete, perform one test for each compressive strength test and additional tests when concrete consistency seems to have changed.
   b. If the slump is adjusted at the job site, the concrete testing agency shall be responsible for reporting the following.

      1) Method used to adjust slump.
      2) Quantity of each material added.
      3) Resulting slump.

2. Air Content. Perform daily for each class of concrete placed in accordance with ASTM C 173 volumetric method for lightweight concrete; ASTM C 231 pressure method for normal weight concrete; one test for each compressive strength test, one test for the first load of each type of air entrained concrete delivered, and one test for each truck when air content is adjusted until consistent results are obtained.
3. Concrete Temperature. Test hourly when air temperature is 40 degrees F and below, when 80 degrees F and above, and each time a set of compressive test specimens is made.

4. Compressive Test Specimen. Perform in accordance with ASTM C 31 and as follows:

   a. Prepare one set of four standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field cured test specimens are required. Contractor may also prepare field cured test specimens to be used for early form removal.
   b. Prepare one set of cylinders for each 100 cy of concrete or fraction thereof, of each concrete class placed in any one day.
   c. Perform compressive strength tests in accordance with ASTM C 39. Test one specimen at 7 days, and two specimens at 28 days, and hold one specimen in reserve for later testing if required.
   d. When frequency of testing will provide fewer than five strength tests for a given class of concrete, conduct testing from at least five randomly selected batches or from each batch if fewer than five are used.
   e. When total quantity of a given class of concrete is less than 50 cy, Engineer/Architect may waive strength test if adequate evidence of satisfactory strength is provided.
   f. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, evaluate current operations and provide corrective procedures for protecting and curing the in-place concrete.
   g. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive strength by more than 500 psi.

C. **Compressive Strength Test Reporting**. Report test results in writing to Engineer/Architect, Ready-Mix producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7 day tests and 28 day tests.

D. **Flatness and Levelness**. Conduct random tests for flatness and levelness in accordance with ASTM E 1155 within 24 hours after final finish and as directed. Pay the cost for testing and any retesting after the defects are corrected.

E. **Floor Slope**. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having required slope within 24 hours after final finish and as directed.

F. **Nondestructive Testing**. Impact hammer, ultrasonic pulse velocity, or other nondestructive testing device may be permitted if approved, but shall not be used as the sole basis for acceptance or rejection.

G. **Additional Tests**. The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure.

1. These tests shall be as directed.
2. Testing service shall conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.
3. Be responsible for all costs associated with such tests.

3.6 DEMONSTRATION

A. **General**. Prior to final acceptance of concrete work, demonstrate to representatives of the Owner and the Engineer/Architect that there are no mechanical defects or damaged areas and that concrete exposed to view is acceptable as to function and appearance.

1. Walls and Other Formed Surfaces. Representatives of the Owner, Contractor, and Engineer/Architect shall review concrete work to verify that tie holes and air voids have been patched, seams have been ground smooth, all surface defects have been repaired, and all rubbed or rubbed and painted surfaces are acceptable in appearance.
2. Floors.

   a. Representatives of the Owner, Contractor, and Engineer/ Architect shall review concrete work to verify that all surface defects have been repaired, all stains removed, residue from floor sealer/dustproof or chemical hardener has been removed, and that the required finish is acceptable.
   b. Where requested, flood selected areas of floor to a depth satisfactory to demonstrate that the area or areas drain properly to the floor drains and sumps and that there are no areas ponding water outside acceptable tolerances.
   c. Furnish water for testing and convey it to the areas being examined.

3. Liquid-Bearing Structures. Demonstrate that all structures designed to hold water or other liquids are watertight in accordance with ACI 350 and Section 01 89 19 "Leakage Test and Disinfection."

B. **Repair or Replacement of Defective Work**. Correct concrete work which is unacceptable in accordance with paragraph 3.4 of this section. Replace concrete which cannot be repaired satisfactorily in an acceptable manner at no additional cost to the Owner.

3.7 CONCRETE CURING AND PROTECTION

A. **General**. Protect freshly placed concrete from premature drying and excessively cold or hot temperatures. In hot, dry, and windy weather, protect concrete from

rapid moisture loss before and during finishing operations with an evaporation control compound applied in accordance with manufacturer's instructions.

B. **Curing Duration**

1. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing.
2. Keep continuously moist for not less than 7 days.
3. Maintain concrete temperatures as recommended in ACI 301 throughout the curing period.

C. **Curing Methods**. Perform curing of concrete by curing compound, by moist curing, by moisture-retaining-cover curing, and by combinations thereof in accordance with the schedule below unless noted otherwise.

1. If unspecified, all methods specified below are acceptable.
2. Prior to use of curing compound on any surface, verify compatibility between curing compound and finish surface treatment.

Location	Curing Method
Floors and other unformed concrete surfaces	Any specified curing method
Formed concrete surfaces	Moist curing prior to form removal, followed by any of the methods specified below
Slabs to receive grout topping	Moisture cure
All other concrete	Any specified curing method

3. Moisture Curing. Provide moisture curing by following methods:

   a. Keep concrete surface continuously wet with a continuous water fog spray.
   b. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet.
   c. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4 inch lap over adjacent absorptive covers.

4. 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 3 inches. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
5. Curing Compound. Provide curing compound as follows:

   a. Apply specified curing compound to concrete as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared).
   b. For formed surfaces, apply curing compound immediately after form removal.

c. Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's directions. Apply in two coats, spread in perpendicular directions.
d. Recoat areas subjected to heavy rainfall within 3 hours after initial application.
e. Maintain continuity of coating and repair damage during curing period.
f. Use curing compounds that will not affect finish materials applied directly to concrete.
g. Do not use curing compounds on surfaces which are to be covered with coating material applied directly to concrete, chemical hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glue down carpet that is not compatible with curing compound), painting, and other coatings and finish materials, unless otherwise approved.

3.8 SHORES AND SUPPORTS

A. **Comply with ACI 347** for shoring and reshoring in multistory construction, and as herein specified.

B. **Extend shoring from ground to roof** for structures four stories or less, unless otherwise permitted.

C. **Extend shoring at least three floors** under floor or roof being placed for structures over four stories.

1. Shore floor directly under floor or roof being placed, so that loads from construction above will transfer directly to these shores.
2. Space shoring in stories below this level in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members where no reinforcing steel is provided.
3. Extend shores beyond minimums to ensure proper distribution of loads throughout structure.

D. **Remove shores and reshore** in a planned sequence to avoid damage to partially cured concrete or to supporting floors. Locate and provide adequate reshoring to support work without excessive stress or deflection.

E. **Keep reshores in place** a minimum of 15 days after placing upper tier, and longer if required, until concrete has attained its required 28 day strength and heavy loads due to construction operations have been removed.

3.9 REMOVAL OF FORMS

A. **Formwork which is not supporting** the weight of concrete, such as sides of beams, walls, columns, and similar parts of the work may be removed after cumulatively curing at not less than 50 degrees F for 24 hours, provided concrete

is sufficiently hard not to be damaged by form removal operations, and provided curing and protection operations are maintained.

B. **Formwork supporting weight** of concrete, such as beam soffits, joists, slabs, and other structure elements, may not be removed in less than 14 days and concrete has attained at least 75 percent of the design 28 day minimum compressive strength. Determine potential compressive strength of in-place concrete by testing field cured specimens representative of concrete location or members.

C. **Form facing material may be removed** 3 days after placement only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

3.10 PROTECTION OF FORMED AND UNFORMED CONCRETE SURFACES

A. **Protect concrete from damage** or discoloration during the construction period caused by subsequent work performed by all other trades, including, but not limited to, concrete forming, reinforcing steel placement, equipment installation, plumbing work, electrical work, construction loading to the point of overstressing concrete, and all other actions which might adversely affect the strength or appearance of the concrete. Repair chipped or damaged concrete and remove rust, stains, efflorescence, and surface deposits by acceptable methods.

END OF SECTION

SECTION 03 62 00

NON-SHRINK GROUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to furnish and install the non-shrink grout in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work to furnish and install the non-shrink grout in compliance with all federal, state, and local codes and regulatory agencies.

B. **Standards**. Materials and workmanship shall be in accordance with the following standards referenced herein.

1. ASTM - American Society for Testing and Materials.

1.4 SUBMITTALS

A. **Product Data**. Submit manufacturer's technical data and installation instructions for each type of grout. Technical data shall show manufacturer's trade name, color, all independent laboratory tests, performance data, method of application, storage requirements, safety fact sheet, container sizes, and mixing instructions.

1.5 JOB CONDITIONS

A. **Surface Preparation.** Clean all surfaces to be grouted of loose mortar and concrete and all dirt and oil.

B. **Coordination**. Coordinate all work with other trades to prevent delays, omissions, damage, and/or interference with other work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Delivery**. Grout shall be delivered to the site in sealed containers bearing a label which shall list the manufacturer's name, trade name, application rate, precautionary methods required, and mixing ratio.

B. **Storage**. Store materials in an enclosed dry area, protected from damage and moisture. Keep storage areas clean and neat at all times.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MATERIAL**

A. **Grout shall be non-shrink**, non-metallic, non-staining, capable of developing a minimum compressive strength of 9,000 pounds per square inch (psi) at 28 days, when tested in 2 inch cubes in accordance with ASTM C-109. Grout shall be free of any metal, plastic, gypsum, and chemicals, and guaranteed not to shrink below its original placement volume at any time.

PART 3 - EXECUTION

3.1 **EXAMINATION**

A. **Verification**. Confirm that all dimensions, elevations, and tolerances are correct prior to placing grout. Equipment shall be free of any vibration and properly supported when operated prior to placing grout.

3.2 **PREPARATION**

A. **Surface Preparation**. Clean all areas to be grouted so they are free of all oils, grease, laitance, loose particles, and foreign materials. Thoroughly wet all concrete to be grouted leaving no puddles prior to grouting.

3.3 **INSTALLATION**

A. **Placement**. Mix and place non-shrink grout in accordance with the manufacturer's instructions. Fill all voids and spaces, trim excess grout, and finish surface to match adjoining surfaces or as directed. Maintain a surface temperature of not less than 50 degrees F for 7 consecutive days after placing the grout and keep the grout wetted for 3 consecutive days after placing.

B. **Items to Be Grouted (Where Applicable)**

1. Pipe, Equipment, Leveling Plates, and Base Plates. After shimming equipment to proper grade, securely tighten anchor bolts. Properly form around the base plates, allowing sufficient room around the edges for placing the grout. Provide adequate depth between the bottom of the base plate and the top of the concrete base to ensure that the void is completely filled with grout.
2. Rail and Fence Posts. After all posts have been properly inserted into the holes, fill the annular space between posts and concrete with the non-shrink, nonmetallic grout. Bevel grout at juncture with post so that moisture flows away from the post.
3. Box Outs and Closing of Openings. Grout all box outs and other openings approved due to late deliveries and required to maintain the work schedule full as shown on the drawings and as specified under paragraph 3.3 A of this section.

3.4 FIELD QUALITY CONTROL

A. **Areas to Be Grouted**. Observe and confirm that all surfaces to be grouted are cleaned of loose mortar and concrete and all dirt and oil.

B. **Shrinkage Cracks**. Visually inspect grouted areas after 3 months and 1 year for evidence of shrinkage cracks. Replace any grout which shows evidence of cracks.

END OF SECTION

SECTION 05 00 00

MISCELLANEOUS METALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to furnish and install the miscellaneous metals in accordance with the drawings and the specifications.

1.3 QUALITY ASSURANCE

A. **Fabricator Qualifications**. Fabrication shall meet requirements of the American Institute of Steel Construction (AISC) standards.

B. **Standards**. Ensure that materials and workmanship are in accordance with the following standards referenced herein.

1. AASHTO – American Association of State Highway and Transportation Officials.
2. AISC.
3. ASTM – American Society for Testing and Materials.
4. AWS – American Welding Society.
5. OSHA – Occupational Safety and Health Administration.

1.4 SUBMITTALS

A. **Submit the following** in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. **Submittal Package No. 1 – Shop Drawings and Product Data**

1. Schedule. No products shall be delivered or installed before this submittal package has been reviewed and approved.
2. Submittal Package Contents.

    a. Manufacturer's name and model numbers.
    b. Manufacturer's standard product data and equipment specifications.
    c. Materials of construction.
    d. Dimensional layouts and required clearances.
    e. Connections including welding.
    f. Weights.
    g. Anchors.

h. Bill of material.
i. Coatings.
j. Complete description in sufficient detail to permit an item by item comparison with the specifications.
k. Manufacturer's instructions.
l. Warranties.

1.5 **JOB CONDITIONS**

A. **Field-verify all dimensions, locations, and elevations** of anchors, bolts, plates, openings, and other miscellaneous metal items and be responsible for their proper fit.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **In accordance with Section** 01 60 00 "Materials and Equipment" and the manufacturer's instructions.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **GENERAL**

A. **Design**

1. Proportion components not sized on the plans to provide ample strength and stiffness for the loads expected.
2. All steel shall meet the requirements of ASTM A 36.
3. All cast iron shall meet the requirements of ASTM A 48.

B. **Fabrication**. Fabricate the miscellaneous metals in accordance with the approved shop drawings.

2.2 **EQUIPMENT**

A. **Chains**

1. Multiple row of 1/4 inch, Type 304 all-welded stainless steel.
2. Type 316 stainless steel swivel safety snap at each end.
3. Type 316 stainless steel eye bolt to the railing or wall.

B. **Gratings**

1. Aluminum.

a. Type 6063 aluminum, rectangular pressure lock type with cross bars flush with the walking surface.

b. Bearing bars shall be not less than 3/16 inch thick with a minimum depth of 1-1/4 inches and spaced not greater than 1-3/16 inches on center.
c. Cross bars shall be 3/4 inch x 1/8 inch spaced 4 inches on center.

2. Design Loading.

a. Uniform load of 300 pounds per square foot with a deflection of not more than 1/160 of the span, unless otherwise shown.
b. Depths noted are minimum; increase depth of grating and support angle as required to meet design loading.
c. Uniform depth in any one area.

3. Supports.

a. Support gratings on all four sides by an angle of the same material as the grating.
b. Securely anchor angle supports.
c. Where the support angle extends across an opening, supplement the support angle with a structural channel.
d. Channel, unless noted otherwise, shall be of the same material as the grating and not less than 3 inches in depth.

4. Banding. Band edges and openings in the gratings with a bar equal to the bearing bar. Provide 1/8 inch thick cover plate with pegs to prevent movement for each opening.
5. Setting.

a. Set gratings flush with the finished surface.
b. Secure gratings to their supports by removable anchors.
c. Set anchors every 4 feet 0 inches on center but not less than two anchors per each section of grating.
d. Clip gratings with a span over 4 feet together.

C. **Planking**

1. Materials. Type 6063-T6 aluminum, unpunched, solid surface with horizontal ribbing.
2. Design Loading. Design planking for a uniform load of 300 pounds per square foot with a deflection of not more than 1/160 of the span, unless otherwise shown.
3. Supports.

a. Support planking on all four sides by an angle of the same material as the planking.
b. Securely anchor angle supports.
c. Where the support angle extends across an opening, supplement the support angle with a structural channel.
d. Channel, unless noted otherwise, shall be of the same material as the planking and not less than 3 inches in depth.

4. Banding. Band edges and openings in planking with a bar equal to the bearing bar. Provide 1/8 inch thick cover plate with pegs to prevent movement for each opening.
5. Setting. Planking shall be set flush with the finished surface, and the planking shall be of uniform depth in any one area.
6. Subject to compliance with the specifications, provide the planking from one of the following approved manufacturers.

    a. IKG Borden HD Style P.
    b. Or equal.

D. **Floor Plate Covers**. Conform to ASTM A 786 made of A283 Grade D or A36 steel.

E. **Structural Shapes**

1. Structural shapes including all lintels shall be ASTM A 36 steel, hot-dipped galvanized, unless noted otherwise.
2. Lintels. Minimum 8 inch bearing on each side of the opening, unless noted otherwise.
3. All structural shapes other than lintels shall be as required to complete the work. All anchors, connections, bearing plates, and fabrication details shall be standard, unless otherwise noted.

F. **Stairs**

1. All stair treads, stringers, railings, angles, landings, anchors, clips, and supports as shown.
2. Designed to meet local, state, and OSHA requirements with a safety factor of 4.
3. Weld bent stringers to develop strength of section.
4. Continuously weld 3/16 inch closure plate to exposed ends of stringers.

G. **Flumes, Baffles, and Weirs**

1. Flumes, baffles, and weirs shall be of the size, shape, and material shown.
2. Weld and grind smooth all joints.
3. Provide watertight expansion joints as shown.

H. **Weir Plates, Stop Plates, and Guide Frames**

1. Fabricate all weir plates, stop plates, and guide frames aluminum alloy 6061-T6 or equivalent, with mill finish, of the sizes and shapes shown.
2. Guide frames shall be straight and true, extruded construction, with all corners mitered, welded, and ground smooth.
3. Fit guide frames with ultra high molecular weight polyethylene seals at all points of contact.
4. Continuously secure seals with dovetail or dado joint.
5. Guide frame shall weigh a minimum of 1.5 pounds per foot.

6. Stiffen plates with structural shapes, welded in place, as required to keep the maximum deflection below 1/360 of the span under the loads developed from maximum head conditions.
7. Plates and frames shall be by the same manufacturer.

I. **Staff Gauges**. Staff gauges shall be Type 6061-T6 aluminum as shown. Numbers shall be Futura Style, 1-1/2 inches high.

J. **Fasteners for aluminum or stainless steel** shall be Type 316 stainless steel.

K. **Anchor Bolts**. In accordance with Section 05 05 23 "Anchors."

L. **Ladders**. Ladders as shown with all anchors, bolts, and necessary appurtenances. Weld and grind smooth all joints.

M. **Stair Nosings**

1. Provide all concrete stairs with anti-slip stair nosings.
2. Stair nosings shall be extruded aluminum with four alternating ribs of abrasive grit.
3. Abrasive grit shall be not less than 19 ounces of aluminum oxide per square foot of nosing.

N. **Stair Treads**

1. Grating Type. Galvanized steel with 1-1/4 inch x 3/16 inch bearing bars at 1-3/16 inches on center with nonskid nosing.
2. Concrete-Filled Steel Pan. 14 gauge steel continuously welded to stringers.

O. **Covers and Frames**

1. Access Openings. Covers and frames for access openings shall be cast iron or mill-finish aluminum of the size, type, and style as shown. All hardware for aluminum access doors shall be Type 316 stainless steel.
2. Pipe Openings. Covers and frames for pipe openings shall be 1/4 inch aluminum plate set in an aluminum bar frame. Covers shall be split ring type for installed pipe and solid for openings of future pipe.
3. Expansion Joints.

    a. Flush Type. Cover and frame for expansion joints shall be flush type, extruded aluminum frame with 1/4 inch aluminum cover plate and neoprene insert.
    b. Surface Type. Cover for expansion joints shall be preformed aluminum shapes with tapered edges, anchored on one side only. Anchors shall be stainless steel, flat head type, set flush, 12 inches on center.

P. **Access Steps**

1. Steps shall conform to the requirements of ASTM C 478, AASHTO M-199, and as shown.

2. Each step shall consist of a 1/2 inch Grade 60 deformed reinforcing bar encapsulated in polypropylene.

   a. The polypropylene shall conform to ASTM D 4101.
   b. The reinforcing bar shall conform to ASTM A 615.

3. Do not exceed 24 inches between the top of opening and the first step.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Take field measurements** prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress; allow for trimming and fitting where taking field measurements before fabrication might delay work.

3.2 PREPARATION

A. **Coordinate and furnish anchorages**, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor rods, and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.3 GENERAL

A. **Fasteners**

1. Conceal fasteners where practical.
2. Countersink all bolts, properly sized, and of proper length to permit full thread in the nut and project not more than a 1/4 inch beyond the nut.
3. Provide lock washers at all nuts and nick the bolt to prevent loosening.
4. All welds shall be smooth and regular, solid, and homogeneous throughout and free from pits, slag, scale, and other defects.
5. Make joints exposed to weather watertight with gaskets or continuous welding.
6. Grind smooth all welds in exposed finished work.

B. **Holes**. Drill or punch all holes with clean, true lines and surfaces.

C. **Welding**

1. Unless otherwise shown, all welding shall be continuous along all adjoining planes and shall produce a neat, even finish and smooth appearance.
2. Conform to welding requirements of AWS.
3. For all welding of aluminum use inert-gas shielded-arc method conforming to AWS D1.2.
4. Weld stainless steel conforming to materials and procedures set forth in "The Procedure Handbook of Arch Welding" by Lincoln Electric Co. or other approved procedures.

D. **Galvanizing**

1. Where galvanized or zinc coated is called for, it shall be hot dipped after fabrication in accordance with the standard specifications of the Hot Dip Galvanizers Association.
2. Do not paint galvanized metal, unless otherwise noted.
3. Coat all abraded areas, welds, or holes drilled in the field with a zinc-rich paint.

E. **Painting**. Unless otherwise noted, see Section 09 90 00 "Painting," for miscellaneous metal coating.

F. **Anchors**. Coat all ferrous anchors that are not galvanized with an asphaltic paint prior to installation.

G. **Aluminum**. Isolate all aluminum in contact with concrete, masonry, or dissimilar metals by coating the contact surfaces with a two-part water-based, gray epoxy primer.

3.4 INSTALLATION

A. **Fabricate and install** the miscellaneous metals specified herein as shown and in accordance with approved shop drawings and the manufacturer's recommendations.

END OF SECTION

SECTION 05 05 14

GALVANIZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.
2. This section sets forth requirements for the performance of the galvanizing process where galvanizing is called for under this Contract.
3. Wherever a part, fabrication, assembly, or other item is noted to be "galvanized" or "hot-dip galvanized" anywhere in the Contract Documents, this section shall govern unless other requirements are specifically noted.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**

1. Provide all labor, materials, tools, and equipment necessary to hot-dip galvanize all items, parts, fabrications, and equipment required to be galvanized by this Contract.
2. It shall be understood that this section governs such galvanizing as described in Paragraph 1.1 whether or not this section is specifically mentioned or noted.

1.3 QUALITY ASSURANCE

A. **Standards**. Ensure that materials and workmanship are in conformance with the following standards as referenced herein:

1. AHDGA – American Hot Dip Galvanizers Association.
2. RCSC – Research Council on Structural Connections of the Engineering Foundation.
3. ASTM – American Society for Testing and Materials.
4. FS – Federal Specifications (DOD and MIL).

B. **Qualifications of the Galvanizer**

1. Must have at least 3 years' experience with hot-dip galvanizing to ASTM standards.

1.4 SUBMITTALS

Not used.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General

1. In storage, raise the articles from the ground and separate with strip spaces to provide free access of air to most parts of the surface.
2. Incline them in a manner which will allow continuous drainage.
3. Do not allow galvanized steel to rest on cinders or clinkers, wet soil, or vegetation.

B. Items without Passivation

1. Store in a dry area protected from the weather.
2. Store in a manner that promotes good air circulation between items.
3. Do not store outside under tarps.
4. Comply with AHDGA Publication MA-10.

C. Items with Passivation

1. Load and store item to prevent the formation of wet storage stain.
2. Stack or bundle the articles to allow air between the galvanized surfaces during transport from the supplier. Additionally, load the material in such a manner that continuous drainage will occur.
3. Comply with AHDGA Publication MA-10.

1.7 SPECIAL WARRANTY

Not used.

1.8 DEFINITIONS

	Term Used in Contract Documents	Definition to Be Used for This Contract
A.	**Galvanized or galv.**	Hot-dip galvanized
B.	**Hot-dip galv. or hot dip galvanized**	Hot-dip galvanized
C.	**Lot**	As defined in ASTM A 123
D.	**Galvanizer**	Company employed to perform the galvanizing work

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Materials

1. Material for galvanizing shall be geometrically suitable for galvanizing as described in ASTM A 384 and A 385. Steel materials suitable for galvanizing include structural shapes, pipe, sheet, fabrications, and assemblies.
2. Steel material shall be chemically suitable for galvanizing.

    a. Recommended steel materials for hot-dip galvanizing include, but are not limited to:

        1) Structural Shapes and Plates. ASTM A 36, A 242 Type 2, A 283, A 500, A 501, A 529, A 572, and A 588.
        2) Steel for Fasteners.

General Category	Bolt Material	Nut Material
Carbon Steel	ASTM A 307 Grade A or B	ASTM A 563 Grade A
High Strength	ASTM A 325 Type 1 or 2 ASTM A 490	ASTM A 563 Grade DH or ASTM A 194 Grade 2H
Tower Bolts	ASTM A 384	ASTM A 563 Grade A
Quenched and Tempered Carbon Steel Bolts	ASTM 499	ASTM A 563 Grade C
Quenched and Tempered Alloy Steel Bolts	ASTM A 354 Grade BC	ASTM A 563 Grade DH

        3) Steel for Sheet Metal Articles. ASTM A 569 or ASTM A 570.
        4) Steel for Pipe or Tubing. ASTM A 53 or ASTM A 595 Gr A or B.

B. Pregalvanizing Fabrication Requirements

1. Fabricate structural steel in accordance with Class I guidelines as described in AHDGA's Recommended Details for Galvanized Structures (MA-11).
2. Fabrication practices for products shall be in accordance with the applicable portions of ASTM A 143, A 384, and A 385, except as specified herein. Avoid fabrication techniques which could cause distortion or embrittlement of the steel.

3. Consult with hot-dip galvanizer regarding potential warpage problems or potential handling problems during the galvanizing process which may require modification of design before fabrication proceeds.
4. Remove all welding slag and burrs prior to delivery for galvanizing.
5. Provide holes and/or lifting lugs to facilitate handling during the galvanizing process at positions as agreed among the designer, fabricator, and galvanizer.
6. Avoid unsuitable marking paints. Consult with galvanizer about removal of grease, oil, paint, and other deleterious material prior to fabrication.
7. Remove by blast cleaning or other suitable methods, surface contaminants and coatings which would not be removable by the normal chemical cleaning process in the galvanizing operation.

2.2 GALVANIZING

A. General

1. All galvanizing shall be by the hot-dip process.
2. Electrogalvanizing, plating, or thermal spray will not be allowed.

B. **Zinc**. Zinc for galvanizing shall conform to ASTM B 6, Prime Western grade.

C. Galvanizing

1. Surface Preparation.

   a. Preclean steelwork utilizing 10 percent sulfuric acid pickle and flux at 160 degrees F.

2. Application of Coating.

   a. Galvanize steel members, fabrications, and assemblies after fabrication by the hot-dip process in accordance with ASTM A 123. Kettle temperature shall be 850 degrees F.
   b. Galvanize bolts, nuts, and washers and iron and steel hardware components in accordance with ASTM A 153. Kettle temperature shall be 1000 degrees F.
   c. Use the "dry" galvanizing process.
   d. Safeguard products against steel embrittlement in conformance with ASTM A 143.
   e. Handle all articles to be galvanized in such a manner as to avoid any mechanical damage and to minimize distortion.

3. Coating Requirements.

   a. Coating Weight. Shall conform with Table 1 of ASTM A 123 or ASTM A 153, as appropriate.
   b. Surface Finish. Shall be continuous, adherent, as smooth and evenly distributed as possible and free from any defect detrimental to the end use of the coated article.

c. Adhesion. Shall withstand normal handling consistent with the nature and thickness of the coating and the normal use of the article.

4. Postgalvanizing Treatments.

a. Apply passivation to all galvanized products which will not be painted. Verify that product will not be painted before applying passivator.
b. Do not treat freshly galvanized or passivated surfaces with oils, grease, or chemicals which might interfere with adhesion of subsequent paint primers and coatings.
c. Where slip factors are required to enable friction grip bolting, obtain these after galvanizing by suitable treatment of the faying surfaces in accordance with the latest edition of the "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" as approved by the Research Council on Structural Connections of the Engineering Foundation.

5. Bolts and Nuts.

a. Galvanize bolts in standard condition as fabricated.
b. Galvanize nuts prior to tapping; then tap oversize to allow for zinc thickness on the bolts.

2.3 SOURCE QUALITY CONTROL

A. **Factory Inspection and Tests**. Inspections, tests, and samples shall conform with ASTM Specifications and Standards. Carry out inspection at the galvanizer's plant. Inspection rights and privileges, procedures, and acceptance or rejection of galvanized steel material shall conform with ASTM A 123 or A 153 as applicable. Inspections and tests shall include the following:

1. Visual examination of samples and finished products.
2. Tests to determine weight or mass of zinc coating per square foot of metal surface.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **Mechanical Damage**

1. Engineer/Architect will inspect all damage caused by such acts as drilling, welding, flame cutting, handling, transport, or erection and determine if damaged areas are field-repairable or if regalvanizing by the hot-dip process is required.
2. Repair field-repairable damage in accordance with Section 09 90 00 "Painting" of these specifications.

a. Accomplish all repair of damaged surfaces at no additional cost to the Owner.
b. Touch-up prime painted surfaces with the same primer applied in the shop.
c. Clean damaged surfaces to ensure proper paint adhesion.
d. Comply with Section 09 90 00 "Painting" for all painting.
e. Verify all mil thicknesses by use of a magnetic thickness gauge.

B. **Wet Storage Stain Damage**. Remove any wet storage stains before installation so that premature failure of the coating will not occur. Remove wet storage stain as follows:

1. Arrange the objects so that their surfaces dry rapidly.
2. Remove light deposits by means of a stiff bristle (not wire) brush.
3. Remove heavier deposits by brushing with a 5 percent solution of sodium or potassium dichromate with the addition of 0.1 percent by volume of concentrated sulfuric acid. Apply this with a stiff bristle brush and leave for about 30 seconds before thoroughly rinsing and drying. Alternatively a proprietary product such as Oakite Highlite or equal which is intended for this purpose may be used according to manufacturer's recommendations.
4. Make a coating thickness check in the affected areas to ensure that the zinc coating remaining after the removal of wet storage stain is sufficient to meet or exceed the requirements of this specification.

3.2 FIELD QUALITY CONTROL

A. **Field Inspection and Tests**

1. Galvanized items may be field-checked by the Owner or the Engineer with a magnetic thickness gauge to determine adequacy of the zinc coating thickness.
2. Use the following conversion ratio: 1.0 ounce per square feet (oz/sf) = 1.7 mils.
3. Inspection shall be in accordance with MA-2 of the AHDGA.
4. All components designated for galvanizing shall receive a minimum galvanize coating of 2.0 oz/sf or 3.4 mils, if not specifically listed in the ASTM guidelines.
5. Items with coating thicknesses not meeting those specified herein will be rejected and shall be returned to the galvanizing subcontractor for compliance with the specifications.

END OF SECTION

SECTION 05 05 23

ANCHORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide all labor, materials, tools, and equipment necessary to furnish and install the anchor rods, expansion anchors, and adhesive anchors and dowels in accordance with the drawings and as specified herein.

1.3 QUALITY ASSURANCE

A. **Standards**. Ensure that materials and workmanship are in conformance with the following standards as referenced herein:

1. AISI – American Iron and Steel Institute.
2. ASTM – American Society for Testing and Materials.

1.4 SUBMITTALS

A. **Submit the following submittals** in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

B. **Submittal Package No. 1 – Shop Drawings, Product Data, and Design Criteria**

1. Schedule. No products shall be delivered or installed before this submittal package has been reviewed and approved.
2. Submittal Package Contents.

   a. Copies of manufacturer's specifications, load tables, data, and dimension diagrams for the devices including manufacturer's recommended working load for each size and type of anchor proposed for use.
   b. Certification that materials conform to ASTM specifications.
   c. Certification that products conform to requirements of Underwriters' Laboratory or Factory Mutual.
   d. Setting drawings and templates for location and installation of anchorage devices.
   e. Anchor rods and bolts showing dimensions and material of construction.
   f. When the size, length, or load carrying capacity of an anchor rod, expansion anchor, and adhesive anchor is not shown on the drawings, provide the size, length, and capacity required to carry the design load times a minimum safety factor of four.

g. Design Loads. Those imposed by the service conditions and as follows:

1) Equipment Anchors. Use the design load recommended by the equipment manufacturer and accepted by the Owner or Engineer.
2) Allowances for vibration are included in the safety factor specified above.

h. Design Data. Provide design load documentation and calculations for items sized or selected.
i. Installation instructions for adhesive anchors.

1.5 **JOB CONDITIONS**

Not used.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Delivery**. Clearly mark all items according to purpose and intended location.

B. **Storage and Handling**. Store and handle all items in accordance with the manufacturer's recommendations, but in no case exposed to the weather.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MATERIALS/MANUFACTURERS**

A. **Threaded and Nutted Anchor Rods**

1. In accordance with ASTM A 276, AISI Type 316.
2. Nuts in accordance with ASTM F 594, Group 2, and tack-welded to anchor rod.

B. **Cracked Concrete Anchors**

1. Provide cracked concrete anchors where International Building Code (IBC) 2006 is the design code and specified on the drawing details. Anchors that are approved for "cracked concrete" situations shall meet the requirements stated in ACI-318-05 Appendix D.
2. Manufacturers. Subject to compliance with the specifications, provide cracked concrete anchors from one of the following approved manufacturers.

a. Expansion Anchors

1) Simpson, Strong-Bolt.
2) Hilti, Inc., Kwik-Bolt-TZ.
3) Simpson Titan-HD.

4) Hilti HSL-3.
5) Hilti HDA.

b. Adhesive Anchors

1) Simpson SET-XP
2) Hilti HIT-RE 500 V3

C. **Expansion Anchors**

1. Provide stainless steel expansion anchors, nuts, and washers complying with ASTM A 276, AISI Type 316.
2. Expansion anchors shall be Underwriters' Laboratories, Factory Mutual, or International Code Council – Evaluation Service (ICC-ES) approved.
3. Subject to compliance with the specifications, provide expansion anchors from one of the following approved manufacturers.

a. Simpson, Wedge-All.
b. Wej-it Corporation.
c. Hilti, Inc., Kwik-Bolt TZ.
d. Ramset Company, Red Head, Trubolt.

D. **Adhesive Anchors**

1. Provide adhesive cartridge as recommended by the manufacturer for the loading and depth required.
2. Provide Type 316 stainless steel threaded rod, nut, and washer or a reinforcing bar of the size and embedment shown on the drawings and in accordance with ASTM A 615, Grade 60.
3. Subject to compliance with the specifications, provide adhesive cartridges from one of the following approved manufacturers.

a. Simpson, SET Epoxy.
b. Simpson, AT Acrylic Adhesive.
c. Hilti, HIT-HY 200.
d. ITW/Red Head, Ceramic 6 Epoxy.
e. Hilti HIT-RE 500 V3.

E. **Adhesive-Anchored Reinforcing Bar**.

1. Provide adhesive cartridges as recommended by the manufacturer to receive reinforcing bar as noted.
2. Manufacturer/Model. Subject to compliance with the specifications, provide adhesive cartridges from one of the following approved manufacturers.

a. Simpson, SET Epoxy.
b. Simpson, AT Acrylic Adhesive.
c. Hilti HIT-RE 500 V3.
d. ITW/Red Head, Ceramic 6 Epoxy.
e. Hilti HIT-HY 200.

3. Reinforcing Bar. Comply with Section 03 30 00 "Cast-in-Place Concrete."

F. **Powder-Actuated Fasteners**. Do not use powder-actuated fasteners and other types of bolts and fasteners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Examine conditions** under which rods, bolts and anchors are to be installed, and notify the Engineer in writing of unsatisfactory conditions existing. Do not proceed with the work until unsatisfactory conditions or deficiencies have been corrected.

3.2 PREPARATION

A. **Notify the Engineer** prior to the installation of all adhesive anchors.

3.3 INSTALLATION

A. **Do not install** anchor rods, expansion anchors, or adhesive anchors until the item to be anchored and the anchoring device as well as related layout drawings have been accepted.

B. **Drilling and setting equipment** used and installation of expansion anchors and adhesive anchors shall be in accordance with manufacturer's instructions.

C. **Drill holes to depth** and diameter recommended by manufacturer.

D. **Clean all holes** for adhesive anchors in strict accordance with the manufacturer's instructions.

E. **Use the type of anchoring** device shown.

F. **Unless otherwise shown**, conform to following for expansion anchors.

1. Minimum embedment depth in concrete – 5 diameters.
2. Minimum anchor spacing on centers – 10 diameters.
3. Minimum distance to edge of concrete – 5 diameters.
4. Increase dimensions above if required to develop the required anchor load capacity.

G. **Unless otherwise shown**, conform with the manufacturer's recommendations for minimum embedment depth, minimum anchor spacing, and minimum edge distance for adhesive anchors except that minimum embedment depth in concrete shall not be less than 4 inches unless noted otherwise.

H. **Use copper-graphite antiseize** compound for all anchor nuts. Thoroughly lubricate all threaded fasteners with compound prior to assembly. Remove excess lubricant after fastener installation.

3.4 FIELD QUALITY CONTROL

A. **Inspection**. Inspect each installation for compliance with this specification and manufacturer's recommendations.

B. **Testing**. At the discretion of the Owner, adhesive anchors may be subjected to pullout-type testing up to the manufacturer's recommended working load for the anchor. If deficient anchors are found, the Contractor will be required to test all anchors and replace any deficient anchors found at no additional cost to the Owner.

C. **Material Testing**

1. At the discretion of the Owner up to 1 percent or up to three (whichever is greater) of each type and size of bolt, nut, washer, and anchor from each and every separate shipment or purchasing lot that are specified to be Type 316 stainless steel may be destructively tested to verify material requirements.
2. Samples will be randomly selected for this testing and be provided at no additional cost to the Owner.
3. Conduct testing at the Owner's expense.
4. The above testing may be performed at any time during the Contract or warranty period.
5. Any shipment or purchasing lot, installed or not, which fails to meet the requirements of the specifications will be rejected and shall be immediately removed from the job site and replaced with material that meets the specifications.
6. Removal and replacement of noncomplying material shall be at the Contractor's expense.

3.5 CLEANING

A. **After embedding concrete** is placed, remove protection and clean rods, anchors, and inserts.

END OF SECTION

SECTION 05 10 00

STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide the labor, tools, equipment, and materials necessary to furnish and install the structural steel in accordance with the plans and specifications.

B. **Types**. This section includes fabrication and erection of structural steel work, as shown on drawings including schedules, notes, and details showing size and location of members, typical connections, and types of steel required.

1. Structural steel is that work defined in American Institute of Steel Construction (AISC) "Code of Standard Practice" and as otherwise shown.
2. Miscellaneous metal fabrications are specified elsewhere in Division 5.
3. Refer to Division 3 for anchor bolt installation in concrete and Division 4 for anchor bolt installation in masonry.

1.3 QUALITY ASSURANCE

A. **Codes and Regulatory Agencies**. Perform all work to furnish and install the structural steel in compliance with all federal, state, and local codes and regulatory agencies. Comply with provisions of following, except as otherwise indicated:

1. AISC "Code of Standard Practice for Steel Buildings and Bridges."

a. Paragraph 4.2.1 of the above code is hereby modified by deletion of the following sentence:

1) "This approval constitutes the owner's acceptance of all responsibility for the design adequacy of any detail configuration of connections developed by the fabricator as a part of his preparation of these shop drawings."

2. AISC "Specifications for Structural Steel Buildings," including "Commentary."
3. "Specifications for Structural Joints Using American Society for Testing and Materials (ASTM) A 325 or A 490 Bolts" approved by the Research Council on Structural Connections.

4. ASTM A 6 "General Requirements for Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use."

B. **Fabrication shall meet requirements** of the American Institute of Steel Construction (AISC) standards.

C. **Qualifications for Welding Work**. Qualify welding procedures and welding operators in accordance with American Welding Society (AWS) "Qualification" requirements.

1. If recertification of welders is required, retesting will be Contractor's responsibility.

1.4 SUBMITTALS

A. **General**. Submit the following in accordance with Conditions of Contract and Division 1 specification sections.

B. **Product Data**. Product data or manufacturer's specifications and installation instructions for following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).

1. Structural steel primer paint.
2. Shrinkage resistant grout.

C. **Shop drawings prepared under supervision** of a licensed Professional Engineer, including complete details and schedules for fabrication and assembly of structural steel members, procedures, and diagrams.

1. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols and show size, length, and type of each weld.
2. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of other sections.

D. **Test reports conducted on field-bolted** and welded connections. Include data on type(s) of tests conducted and test results.

1.5 JOB CONDITIONS

Not used.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **General.** Deliver materials to site at such intervals to ensure uninterrupted progress of work.

B. **Deliver anchor bolts** and anchorage devices which are to be embedded in cast-in-place concrete or masonry in ample time as not to delay work.

C. **Store materials to permit easy access** for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration. If bolts and nuts become dry or rusty, clean and relubricate before use.

1. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **MATERIALS**

A. **Structural Steel Wide Flange Shapes**. ASTM A 992.

B. **Structural Steel Shapes, Plates, and Bars**. ASTM A 36 unless noted otherwise.

C. **Cold-Formed Steel Tubing**. ASTM A 500, Grade B.

D. **Steel Pipe**. ASTM A 53, Type E or S, Grade B; or ASTM A 501.

1. Finish. Black, except where indicated to be galvanized.

E. **Steel Castings**. ASTM A 27, Grade 65-35, medium-strength carbon steel.

F. **Headed Stud-Type Shear Connectors**. ASTM A 108, Grade 1015 or 1020, cold finished carbon steel with dimensions complying with AISC specifications.

G. **Anchor Bolts and Threaded Rods**. ASTM A F 1554, Grade 36, headed type unless otherwise indicated.

H. **Unfinished Threaded Fasteners**. ASTM A 307, Grade A, regular low-carbon-steel bolts and nuts.

1. Provide hexagonal heads and nuts for all connections.

I. **High-Strength (and Alternate Fastener Design) Threaded Fasteners**. Heavy hexagonal structural bolts, heavy hexagonal nuts, and hardened washers, as follows:

1. Quenched and tempered medium carbon steel bolts, nuts, and washers, complying with ASTM A 325.

a. Where indicated as galvanized, provide units that are zinc coated, either mechanically deposited complying with ASTM B 695, Class 50, or hot dip galvanized complying with ASTM A 153.

J. **Direct Tension Indicators**. ASTM F 959, type as required.

1. Use on all A 325 bolts in connections that are slip critical.

K. **Electrodes for Welding**. Comply with AWS Code.

L. **Structural Steel Primer Paint**. Steel Structures Painting Council (SSPC) - Paint 2 oil alkyd unless specified otherwise in Section 09 90 00 "Painting."

M. **Galvanizing**. Where hot-dip galvanizing or hot zinc coating is noted, it shall be done in accordance with ASTM A 123. See Section 05 05 14 "Galvanizing."

N. **Nonmetallic, Shrinkage Resistant Grout**. Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, portland cement, shrinkage compensating agents, plasticizing, and water-reducing agents, complying with ASTM C 1007.

1. Available Products. Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:

a. Sure Grip Grout; Dayton Superior.
b. Euco N.S.; Euclid Chemical Co.
c. Crystex; L & M Construction Chemicals, Inc.
d. Masterflow 713; Master Builders.
e. Sealtight 588 Grout; W. R. Meadows.
f. Five Star Grout; U.S. Grout Corp.

2.2 FABRICATION

A. **Shop-Fabrication and Assembly**. Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items of structural steel in accordance with AISC specifications and as indicated on final shop drawings. Provide camber in structural members where indicated.

1. Properly mark and match mark materials for field-assembly. Fabricate for delivery sequence that will expedite erection and minimize field-handling of materials.
2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.

B. **Remove all surface blemishes** including rust and scale seam marks, roller marks, rolled trade names, and roughness by grinding, or by welding and grinding, prior to cleaning, treating, and applying surface finishes to steel which is exposed to view.

C. **Anchor Bolts**. Provide anchor bolts where indicated on the drawings.

D. **Connections**. Weld or bolt shop connections, as indicated.

1. Provide high-strength threaded fasteners for all bolted connections, except where unfinished bolts are indicated.
2. Design connections to develop 55 percent of the load capacity of the member as tabulated in the beam tables, Part 2, of the AISC "Manual of Steel Construction" unless reactions or specific details are shown.
3. Connections for bracing shall be designed to develop full strength of bracing members unless forces are shown.

E. **Bolt field connections,** except where welded connections or other connections are indicated.

F. **High-Strength Bolted Construction**. Install high-strength threaded fasteners in accordance with AISC "Specifications for Structural Joints Using ASTM A 325 or A 490 Bolts."

G. **Welded Construction**. Comply with AWS code and appearance requirements specified herein.

H. **Shear Connectors**. Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld shear connectors in field, spaced as shown, to beams and girders in composite construction. Use automatic end welding of headed stud shear connectors in accordance with manufacturer's printed instructions and AWS D1.1 requirements.

I. **Steel Wall Framing**. Select members that are true and straight for fabrication of steel wall framing. Straighten as required to provide uniform, square, and true members in completed wall framing.

J. **Build up welded door frames** attached to structural steel framing. Weld exposed joints continuously and grind smooth. Plug-weld steel bar stops to frames, except where shown removable. Secure removable stops to frames with countersunk, cross recessed-head machine screws, uniformly spaced not more than 10 inches on center (o.c.), unless otherwise indicated.

K. **Holes for Other Work**. Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members.

L. **Provide threaded nuts** welded to framing and other specialty items as indicated to receive other work.

M. **Cut, drill, or punch holes** perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

N. **Expansion Joints**. Provide expansion joints in steel shelf angles when part of structural steel frame; locate at vertical brick expansion joints as indicated on drawings.

2.3 SHOP PAINTING

A. **General**. Shop-paint structural steel, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel that is partially exposed on exposed portions and initial 2 inches of embedded areas only.

1. Do not paint surfaces to be welded or high-strength bolted with friction-type connections.
2. Do not paint surfaces scheduled to receive sprayed-on fireproofing.
3. Apply two coats of paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

B. **Surface Preparation**. After inspection and before shipping, clean steelwork to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Clean steel in accordance with SSPC as follows:

1. SP-6 "Commercial Blast Cleaning," unless specified otherwise in Section 09 90 00 "Painting."

C. **Painting**. If not specified otherwise in Section 09 90 00 "Painting," immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide dry film thickness of not less than 1.5 mils. Use painting methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.4 SOURCE QUALITY CONTROL

A. **General**. Materials and fabrication procedures are subject to inspection and tests in mill, shop, and field, conducted by a qualified inspection agency. Such inspections and tests will not relieve Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

1. Promptly remove and replace materials or fabricated components that do not comply.

B. **Design of Members and Connections**. Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work.

1. Promptly notify Engineer/Architect whenever design of members and connections for any portion of structure are not clearly indicated.
2. For connections not detailed on the plans and unless specific reactions, moments, shears, and axial forces are indicated, provide beam connections designed for the reaction due to the maximum uniform load which the beam can support at the span shown. Use the beam tables in the AISC "Manual of Steel Construction, Allowable Stress Design."

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Surveys**. Employ a licensed Land Surveyor for accurate erection of structural steel. Report discrepancies to Engineer/Architect. Do not proceed with erection until corrections have been made or until compensating adjustments to structural steelwork have been agreed upon.

1. Check elevations of concrete and masonry bearing surfaces and location of anchor bolts and similar devices.
2. Check camber and sweep of structural members and compare to permissible variations in AISC "Manual of Steel Construction."
3. Check levelness and elevations of leveling plates and bearing plates.

B. **Examine all structural steel** and discard all damaged members.

3.2 PREPARATION

A. **Anchor Bolts**. Provide anchors as to not delay work.

1. Provide setting drawings to ensure accurate placement.

B. **Temporary Shoring and Bracing**. Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds and to resist wind and earthquake loads.

C. **Temporary Planking**. Provide temporary planking and working platforms as necessary to effectively complete work.

D. **Setting Bases and Bearing Plates**. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.

1. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.
2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
3. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
4. For proprietary grout materials, comply with manufacturer's instructions.

3.3 ERECTION

A. **General**. Comply with Occupational Safety and Health Administration (OSHA) and state safety requirements.

B. **Field-Assembly**. Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

C. **Straightening of structural steel sections** by heating shall not be permitted unless approved.

D. **Level and plumb individual members** of structure within specified AISC tolerances.

E. **Splice members** only where indicated and accepted on shop drawings.

F. **Erection Bolts**. On exposed welded construction, remove erection bolts, fill holes with plug welds, and grind smooth at exposed surfaces.

1. Comply with AISC specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
2. Do not enlarge unfair holes in members by burning or by using drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

G. **Gas Cutting**. Do not use gas cutting torches in field for correcting fabrication errors in primary structural framing. Cutting will be permitted only on secondary members that are not under stress as acceptable. Finish gas-cut sections equal to a sheared appearance when permitted.

H. **Touch-Up Painting**. Unless otherwise specified in Section 09 90 00 "Painting," immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.

1. Apply by brush or spray to provide minimum dry film thickness of 1.5 mils.

3.4 QUALITY CONTROL

A. **General**. Engage an independent testing and inspection agency to inspect, perform test, and prepare test reports on high-strength bolted connections and welded connections. Welds will be visually inspected and some or all welds will be nondestructively tested.

B. **Testing agency shall conduct** and interpret tests, state in each report whether test specimens comply with requirements, and specifically state any deviations from them.

C. **Provide fabrication schedule** for testing agency so that required inspection and testing can be accomplished.

D. **Provide access for testing agency** to places where structural steelwork is being fabricated or produced and to the construction site so that required inspection and testing can be accomplished.

E. **Testing agency may inspect structural steel** at plant before shipment.

F. **Testing agency will inspect structural steel** at the site.

1. Field-Bolted Connections. Inspect in accordance with Research Council on Structural Connections (RCSC) "Specification for Structural Joints Using A 325 or A 490 Bolts."

    a. For direct tension indicators, comply with requirements of ASTM F 959. Verify that gaps are less than gaps specified in Table 2.

2. Field-Welding. Inspect and test during erection of structural steel in accordance with Section 6 of AWS D1.1.

    a. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in work. Record work required and performed to correct deficiencies.
    b. Perform visual inspection of all welds.
    c. Perform tests on 100 percent of the full and partial penetration welds as follows. Inspection procedures listed are to be used at Contractor's option.

        1) Liquid Penetrant Inspection. ASTM E 165.
        2) Magnetic Particle Inspection. ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not acceptable.
        3) Radiographic Inspection. ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
        4) Ultrasonic Inspection. ASTM E 164.

3. Steel Framing. Inspect and verify compliance with the details shown on the approved Contract Documents.

G. **Correct deficiencies in structural steel work** that independent inspections and laboratory test reports have indicated to be not in compliance with Contract Documents. Perform additional tests, at Contractor's expense, as necessary to reconfirm any noncompliance of original work and to show compliance of corrected work.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. **Drawings and general provisions** of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections and Section 23 05 00 apply to this Section.

1.2 SUMMARY

A. **Section Includes:**

1. Balancing Air Systems:

a. Constant-volume air systems.

1.3 DEFINITIONS

A. **AABC:** Associated Air Balance Council.

B. **NEBB:** National Environmental Balancing Bureau.

C. **TAB:** Testing, adjusting, and balancing.

D. **TABB:** Testing, Adjusting, and Balancing Bureau.

E. **TAB Specialist:** An entity engaged to perform TAB Work.

1.4 SUBMITTALS

A. **Qualification Data:** Within **15** days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. **Contract Documents Examination Report:** Within **15** days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. **Strategies and Procedures Plan:** Within **30** days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. **Certified TAB reports.**

E. **Sample report forms.**

F. **Instrument calibration reports,** to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 **QUALITY ASSURANCE**

A. **TAB Contractor Qualifications:** Engage a TAB entity certified by AABC, NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB or TABB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC, NEBB or TABB as a TAB technician.

B. **Certify TAB field data reports** and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. **TAB Report Forms:** Use standard TAB contractor's forms.

D. **Instrumentation Type, Quantity, Accuracy, and Calibration:** As described in ASHRAE 111, Section 5, "Instrumentation."

PART 2 – PRODUCTS

Not Applicable.

PART 3 – EXECUTION

3.1 **EXAMINATION**

A. **Examine the Contract Documents** to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. **Examine the approved submittals** for HVAC systems and equipment.

C. **Examine design data** including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

D. **Examine equipment performance data** including fan curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

E. **Examine system and equipment installations** and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

F. **Examine test reports specified** in individual system and equipment Sections.

G. **Examine HVAC equipment and filters** and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

H. **Examine operating safety interlocks and controls** on HVAC equipment.

I. **Report deficiencies discovered** before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. **Prepare a TAB plan** that includes strategies and step-by-step procedures.

B. **Complete system-readiness checks** and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Consult with the HVAC contractor to assure that systems are complete and ready for balancing.
5. The TAB contractor shall advise the mechanical contractor where and what to install in order to help with balancing.
6. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. **Perform testing and balancing procedures** on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" or SMACNA “Sheet Metal and Air Conditioning Contractors’ Association” and in this Section.

B. **Take and report testing and balancing** measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. **Prepare test reports** for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. **Check airflow patterns** from the outdoor-air louvers and dampers.

C. **Locate start-stop and disconnect switches,** electrical interlocks, and motor starters.

D. **Verify that motor starters** are equipped with properly sized thermal protection.

E. **Check dampers for proper position** to achieve desired airflow path.

F. **Check for airflow blockages.**

G. **Check for proper sealing** of air-handling-unit components.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. **Adjust fans to deliver total indicated airflows** within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    c. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, and other air-handling and -treating equipment.

    a. Report the cleanliness status of filters and the time static pressures are measured.

4. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

5. Obtain approval from the engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors.

B. **Measure air outlets and inlets** without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

C. **Adjust air outlets and inlets for each space** to indicated airflows within specified tolerances of indicated values.

3.6 PROCEDURES FOR MOTORS

A. **Motors, 1/2 HP and Larger:** Test at final balanced conditions and record the following data:

1. Motor horsepower rating.
2. Motor rpm.
3. Efficiency rating.
4. Manufacturer's name, model number, and serial number.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. **Motors Driven by Variable-Frequency Controllers:** Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.7 TOLERANCES

A. **Set HVAC system's air flow rates** within the following tolerances:

1. Supply and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets: Plus or minus 10 percent.

3.8 FINAL REPORT

A. **General: Prepare a certified written report;** tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. **Final Report Contents:** In addition to certified field-report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. **General Report Data:** In addition to form titles and entries, include the following data:

1. Title page.

2. Name and address of the TAB contractor.

3. Project name.

4. Project location.

5. Architect's name and address.

6. Engineer's name and address.

7. Contractor's name and address.

8. Report date.

9. Signature of TAB supervisor who certifies the report.

10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.

13. Notes to explain why certain final data in the body of reports vary from indicated values.

14. Test conditions for fans performance forms including the following:

    a. Settings for outdoor-air dampers.
    b. Conditions of filters.
    c. Fan drive settings including settings and percentage of maximum pitch diameter.
    d. Other system operating conditions that affect performance.

D. **Air-Handling-Unit Test Reports:** For air-handling units include the following:

1. Unit Data:

   a. Unit identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Unit arrangement and class.
   g. Discharge arrangement.
   h. Number, type, and size of filters.

2. Motor Data:

   a. Motor make, and frame type and size.
   b. Horsepower and rpm.
   c. Volts, phase, and hertz.
   d. Full-load amperage and service factor.

3. Test Data (Indicated and Actual Values):

   a. Total air flow rate in cfm.
   b. Total system static pressure in inches wg.
   c. Fan rpm.
   d. Discharge static pressure in inches wg.
   e. Filter static-pressure differential in inches wg.
   f. Outdoor airflow in cfm.
   g. Outdoor-air damper position.

E. **Gas- and Oil-Fired Heat Apparatus Test Reports:** In addition to manufacturer’s factory startup equipment reports, include the following:

1. Unit Data:

   a. System identification.
   b. Make and type.
   c. Model number and unit size.
   d. Manufacturer's serial number.
   e. Fuel type in input data.
   f. Output capacity in Btu/h.
   g. Ignition type.
   h. Burner-control types.

F. **Fan Test Reports:** For exhaust fans, include the following:

1. Fan Data:

   a. System identification.
   b. Location.

c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.

END OF SECTION

SECTION 23 31 13

METAL DUCTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. **Drawings and general provisions** of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections and Section 23 05 00 apply to this Section.

1.2 SUMMARY

A. **Section Includes:**

1. Single-wall rectangular ducts and fittings.
2. Sheet metal materials.
3. Hangers and supports.

B. **Related Sections:**

4. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.

1.3 QUALITY ASSURANCE

A. **Welding Qualifications:** Qualify procedures and personnel according to the following:

5. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
6. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. **ASHRAE Compliance:** Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

C. **ASHRAE/IESNA Compliance:** Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 – PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. **General Fabrication Requirements:** Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. **Transverse Joints:** Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. **Longitudinal Seams:** Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. **Elbows, Transitions, Offsets, Branch Connections,** and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SHEET METAL MATERIALS

A. **General Material Requirements:** Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

E. **Stainless-Steel Sheets:** Comply with ASTM A 480/A 480M, Type 304, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet.

F. **Reinforcement Shapes and Plates:** ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

2.3 HANGERS AND SUPPORTS

A. **Hanger Rods for Corrosive Environments:** Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

G. **Strap and Rod Sizes:** Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. **Steel Cables for Stainless-Steel Ducts:** Stainless steel complying with ASTM A 492.

H. **Steel Cable End Connections:** Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

B. **Duct Attachments:** Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

I. **Trapeze and Riser Supports:**

1. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

PART 3 – EXECUTION

3.1 DUCT INSTALLATION

J. **Install ducts according to** SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

K. **Install ducts with fewest** possible joints.

L. **Unless otherwise indicated,** install ducts vertically and horizontally, and parallel and perpendicular to building lines.

M. **Install ducts close to walls,** overhead construction, columns, and other structural and permanent enclosure elements of building.

N. **Protect duct interiors from moisture,** construction debris and dust, and other foreign materials.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. **Protect ducts exposed in finished spaces** from being dented, scratched, or damaged.

B. **Grind welds to provide smooth surface** free of burrs, sharp edges, and weld splatter.

C. **Maintain consistency,** symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

D. **Repair or replace damaged sections** and finished work that does not comply with these requirements.

3.3 HANGER AND SUPPORT INSTALLATION

A. **Comply with SMACNA's** "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. **Existing hangers**: Since the scope is to replace existing ductwork the contractor shall replace existing hangers with the same type in the same locations.

3.4 FIELD QUALITY CONTROL

A. **Perform tests and inspections.**

B. **Duct System Cleanliness Tests:**

1. Visually inspect duct system to ensure that no visible contaminants are present.

3.5 **START UP**

A. **Air Balance:** Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.6 **DUCT SCHEDULE**

A. **Fabricate ducts with type 304 stainless steel**:

B. **Intermediate Reinforcement:**

1. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Match duct material.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. **Drawings and general provisions** of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections and Section 23 05 00 apply to this Section.

1.2 SUMMARY

A. **Section Includes:**

1. Flange connectors.
2. Flexible connectors.

1.3 SUBMITTALS

A. **Product Data:** For each type of product indicated.

B. **Operation and Maintenance Data:** For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. **Comply with NFPA 90A,** "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 – PRODUCTS

2.1 MATERIALS

A. **Comply with SMACNA's** "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. **Stainless-Steel Sheets:** Comply with ASTM A 480/A 480M, Type 304 with mill finish.

C. **Reinforcement Shapes and Plates:** Stainless-steel reinforcement where installed on stainless steel ducts.

2.2 **FLANGE CONNECTORS**

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. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. **Description:** Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. **Material:** Match connecting ductwork: Type 304 stainless steel or galvanized steel.

D. **Gage and Shape:** Match connecting ductwork.

2.4 FLEXIBLE CONNECTORS

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. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.

B. **Materials:** Flame-retardant or noncombustible fabrics.

C. **Coatings and Adhesives:** Comply with UL 181, Class 1.

D. **Metal-Edged Connectors:** Factory fabricated with a fabric strip 5-3/4 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.032-inch- thick stainless steel sheets.

E. **High-Corrosive-Environment System,** Flexible Connectors: Glass fabric with chemical-resistant coating.

1. Minimum Weight: 14 oz./sq. yd.
2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

2.9 DUCT ACCESSORY HARDWARE

A. **Instrument Test Holes:** Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. **Adhesives:** High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 – EXECUTION

3.1 INSTALLATION

A. **Install duct accessories according to** applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116.

B. **Install duct accessories of materials** suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. **Install flexible connectors** to connect ducts to equipment.

D. **Install duct test holes** where required for testing and balancing purposes.

END OF SECTION

SECTION 23 34 23

HVAC POWER VENTILATORS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. **Drawings and general provisions** of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections and Section 23 05 00 apply to this Section.

1.2 SUMMARY

A. **Section Includes:**

1. Upblast centrifugal roof exhaust fans.

1.3 PERFORMANCE REQUIREMENTS

A. **Project Altitude:** Base fan-performance ratings on sea level.

B. **Operating Limits:** Classify according to AMCA 99.

1.4 SUBMITTALS

A. **Product Data:** For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Fan starter and speed controllers.

C. **Shop Drawings:** Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

D. **Field quality-control reports.**

E. **Operation and Maintenance Data:** For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 **QUALITY ASSURANCE**

A. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. **AMCA Compliance:** Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

PART 2 – PRODUCTS

2.1 **UPBLAST CENTRIFUGAL ROOF EXHAUST FANS**

A. **Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Acme Engineering & Manufacturing Corporation
2. Aerovent; a division of Twin City Fan Companies, Ltd.
3. American Coolair Corporation
4. Ammerman; Millennium Equipment
5. Cincinnati Fan
6. Greenheck Fan Corporation
7. Hartzell Fan Incorporated
8. JencoFan
9. Loren Cook Company
10. New York Blower Company (The)
11. PennBarry

B. **Wind Band, Fan Housing, and Base**: Reinforced and braced aluminum, containing aluminum butterfly dampers and rain trough, motor and drive assembly, and fan wheel.

1. Damper Rods: Steel with nylon bearings.
2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

C. **Fan Wheel**: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.

1. Pitch Mounting: Manufacture curb for roof slope.
2. Metal Liner: Galvanized steel.

D. **Starter**: Provide with combination starter and dual speed motor control panel.

E. **Capacities and Characteristics**: See schedule on drawings.

2.2 **MOTORS**

A. **Comply with NEMA designation,** temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 26 Sections.

F. **Enclosure Type:** Totally enclosed.

2.3 **SOURCE QUALITY CONTROL**

G. **Certify fan performance ratings,** including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 – EXECUTION

3.1 **INSTALLATION**

A. **Install power ventilators** level and plumb.

B. **Install units with clearances** for service and maintenance.

C. **Label units.**

3.2 **CONNECTIONS**

A. **Ground equipment according to Division 26 Section** "Grounding and Bonding for Electrical Systems."

B. **Connect wiring according to Division 26 Section** "Low-Voltage Electrical Power Conductors and Cables."

3.3 **FIELD QUALITY CONTROL**

A. **Perform tests and inspections.**

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. **Tests and Inspections:**

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Remove and replace malfunctioning units and retest as specified above.

C. **Test and adjust controls and safeties.** Replace damaged and malfunctioning controls and equipment.

D. **Prepare test and inspection reports.**

3.4 **ADJUSTING**

A. **Adjust damper linkages** for proper damper operation.

B. **Adjust belt tension.**

C. **Comply with requirements in Division 23 Section** "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. **Replace fan and motor pulleys** as required to achieve design airflow.

E. **Lubricate bearings.**

END OF SECTION

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. **Drawings and general provisions** of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections and Section 23 05 00 apply to this Section.

1.2 SUMMARY

A. **Section Includes:**

1. Fixed face registers and grilles.

1.3 SUBMITTALS

A. **Product Data:** For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.

2. Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 – PRODUCTS

2.1 REGISTERS AND GRILLES

A. **Fixed Face Register or Grille:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Anemostat Products; a Mestek company.
b. Krueger.
c. McGill.
d. Nailor Industries Inc.
e. Price Industries.
f. Titus.
g. Tuttle & Bailey.

2. Material: See schedule on drawings.

3. Finish: Mill.

2.2 **SOURCE QUALITY CONTROL**

A. **Verification of Performance:** Rate registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 – EXECUTION

3.1 **EXAMINATION**

A. **Examine areas where diffusers, registers, and grilles** are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

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

3.2 **INSTALLATION**

A. **Install registers, and grilles** level and plumb.

B. **Install registers, and grilles** with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 **ADJUSTING**

A. **After installation, adjust registers,** and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 237339

INDOOR, DIRECT GAS-FIRED HEATING AND VENTILATING UNITS

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 direct-fired H&V units.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories.

B. Startup service reports.

C. Operation and Maintenance Data: For direct-fired H&V units to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of direct-fired H&V units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

E. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.5 **COORDINATION**

A. Coordinate with existing size and location of intake louver, ductwork, natural gas piping, electrical service and equipment supports.

PART 2 - PRODUCTS

2.1 **MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AbsolutAire, Inc.
2. Applied Air; Mestek, Inc.
3. Cambridge Engineering, Inc.
4. Engineered Air.
5. Greenheck.
6. Hastings Industries; Division of Eric, Inc.
7. Modine Mfg. Co.; Commercial HVAC&R Division.
8. Rapid Engineering, Inc.
9. Reznor-Thomas & Betts Corporation; Mechanical Products Division.

2.2 **PACKAGED UNITS**

A. Factory-assembled, prewired, self-contained unit consisting of cabinet, supply fan, controls, and direct-fired gas furnace to be installed inside the building.

2.3 **CABINET**

A. Cabinet: Double wall galvanized-steel panels, formed to ensure rigidity and supported by galvanized-steel channels or structural channel supports with lifting lugs.

B. Access Panels: Piano hinged with cam-lock fasteners for furnace and fan motor assemblies on both sides of unit.

C. Internal Insulation: Fibrous-glass duct lining, comply with ASTM C 1071, Type II, applied on furnace and fan sections only.

1. Thickness: 1 inch.
2. Insulation Adhesive: Comply with ASTM C 916, Type I.
3. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to casing without damaging liner when applied as recommended by manufacturer and without causing air leakage.

D. Finish: Heat-resistant, baked enamel.

E. Discharge: Horizontal.

F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

2.4 SUPPLY-AIR FAN

A. Fan Type: Centrifugal, rated according to AMCA 210; statically and dynamically balanced, galvanized steel; mounted on solid-steel shaft with heavy-duty, self-aligning, permanently lubricated ball bearings.

B. Motor: Totally enclosed, single-speed motor.

C. Drive: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly.

2.5 DAMPERS

A. Outdoor-Air Damper: Galvanized-steel, opposed-blade dampers with vinyl blade seals and stainless-steel jamb seals, having a maximum leakage of 10 cfm/sq. ft. of damper area, at differential pressure of 2-inch wg.

B. Damper Operator: Direct coupled, electronic with spring return.

2.6 DIRECT-FIRED GAS FURNACE

A. Description: Factory assembled, piped, and wired; and complying with ANSI Z83.4, "Direct Gas-Fired Make-Up Air Heaters"; ANSI Z83.18, "Direct Gas-Fired Industrial Air Heaters"; and NFPA 54, "National Fuel Gas Code."

B. Inside Unit External Housing: Steel cabinet with integral support inserts.

C. Burners: Cast-iron burner with stainless-steel mixing plates.

1. Control Valve: Modulating with minimum turndown ratio of 25:1.
2. Fuel: Natural gas.
3. Pilot: Electrically ignited by hot-surface ceramic igniter.

D. Safety Controls:

1. Gas Manifold: Safety switches and controls to comply with ANSI standards.
2. Purge-Period Timer: Automatically delays burner ignition and bypasses low-limit control.
3. Airflow Proving Switch: Dual pressure switch senses correct airflow before energizing pilot and requires airflow to be maintained within minimum and maximum pressure settings across burner.
4. Manual-Reset, High-Limit Control Device: Stops burner and closes main gas valve if high-limit temperature is exceeded.

5. Gas Train: Redundant, automatic main gas valves, electric pilot valve, electronic-modulating temperature control valve, main and pilot gas regulators, main and pilot manual shutoff valves, main and pilot pressure taps.
6. Safety Lockout Switch: Locks out ignition sequence if burner fails to light after three tries. Controls are reset manually by turning the unit off and on.

2.7 **CONTROLS**

A. Factory-wired, fuse-protected control transformer, connection for power supply and field-wired unit to remote control panel.

B. Control Panel: Surface-mounted remote panel, with the following lights and switches:
1. Summer-Off-Winter switch.
2. Supply-fan operation indicating light.
3. Heating operation indicating light.
4. Alarm indicating light.
5. Thermostat.

C. Fan Control: Interlock fan to start with exhaust fan. See Division 23 Section "HVAC Power Ventilators" for exhaust fan controls.

D. Temperature Control: Operates gas valve to maintain supply-air or room temperature.
1. Operates gas valve to maintain space temperature with wall-mounting, field-wired sensor and adjustment on remote control panel.

2.9 **CAPACITIES AND CHARACTERISTICS: See schedule on drawing.**

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 installation of direct-fired H&V units.

B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

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

3.2 **INSTALLATION**

A. Install gas-fired units according to NFPA 54.

B. Install controls and equipment shipped by manufacturer for field installation with direct-fired H&V units.

3.3 CONNECTIONS

A. Piping Connections: Drawings indicate general arrangement of piping, fittings, and specialties. Install piping adjacent to machine to allow service and maintenance.

1. Connect to existing natural gas piping.

B. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply duct to direct-fired H&V unit with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Air Duct Accessories."

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Inspect for visible damage to furnace combustion chamber.
2. Inspect casing insulation for integrity, moisture content, and adhesion.
3. Verify that clearances have been provided for servicing.
4. Verify that controls are connected and operable.
5. Purge gas line.
6. Verify bearing lubrication.
7. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
8. Adjust fan belts to proper alignment and tension.
9. Start unit according to manufacturer's written instructions.
10. Complete startup sheets and attach copy with Contractor's startup report.
11. Inspect and record performance of interlocks and protective devices; verify sequences.
12. Operate unit for run-in period recommended by manufacturer.
13. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency:

    a. Measure gas pressure on manifold.
    b. Measure combustion-air temperature at inlet to combustion chamber.
    c. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.

14. Calibrate thermostats.
15. Adjust and inspect high-temperature limits.
16. Inspect dampers, if any, for proper stroke and interlock with return-air dampers.
17. Measure and record airflow. Plot fan volumes on fan curve.
18. Verify operation of remote panel, including pilot-operation and failure modes. Inspect the following:

a. High-limit heat.
b. Alarms.

19. After startup and performance testing, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace malfunctioning components that do not pass tests and inspections and retest as specified above.

D. Prepare written report of the results of startup services.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain direct-fired H&V units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 – GENERAL

1.1 SUMMARY

A. **Section Includes**

1. Basic requirements for electrical systems

B. **Related Sections include** but are not necessarily limited to

1. Section 26 05 19 – Low-Voltage Electrical Conductors and Cables

2. Section 26 05 33 – Raceway and Boxes for Electrical Systems

1.2 QUALITY ASSURANCE

A. **Referenced Standards**

1. Aluminum Association (AA)

2. American Iron and Steel Institute (AISI)

3. ASTM International (ASTM)

   a. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   b. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

4. ETL Testing Laboratories (ETL)

5. Institute of Electrical and Electronics Engineers, Inc./American National Standards Institute (IEEE/ANSI)

   a. C2, National Electrical Safety Code (NESC)

6. National Electrical Manufacturers Association (NEMA)

   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum)

7. National Fire Protection Association (NFPA)

   a. 70, National Electrical Code (NEC)

8. Underwriters Laboratories, Inc. (UL)

B. **Where Underwriters Laboratories, Inc. (UL)** test procedures have been established for the product type, use UL or ETL Testing Laboratories (ETL) approved electrical equipment and provide with the UL or ETL label.

1.3 **DEFINITIONS**

A. **For the purposes of providing materials** and installing electrical work the following definitions shall be used.

1. Outdoor area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.

2. Non-architecturally finished interior area: Pump, chemical, mechanical, electrical rooms and other similar process type rooms.

3. Highly corrosive and corrosive area: Areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater.

4. Hazardous areas: Class I, II or III areas as defined in NFPA 70 (NEC).

5. Shop fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.

1.4 **SUBMITTALS**

A. **Shop Drawings**

1. General requirements

a. Provide manufacturer's technical information on products to be used, including product descriptive bulletin.
b. Include data sheets that include manufacturer's name and product model number.
1) **Clearly identify all optional accessories.**
c. Acknowledge that products are UL or ETL listed or are constructed utilizing UL or ETL recognized components.
d. Include Manufacturer's delivery, storage, handling and installation instructions.
e. Provide product installation details.
f. See individual specification sections for any additional requirements.

B. **Operation and Maintenance Manuals**

1. Project coversheet denoting project name, general contractor company name, system integrator company name, job number, phone number, and website address.

2. Record drawings for wiring diagrams, final bills of material, annotated component cutsheets, and user manuals, denoting the equipment and accessories provided.

3. Warranties: Provide copies of warranties and list of factory authorized service agents.

1.5 **DELIVERY, STORAGE, AND HANDLING**

A. **Protect equipment from weather,** condensation, and physical damage during storage.

B. **Protect nameplates on electrical equipment** to prevent defacing.

1.6 **AREA DESIGNATIONS**

A. **Designation of an area** will determine the NEMA rating of the electrical equipment enclosures, types of conduits and installation methods to be used in that area.

1. Outdoor areas

a. Wet
b. Corrosive
c. Hazardous when specifically designated on the Drawings or in the Specifications

2. Indoor areas

a. Dry when above grade, ventilated, with no exposed wastewater
b. Corrosive when below grade with open exposure to wastewater
c. Hazardous when specifically designated on the Drawings or in the Specifications

PART 2 – PRODUCTS

2.1 **ACCEPTABLE MANUFACTURERS**

A. **Refer to specific Division 26 sections** and specific material paragraphs below.

B. **Provide all components** of a similar type by one (1) manufacturer.

2.2 **MATERIALS**

A. **Electrical Equipment Support Pedestals and/or Racks**

1. Approved manufacturers

a. Modular strut
1) **Unistrut Building Systems**
2) **B-Line**
3) **Globe Strut**

4) **Or equal**

2. Material requirements

a. Modular strut
1) **Stainless steel: AISI Type 304 or 316**
b. Mounting hardware
1) **Stainless steel: AISI Type 304 or 316**

PART 3 – EXECUTION

3.1 INSTALLATION

A. **Install and wire all equipment,** including prepurchased equipment, and perform all tests necessary to assure conformance to the Drawings and Specifications and ensure that equipment is ready and safe for energization.

B. **Install equipment in accordance** with the requirements of

1. NFPA 70 (NEC)

2. IEEE/ANSI C2

3. The manufacturer's instructions

C. **In general, conduit routing** is not shown on the Drawings.

1. The Contractor is responsible for routing all conduits including those shown on one-line and control block diagrams and home runs shown on floor plans.

2. Conduit routings and stub-up locations that are shown are approximate; exact routing to be as required for equipment furnished and field conditions.

D. **When complete branch circuiting** is not shown on the Drawings

1. A homerun indicating panelboard name will be shown adjacent to the additional devices (e.g., light fixture and receptacles) on the same circuit.

2. The Contractor is to furnish and install all conduit and conductors required for proper operation of the circuit.

3. The indicated home run conduit and conductor size shall be used for the entire branch circuit.

4. See Section 26 05 33 for combining multiple branch circuits in a common conduit.

E. **Do not use equipment that exceed** dimensions or reduce clearances indicated on the Drawings or as required by the NFPA 70 (NEC).

F. **Install equipment plumb, square and true** with construction features and securely fastened.

G. **Install electrical equipment,** including pull and junction boxes, minimum of 6 inch from process, gas, air and water piping and equipment.

H. **Install equipment so it is readily accessible** for operation and maintenance, is not blocked or concealed and does not interfere with normal operating and maintenance requirements of other equipment.

I. **Avoid interference of electrical equipment** operation and maintenance with structural members, building features and equipment of other trades.

1. When it is necessary to adjust the intended location of electrical equipment, unless specifically dimensioned or detailed, the Contractor may make adjustments in equipment location with the Engineer's approval.

J. **Provide electrical equipment support system** per the following area designations

1. All areas: Stainless steel or aluminum members with stainless steel hardware

K. **Provide all necessary anchoring devices** and supports rated for the equipment load based on dimensions and weights verified from approved submittals, or as recommended by the manufacturer.

1. Do not cut, or weld to, building structural members.

2. Do not mount safety switches or other equipment to equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.

L. **Provide corrosion resistant spacers** to maintain 1/4 inch separation between metallic equipment and/or metallic equipment supports and mounting surface in wet areas, on below grade walls and on walls of liquid containment or processing areas such as Basins, etc.

M. **Do not place equipment** fabricated from aluminum in direct contact with earth or concrete.

N. **Screen or seal all openings** into equipment mounted outdoors to prevent the entrance of rodents and insects.

O. **Do not use materials** that may cause the walls or roof of a building to discolor or rust.

3.2 FIELD QUALITY CONTROL

A. **Verify exact rough-in location** and dimensions for connection to electrified equipment, provided by others.

B. **Replace equipment and systems** found inoperative or defective and re-test.

C. **Replace nameplates damaged** during installation.

END OF SECTION

SECTION 26 05 04

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 – GENERAL

1.1 CONTRACTOR'S UNDERSTANDING

A. **Contractors bidding word under this Contract** shall read and understand Division Zero and Division 1 – General Requirements. If any discrepancies are discovered between the Basic Electrical Materials and Methods and General Requirements, the above mentioned documents shall overrule this section. The Basic Electrical Materials and Methods are intended as a supplement to the above mentioned documents.

B. **The Contractor shall bid as outlined** in the above mentioned Specifications and shall be governed by any alternates or unit prices called for in the form of the proposal.

C. **Each Contractor bidding on the work included** in these Specifications shall view the building site and carefully examine the contract Drawings and Specifications, so that he/she may fully understand what is to be done, and to document existing conditions.

1.2 SCOPE OF WORK

A. **Work included in this section of the Specifications** shall include the furnishings of all labor, material, tools, approvals, utility connection fees, excavation, backfill, and other equipment necessary to install the electrical system as shown on the Contract Drawings and as specified herein.

B. **It also includes installation and connection** of all electrical utilization equipment included in this contract but furnished by other contractors or suppliers.

C. **It is the general intent that all motors** shall be furnished with the particular object of equipment it drives, except where a new motor is to be provided for an item of existing equipment, then it shall be provided under this Division of the specifications.

D. **The Contractor shall furnish and install** all conduit, wire disconnect switches and miscellaneous material to make all electrical connections to all items of utilization equipment to wiring devices except as otherwise specified.

E. **All devices and items of electrical equipment,** including those shown on the Contract Drawings but not specifically mentioned in the Specifications or those mentioned in the Specifications but not shown on the Contract Drawings, are to be furnished under this section of the specifications. Any such device or item of equipment, if not defined in quality, shall be equal to similar Equipment and/or devices specified herein.

F. **All devices and items of equipment mentioned** in this section of the Specifications whether electrical or not whether furnished under this or other Division of the Specifications shall be installed under this Division of the Specifications, unless specifically indicated otherwise.

G. **Where wiring diagrams are not shown** on the Contract Drawings, they are to be provided by the supplier of the equipment served and such diagrams shall be adhered to except as herein modified.

H. **The following is a list of items that may not be defined clearly** on the Contract Drawings or in other parts of these Specifications. The list is meant to be an aid to the Contractor and is not necessarily a complete list of work to be performed under this Contract: Connect all motors and accessories furnished by equipment suppliers.

1. Furnish, install, and connect all motor controls.

2. Furnish, install, and connect lighting.

3. Furnish, install, and connect power and signal lines to all instrumentation equipment, and accessories.

4. Furnish, install, and connect all electrical conduit, duct and cables.

5. Furnish, install, and connect all power distribution equipment.

I. **All raceways and wiring shall be firestopped** where required by code and/or indicated in the Contract Drawings.

1.3 SHOP DRAWINGS, DESCRIPTIVE LITERATURE, INSTALLATION, OPERATION AND MAINTENANCE INFORMATION

A. **Shop Drawings including descriptive literature** and/or installation, operation and maintenance instructions shall be submitted in accordance with Division 1.

B. **Shop Drawings shall be submitted** on the following materials specified in Division.

1. Conduit.

2. Boxes – all types and sizes.

3. Wiring devices.

4. Device plates.

5. Metal framing system (Strut type channel).

6. Conduit fittings, expansion joints, support hardware.

7. Motor control equipment.

8. Power distribution equipment.

9. Adjustable speed equipment and accessories.

10. Miscellaneous spare parts and hardware.

11. Wire.

12. Light fixtures.

13. Wire markers, signs and labels.

14. Lightning/transient suppressors.

15. Motors.

16. Transformers.

C. **The Engineers reserves the right to make modifications** to motor control and power distribution equipment ratings after Shop Drawings review, if the Shop Drawings are submitted prematurely (prematurely meaning submitted before all utilization equipment has been reviewed and accepted). Cost of modifications shall be the Contractor's responsibility.

1.4 SYMBOLS AND ABBREVIATIONS

A. **The symbols and abbreviations general follow** stand electrical and architectural practice, however, exceptions to this shall be as shown on the Contract Drawings.

1.5 COORDINATION WITH OTHER TRADES

A. **The Contractor shall coordinate the electrical work** with that of other trades to ensure proper final location of all electrical and/or connections. The Contractor shall verify door swings to see that light switches are located properly.

1.6 CODES

A. **The minimum standard for all work** shall be the latest revision of the Kentucky Building code (KBC), Uniform Building Code (UBC) and the National Electrical Code (NEC). Whenever and wherever state and/or local laws or ordinances and /or regulations and /or the Engineer's design require a higher standard that the current NEC or KBC, then these laws and/or regulations and/or the design shall be followed.

B. **Following is a list of other applicable Standards or Codes:**

1. Uniform Building Code UBC

2. Kentucky Building Code KBC

3. National Electrical Code NEC

4.	Factory Mutual System	FM
5.	National Fire Protection Association	NFPA
6.	National Electrical Manufacturers Association	NEMA
7.	Occupational Safety and Health Administration	OSHA
8.	Insulated Cable Engineers Association, Inc.	ICEA
9.	Illuminating Engineering Society of North America	IES
10.	Instrument Society of America	ISA
11.	Institute of Electrical and Electronic Engineers, Inc.	IEEE
12.	Certified Ballast Manufacturers Association	CMB
13.	American National Standards Institution, Inc.	ANSI
14.	Anti-Friction Bearing Manufacturers Association, Inc.	AFBMA
15.	Joint Industry Council	JIC
16.	American Society of Heating, Refrigerating And Air Conditioning Engineers, Inc.	ASHRAE
17.	Federal Communications Commission	FCC
18.	American Society for Testing and Materials	ASTM
19.	American Wood Preservers Association	AWPA
20.	Rural Electrification Association	REA
21.	MSD Instrumentation and Controls Guidelines	

1.7 INSPECTIONS AND PERMITS

A. **Inspection of the electrical system** on all construction projects is required. If the local government has appointed a state licensed inspector, the Contractor shall be required to use that person to perform the inspections. If a locally mandated inspector does not exist, the Contractor shall select and hire a state licensed inspector, who has jurisdiction before any work is concealed. The Contractor shall notify the electrical inspector in writing, immediately upon notice to proceed, and a copy of the notice shall be submitted to the Engineers.

B. **At the time of completion of the project,** there shall be furnished to the Owner a certificate of compliance, from the agency having jurisdiction pursuant to all electrical work performed. The Engineer shall also receive a Photostatic copy.

C. **All costs incurred by the Contractor** to execute the above mentioned requirements shall be paid by the Contractor at no extra cost to Owner.

D. **All permits necessary for the complete electrical system** shall be obtained by the Contractor from the authorities governing such work. For further information, see Division 1.

1.8 **STORAGE**

A. **All work, equipment and materials** shall be protected against dirt, water, or other injury during the period of construction.

B. **Sensitive electrical equipment** such as light fixtures, motor starters, controls, and panel boards, delivered to job site, shall be protected against injury or corrosion due to atmospheric conditions or physical damage by other means. Protection is interpreted to mean that equipment shall be stored under roof, in a structure properly heated in cold weather and ventilated in hot weather. Provision shall be made to control the humidity in the storage area to 50 percent relative. The stored equipment shall be inspected periodically, and if it is found that the protection is inadequate, further protective measures shall be employed. Electrical equipment other than boxes and conduit shall not be installed until the structure is under roof with doors and windows installed.

C. **No light fixtures or device plates** shall be hung or installed until after painting is completed; however, temporary lighting shall be provided by the Contractor.

D. **The Contractor shall not store** submersible pump units in the wet well. If it is absolutely necessary to do so, the open power cable ends are to be suspended above the maximum flood elevation or maximum expected water level. If not stored in this manner, the Contractor may be called upon to replace the pump motors and cables with new units to ensure that water has not penetrated the cable and entered the motor housing.

1.9 **MATERIALS**

A. **All materials used shall be new and at least meet the minimum standards** as established by the NEC and/or National Electrical Manufacturers Association (NEMA). All materials shall be UL listed for the application, where a listing exists. Additional requirements are found in Division 1. All equipment shall meet applicable FCC requirements and restrictions.

B. **The material and equipment described herein** has been specified according to a particular trade name or make to set quality standards. However, each Contractor has the right to substitute other material and equipment in lieu of that specified, other than those specifically mentioned at matching or for standardization, providing such material and equipment meets all of the requirements of those specified and is accepted, in writing by the Engineer.

C. **The reuse of salvaged electrical equipment and/or wiring** will not be permitted unless specified herein or indicated on the Contract Drawings.

D. **All salvaged or abandoned electrical materials** shall become the property of the Contractor and shall be removed from the job site upon completion of the project, unless otherwise noted on the Contract Drawings or specified herein.

1.10 **ERRORS, CORRECTIONS, AND/OR OMISSIONS**

A. **Should a piece of utilization equipment be supplied** of a different size or horsepower than shown on the Contract Drawings, the Contractor shall be responsible for installing the proper size wiring, conduit, starters, circuit breakers, etc., for proper operation of that unit and the complete electrical system at no extra cost to the Owner.

B. **It is the intent of these Specifications** to provide for an electrical system installation complete in every respect, to operate in the manner and under conditions as shown in these Specifications and on the Contract Drawings. The Contractor shall notify the Engineer, in writing, of any omission or error at least 10 days prior to opening of bids. In the event of the Contractor's failure to give such notice, he/she may be required to correct work and/or furnish items omitted without additional cost. Further requirements on this subject may be found in the General Requirements, Division 1.

C. **Necessary changes or revisions in electrical work** to meet any code or power company requirement shall be made by the Contractor without additional charge.

1.11 **GUARANTEES AND WARRANTIES**

A. **The Contractor shall guarantee all work** including materials and workmanship. This guarantee shall be against all defects of any of the above and shall run for a period of 1 year from the date of Final Completion, concurrent with the one year guarantee period designated for the general construction contract under which electrical work is performed. Date of acceptance shall be considered to be the date on which all "punch list" items are completed ("punch list" is defined to be the written listing of work that is incomplete or deficient that must be finished or replaced/repaired before the Contractor receives final payment).

B. **The Contractor shall guarantee all equipment**. This guarantee shall be against all defects of any of the above and shall run for a period of 1 year from the date of Substantial Completion.

C. **Repair and maintenance for the guarantee period** is the responsibility of the Contractor and shall include all repairs and maintenance other than that which is considered as routine.

1.12 **TESTING**

A. **After the wiring system is complete,** and at such time as the Engineer may direct, the Contractor shall conduct an operating test for acceptance. The equipment shall be demonstrated to operate in accordance with the requirements of these Specifications and the Contract Drawings. The test shall be performed in the presence of the Engineer or his authorized representative. The Contractor

shall furnish all instruments and personnel required for the tests, as well as the necessary electrical power.

B. **Before energizing the system, the Contractor** shall check all connections and set all relays and instruments for proper operation. He shall obtain all necessary clearances, approvals, and instructions from the serving utility company and/or equipment manufacturers prior to placing power on the equipment.

C. **Tests may be performed by the Engineer** to determine integrity of insulation on wiring circuits selected by the Engineer at random.

D. **Cost of utilities for testing done** prior to beneficial occupancy by the Owner shall be borne by the Contractor.

1.13 **CLEANUP**

A. **Cleanup shall be completed as soon as possible** after the electrical installation is complete. All light fixtures, outlets, switches, starters, disconnect switches and other electrical equipment shall be free of shipping tags, stickers, etc. All painted equipment shall be left free of scratches or other blemishes, such as splattered or blistered paint, etc. All light fixture diffusers shall be clean and the interior of all motor controls, etc., shall be free of dust, dirt, wire strippings, etc. Surplus material, rubbish and equipment resulting from the work shall be removed from the job site by the Contractor upon completion of the work.

B. **During construction, cover all Owner equipment and furnishings** subject to mechanical damage or contamination in any way.

1.14 **CUTTING AND PATCHING**

A. **Cutting and patching shall be held to an absolute minimum** and such work shall be done only under the direction of the Engineer or Owner. The Contractor shall be responsible for and shall pay for all openings that may be required in the floors or walls, and he shall be responsible for putting said surfaces back in their original condition. Every attempt shall be made to avoid cutting reinforcing steel bars when an opening is required in a reinforced concrete wall or floor slab.

1.15 **EXCAVATION AND BACKFILL**

A. **Excavation**

Excavation for conduits shall be of sufficient width to allow for proper jointing and alignment of the type conduit used. Conduit shall be bedded on original ground. Where conduit is in solid rock, a 6 inch earth cushion must be provided. Conduit shall be laid in straight lines between pull boxes and/or structures unless otherwise notes on the Contract Drawings. The cost of solid rock excavation shall be included in the lump sum bid with no extra pay allowed (unclassified).

B. **Backfill**

Backfill shall be hand placed, loose granular earth for a height of 6 inches above the top of the largest conduit. This material shall be free of rocks over 2 inches

in diameter. Above this, large rocks may be included but must be mixed with sufficient earth to fill all voids.

1.16 **SLEEVES, CHASES AND OPENING**

A. **It is the Contractor's responsibility** to leave openings to allow installation of the complete, operational electrical system. Openings required but not left shall be cut as outlined under cutting and patching. The Contractor shall coordinate all holes and other openings with necessary diameters for proper fire stopping.

1.17 **POWER COMPANY COORDINATION**

A. **The Contractor is responsible for coordinating all activities** onsite by the power company. It is the Contractor's responsibility to contact the power company to schedule service installation and/or modifications.

B. **All power company metering equipment** shall be electrically located "upstream" of any automatic transfer equipment on projects requiring onsite emergency power generation equipment.

C. **Any special provisions required by the serving electrical utility** shall be as outlined on the Contract Drawings or as advised by the utility at the time of construction, and work required by these special provisions shall be executed with no extra cost to the Owner.

1.18 **TEMPORARY ELECTRICAL POWER**

A. **The Contractor shall be responsible for** providing temporary electrical power as required during the course of construction and shall remove the temporary service equipment when no longer required. Temporary power is also addressed in Division1.

1.19 **OVERCURRENT PROTECTION**

A. **Circuit breakers or fused switches** shall be the size and type as written herein and shown on the Contract Drawings. Any additional overcurrent protection required to maintain an equipment listing by an authority having jurisdiction shall be installed by the Contractor at no extra cost to the Owner.

B. **The Contractor shall submit to the Engineer** actual nameplate data from motors shipped to the site, stating motor identification as well as characteristics. Overload relay thermal unit selection tables shall accompany the motor data. The Engineer will select thermal unit sizes from this data for use by the Contractor in ordering proper thermal units.

1.20 **AS BUILT DRAWINGS**

A. **The Contractor shall maintain 1 set of the Contract Drawings** on the job in good condition for examination at all times. The Contractor's qualified representative shall enter upon these drawings, from day to day, the actual "as-built" record of construction and/or alteration progress. Entries and notes shall be made in a neat and legible manner and these drawings delivered to the

Engineer after completion of the construction, for use in preparation of Record Drawings.

1.21 **MAINTAINING CONTINUOUS ELECTRICAL SYSTEM AND SERVICE**

A. **When additions and taps to existing service(s) require** electrical outages of duration in excess of a few minutes, arrangements shall be made in advance for such outages. All outages shall be held to an acceptable minimum with none exceeding 8 hours continuous duration. If necessary, cuts shall be performed on premium time. If performed at night, requiring a general outage, the Contractor shall furnish an auxiliary source of light and power as required. Under no circumstances shall an electrical outage of any duration be initiated until the Owner and Engineer have concurred, and as far as possible in advance.

1.22 **GROUNDING AND BONDING**

A. **All metallic conduit, cabinets, equipment, and service** shall be grounded in accordance with the latest issue of the National Electrical Code. All supporting framework and other metal or metal clad equipment or materials which are in contact with electrical conduit, cable and/or enclosures shall be properly grounded to meet the code requirements.

1.23 **RELATED SPECIFICATION DIVISIONS**

A. **Additional Specification divisions contain Specifications** on utilization equipment, equipment accessories, and procedures related to execution of the electrical work, and are included here for the Contractor's information. Bids shall still be based on complete Contract Documents.

1.24 **CONTRACTOR LICENSING**

A. **The Contractor performing the electrical work** on this project shall be locally licensed, if required by local law or ordinance. If the Contractor has passed the State test, it may not be necessary to meet local testing requirements. It shall be the Contractor's responsibility to investigate these requirements and comply with same.

1.25 **ANCHORING/MOUNTING**

A. **Electrical conduits and/or equipment** shall be rigidly supported. Anchors used shall be metallic expansion type, or if appropriate to prevent spalling concrete, epoxy set type. Plastic or explosive type anchors are prohibited.

B. **Since this project is in Seismic Zone,** the Contractor shall be sure that all supports are consistent with the KBC requirements in this regard.

1.26 **ELECTRICAL COMPONENT MOUNTING HEIGHTS**

A. **Unless otherwise indicated, mounting height for components** shall be as defined herein. In cases of conflicts with architectural or structural aspects, the components may be relocated. If an indicated height conflicts with a code requirement, the code shall govern.

B. **Mounting heights are given** from finished floor elevation to the centerline of the component, unless otherwise noted.

	Component	Height	Comments
1.	Wall type light switch	4'-0"	To top of box
2.	Low wall outlet	16"	To bottom
3.	High wall outlet or fixture	7'-0"	
4.	Push-button or control stations	4'-0"	
5.	Top of panel boards or control panels	6'-6"	Maximum (except for handicapped areas)
6.	Top of local motor controller	6’-0”	Maximum
7.	Top of switch handle on VFD cabinet	6'-6"	Maximum
8.	Top of local disconnect switch	6'-0"	Maximum
9.	Wall mount exterior light fixtures	8'-0"	
10.	Wall thermostats	4'-0"	To top of thermostat

C. **In situations where there appears to be a conflict** with Americans with Disabilities Act (ADA) legislation, utilize the ADA requirements herein.

1.27 **RECEIPTS**

A. **Some sections of the Specifications** call for equipment, materials, accessories, etc. to be provided and “turned over to the Owner” or like requirements. The Contractor shall obtain a receipt for each item turned over, signed by the Owner or his representative. A copy of this receipt shall be transmitted to the Engineer.

B. **When a question arises concerning** whether items have been turned over to the Owner, and there is no signed receipt, it may be assumed that the items were not provided.

PART 2 – PRODUCTS

Not Applicable.

PART 3 – EXECUTION

Not Applicable.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL CONDUCTORS AND CABLES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes

1. Material and installation requirements for

    a. Building wire
    b. Power cable
    c. Control cable
    d. Instrumentation cable
    e. Communication cable
    f. Wire connectors
    g. Insulating tape
    h. Pulling lubricant
    i. Wire labels

B. **Related Sections include** but are not necessarily limited to

1. Section 26 05 00 – Common Work Results for Electrical

1.2 QUALITY ASSURANCE

A. Referenced Standards

1. Canadian Standards Association (CSA)

    a. Test Methods for Electrical Wires and Cables

2. Institute of Electrical and Electronics Engineers, Inc./American National Standards Institute (IEEE/ANSI)

3. National Electrical Manufacturers Association (NEMA)

    a. ICS 4, Industrial Control and Systems: Terminal Blocks

4. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA)

    a. WC 57/S-73-532, Standard for Control Cables
    b. WC 70/S-95-658, Non-Shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy

5. National Fire Protection Association (NFPA)

    a. 70, National Electrical Code (NEC)

6. Underwriters Laboratories, Inc. (UL)

   a. 44, Standard for Safety Thermoset-Insulated Wires and Cables
   b. 83, Standard for Safety Thermoplastic-Insulated Wires and Cables
   c. 467, Standard for Safety Grounding and Bonding Equipment
   d. 486A, Standard for Safety Wire Connectors and Soldering Lugs for use with Copper Conductors
   e. 486C, Standard for Safety Splicing Wire Connections
   f. 510, Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
   g. 1277, Standard for Safety Electrical Power and Control Tray Cables with Optional Optical-Fiber Members
   h. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords

1.3 DEFINITIONS

A. **Cable: Multi-conductor, insulated,** with outer sheath containing either building wire or instrumentation wire

B. **Instrumentation Cable**

1. Multiple conductor, insulated, twisted, with outer sheath.

2. The following are specific types of instrumentation cables

   a. Analog signal cable
      1) **Used for the transmission of low current (e.g., 4-20mA DC) or low voltage (e.g., 0-10 Vdc) signals, using No. 18 AWG and smaller conductors**
      2) **Commonly used types are defined in the following**
         a) **STP: Twisted shielded pair**

C. **Digital Signal Communication Cable**

1. Multiple conductor cable used for the transmission of digital signals between computers, PLC's, RTU's, etc.

1.4 SUBMITTALS

A. **Shop Drawings**

1. Product technical data

   a. Provide submittal data for all products specified in Part 2 of this specification except:
      1) **Wire connectors**
      2) **Insulating tape**
      3) **Cable lubricant**

b. See Section 26 05 00 – Common Work Results for Electrical, for additional requirements.

1.5 **DELIVERY, STORAGE, AND HANDLING**

A. **See Section 26 05 00 –** Common Work Results for Electrical.

PART 2 – PRODUCTS

2.1 **ACCEPTABLE MANUFACTURERS**

A. **Subject to compliance with** the Contract Documents, the following manufacturers are acceptable

1. Building wire, power and control cable and multiplex cable

a. American Insulated Wire Corporation
b. General Cable
c. Manhattan/CDT
d. Southwire Company
e. Or equal

2. Instrumentation cable

a. Analog cable
1) **Alpha Wire Corporation**
2) **American Insulated Wire Corporation**
3) **Belden CDT Inc.**
4) **General Cable**
5) **Manhattan/CDT**
6) **Or equal**

3. Digital Signal Communication Cable

a. Category 6a cable
1) **Belden Inc.**
2) **Or equal**

4. Wire connectors

a. Burndy Corporation
b. Buchanan
c. Ideal
d. Ilsco
e. 3M Co.
f. Teledyne Penn Union
g. Thomas and Betts
h. Or equal

5. Insulating and color coding tape

    a. 3M Co.
    b. Plymouth Bishop Tapes
    c. Red Seal Electric Co.

6. Wire labels

    a. Brady Durasleeve wire marking inserts and wire carriers, no exceptions

2.2 MANUFACTURED UNITS

A. Building Wire

1. Conductor shall be copper with 600 V rated insulation.

2. Conductors shall be stranded.

3. Include surface mark with manufacturers name or trademark, conductor size, insulation type and UL label.

4. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 for type THHN/THWN and THHN/THWN-2 insulation.

B. Electrical Equipment Control Wire

1. Conductor shall be copper with 600 V rated insulation.

2. Conductors shall be stranded.

3. Include surface mark with manufacturers name or trademark, conductor size, insulation type and UL label.

4. Conform to UL 44 for Type SIS insulation.

5. Conform to UL 83 for Type MTW insulation.

C. Instrumentation Cable

1. Include surface mark with manufacturers name or trademark, conductor size, insulation type and UL label.

2. Analog cable

    a. Tinned stranded, copper conductors
    b. 600 V Type TCER PVC insulation with PVC jacket
    c. Twisted with 100 percent foil shield coverage with drain wire
    d. Six (6) twists per foot minimum
    e. Individual conductor color coding: ICEA Method 1, Table K-2
    f. Conform to IEEE/ANSI 1202 or CSA FT-4 or NFPA 262,} UL 2250, UL 1581 and NFPA 70 Type ITC

3. Digital cable

    a. As recommended by equipment (e.g., PLC, RTU) manufacturer
    b. Conform to IEEE/ANSI 1202 or CSA FT-4

D. **Digital Signal Communication Cable**

1. TIA/EIA-568-B.2 Category 6a

2. 4 twisted pairs

3. Indoor/Outdoor applications

4. Heavy duty PVC jacket sequentially marked at 2-foot intervals

5. Polyolefin conductor insulation

6. #24AWG copper conductors

7. RJ-45 compatible

E. **Wire Connectors**

1. Twist/screw on type

    a. Insulated pressure or spring type solderless connector
    b. 600 V rated
    c. Ground conductors: Conform to UL 486C and/or UL 467 when required by local codes
    d. Phase and neutral conductors: Conform to UL 486C

2. Compression and mechanical screw type

    a. 600 V rated
    b. Ground conductors: Conform to UL 467
    c. Phase and neutral conductors: Conform to UL 486A

3. Terminal block type

    a. High density, screw-post barrier-type with white center marker strip
    b. 600 V and ampere rating as required, for power circuits
    c. 600 V, 20 ampere rated for control circuits
    d. 300 V, 15 ampere rated for instrumentation circuits
    e. Conform to NEMA ICS 4 and UL 486A

F. **Insulating and Color Coding Tape**

1. Pressure sensitive vinyl

2. Premium grade

3. Heat, cold, moisture, and sunlight resistant

4. Thickness, depending on use conditions: 7, 8.5, or 10 mil.

5. For cold weather or outdoor location, tape must also be all-weather.

6. Color

   a. Insulating tape: Black
   b. Color coding tape: Fade-resistant color as specified herein

7. Comply with UL 510

G. **Pulling Lubricant:** Cable manufacturer's standard containing no petroleum or other products which will deteriorate insulation

PART 3 – EXECUTION

3.1 INSTALLATION

A. General

1. Conductors shall be continuous from outlet to outlet and no splices shall be made except at terminal strips or power distribution blocks, or specifically indicated on Drawings.

2. Conductors shall be pulled into raceways in strict accordance with manufacturer’s recommendations.

3. Ample slack conductors shall be allowed at each terminal point, and pull or junction box, to permit installation with ease and without crowding.

4. All conductors terminating at terminal blocks shall be identified with numbers and/or letters identical to circuit or control identification.

5. No conductors shall be drawn into conduits until all work which may cause wire or cable damage is completed. Wire pulling shall be accomplished utilizing machinery and accessories intended for the purpose.

6. All connections and splices shall be made in accordance with conductor manufacturer’s recommendations, and as written herein.

7. In general, feeder sizes shown are based on no more than three current carrying conductors in a conduit. Multiple small branch circuit feeders may be combined in a common conduit, provided conductors are derated in accordance with NEC article 310-15.

8. Unless otherwise specifically indicated, neutrals may not be shared.

B. **Permitted Usage of Insulation Types**

1. Type THHN/THWN and THHN/THWN-2

   a. Building wire and power and control cable in architectural and non-architectural finished areas

2. Type SIS and MTW

   a. For the wiring of control equipment within control panels and field wiring of control equipment within switchgear, switchboards, motor control centers

C. **Conductor Size Limitations**

1. Minimum conductor size shall be AWG number 12 except branch circuits in excess of 75 feet from panel to first outlet not smaller than no. 10 AWG. Minimum voltage rating shall be 600 volts. Conductors for small power may be solid (i.e. lighting, receptacles), but conductors for control work shall be stranded.

2. Conductors with high temperature rated insulations and special construction shall be used where required in connecting to light fixtures or appliances that have special requirements.

3. Control conductors shall not be smaller than No. 14 AWG unless otherwise indicated on the Drawings.

4. Instrumentation conductors shall not be smaller than No. 18 AWG unless otherwise indicated on the Drawings.

D. **Color Code All Wiring as Follows**

1. Building wire

	240 V, 208 V, 240/120 V, 208/120 V
Phase 1	Black
Phase 2	Red *
Phase 3	Blue
Neutral	White
Ground	Green

* Orange when it is a high leg of a 120/240 V Delta system.

   a. Conductors No. 6 AWG and smaller: Insulated phase, neutral and ground conductors shall be identified by a continuous colored outer finish along its entire length.

b. Conductors larger than No. 6 AWG
   1) **Insulated phase and neutral conductors shall be identified by one (1) of the following methods**
      a) Continuous colored outer finish along its entire length
      b) 3 inch of colored tape applied at the termination
   2) **Insulated grounding conductor shall be identified by one (1) of the following methods**
      a) Continuous green outer finish along its entire length
      b) Stripping the insulation from the entire exposed length
      c) Using green tape to cover the entire exposed length
   3) **The color coding shall be applied at all accessible locations, including but not limited to: Junction and pull boxes, wireways, manholes and handholes.**

E. **Install all wiring in raceway** unless otherwise indicated on the Drawings.

F. **Feeder, branch, control and instrumentation circuits** shall not be combined in a raceway, junction or pull box, except as permitted in the following

1. Where specifically indicated on the Drawings

2. Where field conditions dictate and written permission is obtained from the Engineer

3. Control circuits shall be isolated from feeder and branch power and instrumentation circuits but combining of control circuits is permitted.

   a. The combinations shall comply with the following
      1) **12 Vdc, 24 Vdc and 48 Vdc may be combined**
      2) **125 Vdc shall be isolated from all other AC and DC circuits**
      3) **AC control circuits shall be isolated from all DC circuits**

4. Instrumentation circuits shall be isolated from feeder and branch power and control circuits but combining of instrumentation circuits is permitted.

   a. The combinations shall comply with the following
      1) **Analog signal circuits may be combined.**
      2) **Discrete circuits < 30VDC may be combined and combined with analog circuits.**
      3) **120VAC discrete circuits may be combined.**
      4) **120VAC discrete circuits may not be combined with DC or analog instrumentation circuits of any kind.**

5. Multiple branch circuits for lighting, receptacle and other 120 Vac circuits are allowed to be combined into a common raceway.

    a. Contractor is responsible for making the required adjustments in conductor and raceway size, in accordance with all requirements of the NEC, including but not limited to
        1) **Up sizing conductor size for required ampacity de-ratings for the number of current carrying conductors in the raceway**
        2) **The neutral conductor may be shared on sequential circuits (e.g., circuit numbers 1,3,5)**
        3) **Up sizing raceway size for the size and quantity of conductors**

G. **Ground the drain wire** of shielded instrumentation cables at one (1) end only.

1. The preferred grounding location is at the load (e.g., control panel), not at the source (e.g., field mounted instrument).

H. **Splices and terminations** for the following circuit types shall be made in the indicated enclosure type using the indicated method.

1. Feeder and branch power circuits

    a. Motor terminal boxes:
        1) **Twist/screw on type connectors for use on No. 10 AWG and smaller wire**
        2) **Mechanical screw type connectors for use on No. 8 AWG and larger wire**
    b. Motor controllers: Mechanical lugs provided at the motor controller enclosure
    c. Receptacle and lighting circuits: Twist/screw-on wiring connectors at fixture ballasts and device boxes only, power blocks and terminal blocks elsewhere

2. Control circuits

    a. Junction and pull boxes: Terminal block type connector
    b. Control panels and motor control centers: Terminal block or strips provided within the equipment or field installed within the equipment by the Contractor

3. Instrumentation circuits may be spliced with written permission from the Engineer.

    a. Maintain electrical continuity of the shield when splicing twisted shielded conductors.
    b. Junction and pull boxes: Terminal block type connector
    c. Control panels and motor control centers: Terminal block or strip provided within the equipment or field installed within the equipment by the Contractor

I. **Insulating Tape Usage**

1. For insulating connections of No. 8 AWG wire and smaller: 7 mil vinyl tape

2. For insulating splices and taps of No. 6 AWG wire or larger: 10 mil vinyl tape

3. For insulating connections made in cold weather or in outdoor locations: 8.5 mil, all weather vinyl tape

J. **Color Coding Tape Usage**: For color coding of conductors

3.2 FIELD QUALITY CONTROL

A. **Acceptance Testing**

1. See Section 26 01 26 – Testing of Electrical Systems

B. **Testing Agency: The Contractor shall engage** a qualified testing agency to perform tests and inspections and prepare tests reports.

C. **Perform tests and inspections** and prepare test reports.

D. **Test and Inspections**

1. After installing conductors and cables and before electrical circuitry has been energized, test all new feeders and control wiring for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Infrared Scanning: After substantial completion, but not more than 60 days after final acceptance, perform an infrared scan of each splice in cables and conductors #3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

E. **Test Reports: Prepare a written** report record the following:

1. Test procedures used.

2. Test results that comply with requirements.

3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

F. **Remove and replace wiring and/or splices** that do not meet the NETA criteria for the given circuit type and retest as specified above.

END OF SECTION

SECTION 26 05 29

SUPPORTING DEVICES

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. **All electric equipment** shall be rigidly mounted, and installed using supporting devices as indicated on the Contract Drawings, as required by the work, and described herein.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. **"Cooper B-Line" or "Unistrut."**

2.2 MATERIALS

A. **All mounting brackets and strut used** shall be stainless steel. Fasteners used to mount equipment outside shall be stainless steel.

B. **Fasteners used inside to mount equipment** into concrete shall also be stainless steel.

PART 3 – EXECUTION

3.1 ANCHORING CABINETRY

A. **All free standing equipment** shall be anchored to its foundation using expansion bolts of the size and number recommended by the equipment manufacturer.

3.2 SEISMIC CONSIDERATIONS

A. **Where required, seismic restraints** shall be provided for electrical equipment.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

A. **Section Includes**

1. Material and installation requirements for

a. Conduits
b. Conduit fittings
c. Conduit supports
d. Wireways
e. Outlet boxes
f. Pull and junction boxes

B. **Related Specification Sections** include but are not necessarily limited to

1. Section 26 05 00 – Common Work Results for Electrical

1.2 QUALITY ASSURANCE

A. **Referenced Standards**

1. American Iron and Steel Institute (AISI)

2. ASTM International (ASTM)

a. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
b. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
c. D2564, Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems

3. National Electrical Manufacturers Association (NEMA)

a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum)
b. OS 1, Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
c. RN 1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
d. TC 2, Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80)
e. TC 3, PVC Fittings for Use with Rigid PVC Conduit and Tubing

4. National Electrical Manufacturers Association/American National Standards Institute

5. (NEMA/ANSI)

   a. C80.1, Rigid Steel Conduit - Zinc-Coated
   b. C80.3, Electrical Metallic Tubing
   c. C80.5, Rigid aluminum conduit

6. National Fire Protection Association (NFPA)

   a. 70, National Electrical Code (NEC)

7. Underwriters Laboratories, Inc. (UL)

   a. 1, Standard for Safety Flexible Metal Conduit
   b. 6, Standard for Safety Rigid Metal Conduit
   c. 50, Standard for Safety Enclosures for Electrical Equipment
   d. 360, Standard for Safety Liquid-Tight Flexible Steel Conduit
   e. 467, Standard for Safety Grounding and Bonding Equipment
   f. 514A, Standard for Safety Metallic Outlet Boxes
   g. 514B, Standard for Safety Fittings for Cable and Conduit
   h. 651, Standard for Safety Schedule 40 and 80 Rigid PVC Conduit
   i. 870, Standard for Safety Wireways, Auxiliary Gutters, and Associated Fittings
   j. 886, Standard for Safety Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations

1.3 SUBMITTALS

A. Shop Drawings

1. Product technical data

   a. Provide submittal data for all products specified in PART 2 of this Specification Section.
   b. See Specification Section 26 05 00 - Common Work Results for Electrical for additional requirements.
   c. See Specification Section 01 33 00 – Submittals, for shop drawing submittal processing requirements.

2. Fabrication and/or layout drawings

   a. Identify dimensional size of pull and junction boxes to be used.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. **Subject to compliance with** the Contract Documents, the following manufacturers are acceptable

1. Aluminum, Rigid, Heavy-Wall, Threaded metallic conduits

    a. Allied Tube and Conduit Corporation
    b. Triangle PWC Inc.
    c. Wheatland Tube Company
    d. Thomas and Betts
    e. Or equivalent

2. Plastic (PVC), Type A (Thin Wall), Type 40 (or Schedule 40), Type 80 (or Schedule 80) (Heavy Wall), Rigid non-metallic conduit

    a. Carlon
    b. Cantex
    c. Allied Tube and Conduit Corporation
    d. Or equivalent

3. PVC Coated Rigid Steel

    a. Robroy
    b. Or equivalent

4. Liquidtight Flexible Metal conduit

    a. AFC Cable Systems
    b. Anamet, Inc.
    c. Electri-Flex
    d. Flexible Metal Hose Company
    e. International Metal Hose Company
    f. Triangle PWC Inc.
    g. LTV Steel Company
    h. Thomas and Betts
    i. Carlon
    j. Or equivalent

5. Wireway

    a. Hoffman Engineering Company
    b. Wiegmann
    c. Square D
    d. Or equivalent

6. Conduit fittings and accessories

    a. Appleton
    b. Carlon
    c. Cantex
    d. Crouse-Hinds
    e. Killark

f. OZ Gedney Company
g. RACO
h. Thomas and Betts
i. Or equivalent

7. Support systems

a. Unistrut Building Systems
b. B-Line Systems Inc.
c. Kindorf
d. Or equivalent

8. Outlet, pull and junction boxes

a. Appleton Electric Co.
b. Crouse-Hinds
c. Killark
d. O-Z/Gedney
e. Raco
f. Hoffman Engineering Co.
g. Wiegmann
h. Rittal
i. Robroy Industries
j. Cloud Concrete Products
k. Spring City
l. Carlon
m. Or equivalent

2.2 RIGID METALLIC CONDUITS

A. Rigid Galvanized Steel Conduit (RGS)

1. Mild steel with continuous welded seam

2. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing

3. Threads galvanized after cutting

4. Internal coating: Baked lacquer, varnish or enamel for a smooth surface

5. Standards: NEMA/ANSI C80.1, UL 6

B. Rigid Aluminum Conduit (RAC)

1. T-1 temper designation

2. Standards: NEMA/ANSI C80.5 UL 6A

3. Aluminum conduit shall be extruded from alloy 6063 and shall be the rigid type, non-toxic, corrosion resistant, and non-staining. It shall be manufactured per UL standards as well as listed/labeled by same.

4. Fittings, boxes, and accessories used in conjunction with aluminum conduit shall be die cast, copper free type. They shall be resistant to both chemical and galvanic corrosion. All covers shall have neoprene gaskets.

5. Aluminum conduit proposed for concrete slab or underground applications shall be UL listed for the purpose and factory pre-coated.

C. **PVC Coated Rigid Conduit**

1. PVC coated rigid conduit shall be hot dip galvanized prior to PVC coating. All threads shall be galvanized. The exterior galvanized surface shall be coated with a primer prior to PVC coating to insure adhesion. The bond on conduit and fittings shall be greater than the tensile strength of the plastic coating. The PVC coating on the exterior of the conduits shall be applied by a plastisol dip method to a nominal thickness of 40 mils, minimum. The interior of the conduit and fittings, and threads shall be painted with a urethane coating. The coating shall allow flexibility for field bending without cracking. PVC sleeves shall be formed at each female opening, with the inside diameter of the sleeve matching the outside of the conduit.

2.3 RIGID NON-METALLIC CONDUIT

A. **Schedules 40 (PVC-40) and 80 (PVC-80)**

1. Polyvinyl-chloride (PVC) plastic compound which includes inert modifiers to improve weatherability and heat distribution

2. Rated for direct sunlight exposure

3. Fire retardant and low smoke emission

4. Shall be suitable for use with 90 degrees C wire and shall be marked "maximum 90 degrees C"

5. Standards: NEMA TC 2, UL 651

6. PVC conduit and fittings shall be Schedule 40, 80 heavy wall, or thinwall, as indicated in these Specifications manufactured to conform to UL standards. It shall be listed and labeled by UL. It shall have at least the same temperature rating as the conductor insulation. Expansion joints shall be used as recommended by the manufacturer in published literature. PVC systems shall have a tensile strength of 7,000 psi @ 73.4 degrees Fahrenheit, flexural strength of 11,000 psi and compressive strength of 8,000 psi.

2.4 FLEXIBLE CONDUIT

A. **PVC-Coated Flexible aluminum (liquid-tight) Conduit (FLEX-LT)**

1. Core formed of continuous, spiral wound, aluminum strip with successive convolutions securely interlocked

2. Extruded PVC outer jacket positively locked to the steel core

3. Liquid and vaportight

4. Standard: UL 360

5. Flexible metallic conduit shall be constructed from flexibly or spirally wound aluminum. Connections shall be by means of aluminum squeeze type fittings, not exceeding 3/4 inch. Liquidtight conduit shall be light gray in color and have sealtight fittings, type UA.

2.5 WIREWAY

A. General

1. Suitable for lay-in conductors

2. Designed for continuous grounding

3. Covers

   a. Hinged or removable in accessible areas
   b. Non-removable when passing through partitions

4. Finish: Rust inhibiting primer and manufacturers standard paint inside and out except for stainless steel type.

5. Standards: UL 870, NEMA 250

B. Watertight (NEMA 4X rated) Wireway

1. 14 GA Type 304 or 316 stainless steel bodies and covers without knockouts and 10 GA stainless steel flanges.

2. Cover: Fully gasketed and held in place with captive clamp type latches

3. Flanges: Fully gasketed and bolted

C. Dusttight (NEMA 12 rated) Wireway

1. 14 GA steel bodies and covers without knockouts and 10 GA steel flanges

2. Cover: Fully gasketed and held in place with captive clamp type latches

3. Flanges: Fully gasketed and bolted

2.6 CONDUIT FITTINGS AND ACCESSORIES

A. Fittings for Use with RAC

1. General

    a. In hazardous locations listed for use in Class I, Groups C and D locations

2. Locknuts

    a. Threaded metallic
    b. Gasketed or non-gasketed
    c. Grounding or non-grounding type

3. Bushings

    a. Threaded, insulated metallic
    b. Grounding or non-grounding type

4. Hubs: Threaded, insulated and gasketed aluminum for raintight connection

5. Couplings

    a. Threaded straight type: Same material and finish as the conduit
    b. Threadless type: Gland compression or self-threading type, concrete tight

6. Unions: Threaded aluminum

7. Conduit bodies (ells and tees)

    a. Body: Cast copper free aluminum with threaded hubs
    b. Standard and mogul size
    c. Cover
        1) **Clip-on type with stainless steel screws**
        2) **Gasketed copper free aluminum**

8. Conduit bodies (round)

    a. Body: Cast copper free aluminum with threaded hubs
    b. Cover: Threaded screw on type, gasketed, cast copper free aluminum

9. Sealing fittings

    a. Body: Cast copper free aluminum with threaded hubs
    b. Standard and mogul size
    c. With or without drain and breather
    d. Fiber and sealing compound: UL listed for use with the sealing fitting

10. Hazardous location flexible coupling (HAZ-FLEX)

    a. Liquid tight and arc resistant
    b. Electrically conductive so no bonding jumper is required
    c. All areas
        1) **Stainless steel braided covering over flexible stainless steel core**
        2) **Stainless steel end fittings**
        3) **Aluminum unions and nipples**

11. Expansion couplings

    a. 2 inches nominal straight-line conduit movement in either direction
    b. Metallic with insulated bushing
    c. Gasketed for wet locations
    d. Internally or externally grounded

12. Expansion/deflection couplings

    a. 3/4 inches nominal straight-line conduit movement in either direction
    b. 30-degree nominal deflection from the normal in all directions
    c. Metallic hubs, neoprene outer jacket and stainless steel jacket clamps
    d. Internally or externally grounded
    e. Watertight, raintight and concrete tight

13. Standards: UL 467, UL 514B, UL 886

B. **Fittings for Use with FLEX-LT**

1. Connector

    a. Straight or angle type
    b. Metal construction, insulated and gasketed
    c. Composed of locknut, grounding ferrule and gland compression nut
    d. Liquid tight

2. Standards: UL 467, UL 514B

C. **Fittings for Use with Rigid Non-Metallic PVC Conduit**

1. Coupling, adapters and conduit bodies

    a. Same material, thickness, and construction as the conduits with which they are used.
    b. Homogeneous plastic free from visible cracks, holes or foreign inclusions.

c. Bore smooth and free of blisters, nicks or other imperfections which could damage the conductor.

2. Solvent cement for welding fittings shall be supplied by the same manufacturer as the conduit and fittings.

3. Standards: ASTM D2564, NEMA TC 3, UL 651, UL 514B

D. **Weather and Corrosion Protection Tape**

1. PVC based tape, 10 mils thick.

2. Protection against moisture, acids, alkalis, salts and sewage and suitable for direct bury.

3. Used with appropriate pipe primer.

2.7 ALL RACEWAY AND FITTINGS

A. **Mark Products**

1. Identify the nominal trade size on the product.

2. Stamp with the name or trademark of the manufacturer.

2.8 OUTLET BOXES

A. **Cast Outlet Boxes**

1. Die-cast copper free aluminum with manufacturers standard finish

2. Threaded hubs and grounding screw

3. Styles

a. "FS" or "FD"
b. "Bell"
c. Single or multiple gang and tandem
d. "EDS" or "EFS" for hazardous locations

4. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating

5. Standards: UL 514A, UL 886

B. **See Section 26 27 26** for wiring devices, wallplates and coverplates.

2.9 PULL AND JUNCTION BOXES

A. **NEMA 1 Rated**

1. All junction and/or pull boxes for dry (non-corrosive) areas shall be of code gauge sheet metal construction, of the inside dimensions as required by code, with covers.

A. **NEMA 4X Rated (metallic)**

1. Body and cover: 14 GA Type 304 or 316 stainless steel

2. Seams continuously welded and ground smooth

3. No knockouts

4. External mounting flanges

5. Hinged door and stainless steel screws and clamps

6. Door with oil-resistant gasket

B. **NEMA 7 and 9 Rated**

1. Copper-free aluminum with manufacturers standard finish

2. Drilled and tapped openings or tapered threaded hub

3. Cover bolted-down with stainless steel bolts or threaded cover with neoprene gasket

4. External mounting flanges

5. Grounding lug

6. Junction boxes for use in wet-wells and other hazardous areas shall be watertight, rustproof and corrosion resistant, and explosion proof with threaded conduit openings (5 2 full threads - minimum) and provided with rustproof hardware.

C. **NEMA 12 Rated**

1. Body and cover

   a. Type 5052 H-32 aluminum, unpainted

2. Seams continuously welded and ground smooth

3. No knockouts

4. External mounting flanges

5. Non-hinged cover held closed with captivated cover screws threaded into sealed wells or hinged cover held closed with stainless steel screws and clamps.

6. Flat door with oil resistant gasket

D. **Miscellaneous Accessories**

1. Rigid handles for covers larger than 9 SF or heavier than 25 lbs

2. Split covers when heavier than 25 lbs

3. Weldnuts for mounting optional panels and terminal kits

4. Terminal blocks: Screw-post barrier-type, rated 600 volt and 20 ampere minimum

E. **Standards: NEMA 250, UL 50**

2.10 **UNDERGROUND PULLBOXES**

A. **Underground junction or pull boxes** shall be constructed of reinforced concrete cast-in-place or pre-fabricated as detailed on the Contract Drawings.

2.11 **SUPPORT SYSTEMS**

A. **Multi-conduit Surface or Trapeze Type** Support and Pull or Junction Box Supports

1. Material requirements

a. Stainless steel: AISI Type 304 or 316
b. Aluminum

B. **Single Conduit and Outlet** Box Support Fasteners

1. Material requirements

a. Stainless steel
b. Aluminum

PART 3 – EXECUTION

3.1 **RACEWAY INSTALLATION - GENERAL**

A. **Shall be in accordance with** the requirements of

1. NFPA 70

2. Manufacturer instructions

B. **Size of Raceways**

1. Raceway sizes are shown on the Drawings, if not shown on the Drawings, then size in accordance with NFPA 70.

2. Unless specifically indicated otherwise, the minimum raceway size shall be

   a. Conduit: 3/4 inches
   b. Wireway: 2-1/2 inches x 2-1/2 inches

C. **Field Bending and Cutting** of Conduits

1. Utilize tools and equipment recommended by the manufacturer of the conduit, designed for the purpose and the conduit material to make all field bends and cuts.

2. Do not reduce the internal diameter of the conduit when making conduit bends.

3. Degrease threads after threading and apply a zinc rich paint.

4. Debur interior and exterior after cutting.

D. **Male threads of conduit systems** shall be coated with an electrically conductive anti-seize compound.

E. **The protective coating integrity** of conduits, fittings, outlet, pull and junction boxes and accessories shall be maintained.

1. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.

2. Repair surfaces which will be inaccessible after installation prior to installation.

F. **Remove moisture and debris** from conduit before wire is pulled into place.

1. Pull mandrel with diameter nominally 1/4 inches smaller than the interior of the conduit, to remove obstructions.

2. Swab conduit by pulling a clean, tight-fitting rag through the conduit.

3. Tightly plug ends of conduit with tapered wood plugs or plastic inserts until wire is pulled.

G. **Only nylon or polyethylene rope** shall be used to pull wire and cable in conduit systems.

H. **Where portions of a raceway are subject to** different temperatures and where condensation is known to be a problem, as in cold storage areas of buildings or where passing from the interior to the exterior of a building, the raceway shall be sealed to prevent circulation of warm air to colder section of the raceway.

I. **Equipment connections shall be made with flexible or rigid conduit** as required controllers for motors, disconnect switches, and all control protective and signal devices for motor circuits, except where such apparatus is furnished

mounted and connected integrally with the motor driven equipment, shall be installed, connected and left in operating condition. The number and size of conductors between motors and control or protective apparatus shall be as required to obtain the operation described in these Specifications, and /or by the Contractor Documents, and/or as shown in manufacturer furnished, Engineer reviewed Shop Drawings.

3.2 RACEWAY ROUTING

A. **Raceways shall be routed** in the field unless otherwise indicated.

1. Conduit and fittings shall be installed, as required, for a complete system that has a neat appearance and is in compliance with all applicable codes.

2. All conduit shall be installed in a first class workmanship manner. It shall be installed in horizontal and vertical runs in such a manner as to ensure against trouble from the collection of trapped condensation and shall be arranged so as to be devoid of traps wherever possible. Special care shall be used in assuring that exposed conduit runs are parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. No open wiring is allowed.

3. Do not route conduits

   a. Through areas of high ambient temperature or radiant heat.
   b. In suspended concrete slabs.

4. Conduit shall not interfere with, or prevent access to, piping, valves, ductwork, or other equipment for operation, maintenance and repair.

5. Provide pull boxes or conduit bodies as needed so that there is a maximum of 360 degrees of bends in the conduit run or in long straight runs to limit pulling tensions.

B. **All rigid conduits within a structure** shall be installed exposed except as follows

1. As indicated on the Drawings.

2. Concealed above gypsum wall board or acoustical tile suspended ceilings.

3. Concealed within stud frame, poured concrete, concrete block and brick walls of an architecturally finished area.

4. Embedded in floor slabs or buried under floor slabs where shown on the Contract Drawings or with the Engineer's permission.

C. **Maintain minimum spacing between** parallel conduit and piping runs in accordance with the following when the runs are greater than 30 feet

1. Between instrumentation: 1 inch

2. Between instrumentation and 125 V, 48 V and 24 Vdc, 2 inches

3. Between instrumentation and 600 V and less AC power or control: 6 inches

4. Between instrumentation and greater than 600 Vac power: 12 inches

5. Between 600 V and less AC power or control: 6 inches

6. Between 125 V, 48 V and 24 Vdc and 600 V and less AC power or control: 2 inches

7. Between 125 V, 48 V and 24 Vdc and greater than 600 Vac power: 2 inches

8. Between 600 V and less AC and greater than 600 Vac: 2 inches

9. Between process, gas, air and water pipes: 6 inches

10. The following table shows the minimum burial depth required for all exterior conduit or cable:

Rigid Metal Conduit	18”
Schedule 80 PVC	30”

Maximum conduit burial depth shall be 60” unless otherwise indicated or agreed on a case-by-case basis.

D. **Conduits shall be installed** to eliminate moisture pockets.

1. Where water cannot drain to openings, provide drain fittings in the low spots of the conduit run where feasible.

2. All underground conduits entering a building shall be sealed against water/condensate entering around the conductors. Sealant may be silicone rubber based caulk.

3. During construction, all conduit work shall be protected to prevent lodgement of dirt, plaster or trash in conduits, fittings or boxes. Conduits which have been plugged shall be entirely freed of accumulations or be replaced. All conduits in floors or below grade shall be swabbed free of debris and moisture before wires are pulled. Crushed or deformed conduit shall not be permitted.

E. **Conduit shall not be routed** on the exterior of structures except as specifically indicated on the Drawings.

F. **Where sufficient room exists** within the housing of roof-mounted equipment, the conduit shall be stubbed up inside the housing.

3.3 RACEWAY APPLICATIONS

A. **Permitted Raceway Types** per Routing Locations

1. Areas of use for each type of conduit:

Space Description	Schedule 40 PVC	Schedule 80 PVC	Aluminum	PVC Coated GRS
Interior Finished Spaces (Concealed Only)			X	
Electrical Rooms			X	
Exterior Exposed			X	
Mechanical and Process Rooms			X	
Exterior Underground to Above Grade Transition				X
Exterior Underground-Concrete Encased	X	X		
Exterior Underground-Direct Bury		X		

2. In stud framed walls

   a. RAC

3. In concrete block or brick walls

   a. PVC-40

4. Embedded in poured concrete structural slabs

   a. PVC-40

5. Beneath floor slab-on-grade

   a. PVC-40

6. Through floor penetrations

   a. RAC wrapped with factory applied weather and corrosion protection tape when emerging from concrete into areas designated as dry, wet, corrosive or highly corrosive.
   b. RAC in areas designated as wet, corrosive or highly corrosive.

7. PVC conduit installed underground for low voltage application shall be schedule 80 without encasement, except service entrance conduits and conduits under roadways shall be schedule 40 PVC and shall be concrete encased. Where PVC conduit is installed, transition shall be made to wrapped aluminum conduit at. Long radius sweeps shall be used at utility riser poles.

8. Concrete encased ductbanks

    a. PVC-40
    b. 90 degree elbows for transitions to above grade
    c. Long sweeping bends greater than 15 degrees

B. **FLEX conduits shall be installed** for connections to light fixtures, HVAC equipment and other similar devices above the ceilings.

1. The maximum length shall not exceed

    a. 5 feet to light fixtures
    b. 3 feet to all other equipment

C. **FLEX-LT conduits shall be installed** as the final conduit connection to light fixtures, dry type transformers, motors, electrically operated valves, instrumentation primary elements, and other electrical equipment that is liable to vibrate.

1. The final section of conduit connecting each motor or piece of utilization equipment subject to vibration shall be of the flexible type. Only liquidtight flexible conduit is permitted. Flexible conduit to space heaters shall be long enough to allow swivel action.

2. The maximum length shall not exceed

    a. 5 feet to light fixtures
    b. 3 feet to motors
    c. 2 feet to all other equipment

D. **HAZ-FLEX coupling shall be installed** as the final conduit to motors, electrically operated valves, instrumentation primary elements and electrical equipment that is liable to vibrate.

1. The maximum length shall not exceed

    a. 3 feet to motors
    b. 2 feet to all other equipment

E. **NEMA 4X Rated Wireway**

1. Surface mounted in areas designated as wet and or corrosive.

F. **NEMA 12 Rated Wireway**

1. Surface mounted in dry, non-corrosive areas such as electric rooms.

G. **RGS Conduit and Fittings**

1. RGS conduit and fittings will be considered on a case-by-case basis by Engineer upon request by Contractor in instances requiring structural rigidity or other unusual circumstances.

3.4 CONDUIT FITTINGS AND ACCESSORIES

A. **Conduit Seals**

1. Installed in conduit systems located in hazardous areas as required by the NFPA 70

B. **Rigid non-metallic conduit and fittings** shall be joined utilizing solvent cement.

1. Immediately after installation of conduit and fitting, the fitting or conduit shall be rotated 1/4 turn to provide uniform contact.

C. **Install Expansion Fittings**

1. Where conduits are exposed to the sun and conduit run is greater than 200 feet.

2. Elsewhere as identified on the Drawings

D. **Install Expansion/Deflection Fittings**

1. Where conduits enter a structure.

   a. Except electrical manholes and handholes.
   b. Except where the ductbank is tied to the structure with rebar.

2. Where conduits span structural expansions joints.

3. Elsewhere as identified on the Drawings.

E. **Threaded connections shall be** made wrench-tight.

F. **Conduit joints shall be watertight**

1. Where subjected to possible submersion.

2. In areas classified as wet.

3. Underground.

G. **Terminate Conduits**

1. In metallic outlet boxes

   a. Conduit hub and locknut.
   b. Insulated bushing and two (2) locknuts.
   c. Use grounding type locknut or bushing when required by NFPA 70.

2. In NEMA 1 rated enclosures

   a. Conduit hub and locknut.

b. Insulated bushing and two (2) locknuts.
c. Use grounding type locknut or bushing when required by NFPA 70.

3. In NEMA 12 rated enclosures

a. Watertight, insulated and gasketed hub and locknut.
b. Use grounding type locknut or bushing when required by NFPA 70.

4. In NEMA 4 and 4X rated enclosures

a. Watertight, insulated and gasketed hub and locknut.

5. When stubbed up through the floor into floor mount equipment

a. With an insulated grounding bushing on metallic conduits.
b. With end bells on non-metallic conduits.

H. **Threadless couplings shall only be used** to join new conduit to existing conduit when the existing conduit end is not threaded and it is not practical or possible to cut threads on the existing conduit with a pipe threader.

3.5 CONDUIT SUPPORT

A. **Permitted multi-conduit surface** or trapeze type support system per area designations and conduit types

1. All areas

a. Stainless steel
b. Aluminum

2. Conduit type shall be compatible with the support system material.

a. Stainless steel or aluminum system may be used with RAC.

B. **Permitted single conduit support fasteners** per area designations and conduit types

1. All areas

a. Stainless steel or aluminum.
b. Types of fasteners: Spring type hangers and clips, straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
c. Provide anti-rattle conduit supports when conduits are routed through metal studs.

2. Conduit type shall be compatible with the support fastener material.

a. Stainless steel or aluminum system may be used with RAC.

C. **Conduit Support General Requirements**

1. Maximum spacing between conduit supports per NFPA 70.

2. Support conduit from the building structure.

3. Do not support conduit from process, gas, air or water piping; or from other conduits.

4. Provide hangers and brackets to limit the maximum uniform load on a single support to 25 lbs or to the maximum uniform load recommended by the manufacturer if the support is rated less than 25 lbs.

   a. Do not exceed maximum concentrated load recommended by the manufacturer on any support.
   b. Conduit hangers
      1) **Continuous threaded rods combined with struts or conduit clamps: Do not use perforated strap hangers and iron bailing wire.**
   c. Do not use suspended ceiling support systems to support raceways.
   d. Hangers in metal roof decks
      1) **Utilize fender washers.**
      2) **Do not extend above top of ribs.**
      3) **Do not interfere with vapor barrier, insulation, or roofing.**

5. Conduit support system fasteners

   a. Use sleeve-type expansion anchors as fasteners in masonry wall construction.
   b. Do not use concrete nails and power-driven fasteners.

3.6 OUTLET, PULL AND JUNCTION BOX INSTALLATION

A. **General**

1. Install products in accordance with manufacturer's instructions.

2. See Specification Section 26 05 00 – Common Work Results for Electrical, and the Drawings for area classifications.

3. Fill unused punched-out, tapped, or threaded hub openings with insert plugs.

4. Size boxes to accommodate quantity of conductors enclosed and quantity of conduits connected to the box.

B. **Pull and Junction Boxes**

1. Install pull or junction boxes in conduit runs where indicated or required to facilitate pulling of wires or making connections.

   a. Make covers of boxes accessible.

2. Permitted uses of NEMA 4X metallic enclosure

   a. Pull or junction box surface mounted in areas designated as wet and/or corrosive.

3. Permitted uses of NEMA 7 enclosure

   a. Pull or junction box surface mounted in areas designated as Class I hazardous
      1) **Provide NEMA 4X corrosion resistance.**

4. Permitted uses of NEMA 12 enclosure

   a. Pull or junction box surface mounted in electric rooms and areas designated as dry.

5. Pull boxes for exterior underground work are shown on the Contract Drawings and are the minimum number required. Others may be added at the Contractor's option, but no extra pay shall be allowed. Interior pull boxes are not shown but shall be used as needed. Pull box types are as follows:

6. Exterior – Precast concrete with open gravel bottom. Enclosure, box, and cover shall conform to all test provisions of ANSI/SCTE 77 for Tier 15 applications. All components in an assembly shall be manufactured using matched surface tooling. All covers shall have a minimum coefficient of friction of 0.05 in accordance with ASTM C1028 and the corresponding Tier level embossed on the top surface. Dimensions shall be as required to meet applicable NEC requirements for the number and configuration of conduits entering and exiting the enclosure. Box depth shall be as required for conduit burial depth. Cover shall be stamped "ELECTRICAL" or "COMMUNICATIONS" as applicable.

7. Interior - Interior pull boxes in dry areas shall be of code gauge steel of not less than the minimum required by the NEC and shall be provided with hinged covers. In process areas , they shall be rated watertight, of stainless steel, cast aluminum, PVC, fiberglass, or equal. Hardware shall be stainless steel.

END OF SECTION

SECTION 26 05 53

ELECTRICAL IDENTIFICATION

PART 1 – GENERAL

1.1 EQUIPMENT LABELING

A. **All starters, feeder units in panel boards, switchboards, disconnects, instruments, etc.,** shall be marked to indicate the motor, outlet, circuit they control, or variable monitored. Marking is to be done with engraved laminated nameplates and shall bear the designation shown on the Contract Drawings where this information is given. Nameplates shall be fastened to equipment with stainless steel screws, minimum of one each side. In no way shall the installation of mounting screws void the NEMA enclosure rating of the equipment in which they are installed. If there are more than one identical unit, they shall be given consecutive numbers or other descriptions as designated by the Engineer. Nameplate background color shall be white, with black engraved letters, unless otherwise noted.

B. **Branch circuits in panelboards** shall be typed on a card suitable for the card frame furnished with the panel. The card shall bear the panel designation listed on the Contract Drawings where this information is given, as well as indicate what each circuit controls.

C. **Furnish and install "Authorized Personnel Only" signs** by doors into all power distribution equipment rooms/buildings. Furnish and install other signs as indicated on the Contract Drawings.

D. **See Section 26 09 16,** controls for additional labeling requirements.

1.2 LOCATING UNDERGROUND UTILITIES

A. **Warning tape: Plastic 6-inch wide yellow warning tape** bearing the general notation of "Power" or "Communications" with metal tracer shall be placed in trenches with backfill approximately 12 inches below finished grade on all underground conduit runs, and on others as indicated on the Contract Drawings.

1.3 CONTROL & INSTRUMENTATION WIRE LABELING

A. **Refer to Instrumentation Legend Sheet** for wire tagging convention.

PART 2 – PRODUCTS

Not Applicable.

PART 3 – EXECUTION

Not Applicable.

END OF SECTION

SECTION 26 09 16

CONTROLS

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. **Equipment controls shall be as specified herein** and shown on the Contract Drawings. Legends for starter nameplates shall be taken from the one line diagram in the Contract Drawings.

B. **All control panels furnished under this Contract** shall be manufactured in accordance with industry standards and as herein specified. Some control panels are specified to be furnished with the equipment controlled and others are to be furnished by the Contractor, as written elsewhere.

1.2 CUSTOM CONTROL PANELS

A. **Panel construction shall comply with OSHA** and other code requirements as applicable, and may be attested to by UL listing the panels as an assembly. All internal components shall be individually UL listed where applicable.

B. **Control panels to be furnished on this project** shall be wired to function according to schematics shown on the contract Drawings. In addition to the requirements shown on the Contract Drawings, the panels shall adhere to additional requirements as written herein, and in the utilization equipment specifications.

C. **All relays, timers, terminal strips, etc.,** shall be mounted to a subpanel inside the enclosure.

D. **All terminal strips and lugs shall be of a type UL listed** to terminate the size and quantity of wires encountered. Where conduits enter the boxes, if they are NEMA 4, 4X or 3R, sealing locknuts or hubs must be used to maintain the box rating.

E. **Elementary control schematics and connection diagrams** showing the spatial relationship of components and wiring shall be submitted for review. Also, a bill of materials, drawing of device arrangement on front, and enclosure fabrication drawings shall be submitted. Further, descriptive literature is required on all components. A copy of the shop drawings shall be furnished and stored in a pocket inside the enclosure.

F. **Sleeve type wire markers** shall be installed on all wires, keynoted back to the elementary schematic or the connection diagram, and all terminals identified. Markers shall be Brady “Durasleeve” or equal.

G. **All panels shall be furnished wire management channels** for routing internal panel wiring. Channels shall be made of rigid vinyl and provided with snap-on covers which interlock with lip on channel side wall.

H. **All panels shall be provided with rear adjustable channel** for mounting racks, shelves, or DIN rails. DIN rails shall be provided where required for internal panel equipment installed.

I. **All panels shall be furnished with print storage pockets** on the inside of the enclosure door in a convenient location.

J. **All enclosures shall be furnished with the appropriate hardware** for the mounting arrangement shown. Mounting hardware shall be stainless steel for metal enclosures, or non-metallic for fiberglass enclosures.

K. **All enclosure doors,** including window kits, shall have locking latches.

L. **All panels shall be furnished with oxidation inhibitors** mounted to the inside.

M. **All exterior panels shall be furnished** with thermostatically controlled condensate heaters.

N. **Where panel-mounted thermal management equipment is shown,** it shall meet the criteria below. The installation of the thermal management equipment shall in no way void the NEMA rating of the enclosure.

O. **See other Specifications for requirements** for motor control, power distribution, and pilot devices. Note that all switches, pilot lights, etc. shall be oiltight regardless of the NEMA rating of the enclosure.

P. **Unless otherwise indicated, control wiring shall be 120V,** protected by a 20A/1P circuit breaker mounted inside the panel. A transient voltage surge suppressor shall be furnished on the incoming power circuit and mounted inside the panel.

PART 2 – PRODUCTS

2.2 MANUFACTURERS

A. **Enclosures shall be manufactured** by Hoffman, or Saginaw.

2.3 ENCLOSURES

A. **Single Door, Wall-Mount Enclosures for Indoor/Dry Locations**

1. Enclosures shall be manufactured from 14 gauge steel with gray polyester powder coating inside and out over phosphatized surfaces. Seams shall be continuously welded and ground smooth. A body flange trough shall be provided to prevent entrance of liquid and contaminants.

2. Hinges shall be concealed with captive pins for door replacement. The door shall have a seamless, one-piece gasket.

3. The latching system shall be quarter-turn or three-point, lockable. Enclosures with screw-down clamps are not acceptable.

4. Operator devices shall be mounted on the front of the door in an accessible location.

5. The enclosure shall be UL listed for NEMA Type 12.

B. **Single Door, Wall-Mount Enclosures for Outdoor/Wet/Corrosive Locations**

1. Enclosures shall be manufactured from 14 gauge 304 stainless steel. Seams shall be continuously welded and ground smooth. A body flange trough shall be provided to prevent entrance of liquid and contaminants.

2. Hinges shall be concealed with captive pins for door replacement. The door shall have a seamless, one-piece gasket.

3. The latching system shall be quarter-turn or three-point, lockable. Enclosures with screw-down clamps are not acceptable.

4. The exterior door shall be blank. Operator devices shall be mounted on an inner hinged swing-out panel with an opening of at least 106 degrees.

5. The enclosure shall be UL listed for NEMA Type 4X.

C. **Double or Single Door, Freestanding Enclosures for Indoor/Dry Locations**

1. Enclosures shall be manufactured from 12 gauge steel with gray polyester powder coating inside and out over phosphatized surfaces. Seams shall be continuously welded and ground smooth. A body flange trough shall be provided to prevent entrance of liquid and contaminants. Stiffeners shall be provided for added panel rigidity.

2. Hinges shall be continuous, heavy duty. The door shall have an oil-resistant gasket held in place with steel retraining clips.

3. The latching system shall be three-point roller type with lockable handle. Enclosures with screw-down clamps are not acceptable.

4. Operator devices shall be mounted on the front of the door in an accessible location.

5. Enclosures shall be furnished with floor stand kits which elevate the bottom of the enclosure above the floor. One stand shall be provided at each end of the enclosure, each constructed of 12 gauge steel, painted with the same finish and color as the enclosure.

6. Enclosure shall have heavy duty, removable lifting eyes.

7. The enclosure shall be UL listed for NEMA Type 12.

D. **Double or Single Door, Freestanding Enclosures for Outdoor/Wet/Corrosive Locations**

1. Enclosures shall be manufactured from 12 gauge 304 stainless steel. Seams shall be continuously welded and ground smooth. A body flange trough shall be provided to prevent entrance of liquid and contaminants. Stiffeners shall be provided for added panel rigidity.

2. Hinges shall be continuous, heavy duty. The door shall have an oil-resistant gasket held in place with steel retraining clips.

3. The latching system shall be three-point roller type with lockable handle. Enclosures with screw-down clamps are not acceptable.

4. Operator devices shall be mounted on the front of the door, but covered completely, protected, and secured by a lockable window kit. The window kit shall include a continuous aluminum hinge on one side. The window shall be constructed of minimum 0.188 inch thick clear polycarbonate. A 2 inch space between the door of the enclosure and the window shall be provided to allow space for pilot devices. The window kit shall be furnished with a lockable latch.

5. Enclosures shall be furnished with floor stand kits which elevate the bottom of the enclosure above the floor. One stand shall be provided at each end of the enclosure, each constructed of 304 stainless steel.

6. Enclosure shall have heavy duty, removable lifting eyes.

7. The enclosure shall be UL listed for NEMA Type 4X.

2.4 **THERMAL MANAGEMENT**

A. **General - Where heat producing equipment is installed** in custom control panels, provisions shall be made to maintain the required interior temperature to within the operating temperature range of the internal components. Fans, air conditioners, blowers, etc. shall be installed for this purpose, but in no way shall the installation of these devices void the specified NEMA rating of the enclosure.

B. **Fans**

1. Fan packages may be used for NEMA 1 or NEMA 12 enclosures. Installation shall consist of a fan and exhaust grille to provide pressurization of the enclosure to prevent entrance of doors or other panel openings.

2. Fan and exhaust grilles shall be provided with filters and sealing gaskets to provide an IP 54 rating. Grilles shall be provided with exterior access to the filter for replacement by removing the grille cover.

3. Fans shall be powered through the control circuit within the panel, with overcurrent protection as required.

C. **Panel Mounted Air Conditioners**

1. Air conditioners shall be utilized for NEMA 4 or 4X enclosures, and/or where ambient temperature will be below 50 degrees F.

2. The unit shall be furnished for mounting on the side of the enclosure in accordance with manufacturer's instructions. The unit shall be constructed of 304 stainless steel, and provided with hinged access covers for access to all components. A protective shield shall be provided as required to maintain the NEMA 4X and hosedown ratings.

3. The unit shall operate using CFC-free refrigerant. Condensate management system shall allow for moisture evaporation from the enclosure.

4. Unit shall be thermostatically controlled. The thermostat shall be furnished with a tin-plating and all coils and piping which are exposed to the ambient air shall be provided with a corrosion resistant coating.

5. The air conditioning equipment shall be powered through the control circuit within the panel, with overcurrent protection as required.

PART 3 – EXECUTION

Not Applicable.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. **This section of the Technical Specifications** includes furnishing all labor, materials, equipment, and incidentals required for the installation of all lighting and distribution panelboards as hereinafter specified and as shown on the Contract Drawings.

B. **The panelboards for installation under this Contract** shall be selected from the following types with the panel voltage and main sizes the determining factors. All panelboards shall be by the same manufacturer.

C. **Circuit breakers of size and type** shown on Contract Drawings and described herein shall be provided with the panelboards.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. **"Square D", "Siemens", "General Electric", or equal.**

2.2 GENERAL REQUIREMENTS

A. **Rating - Panelboard ratings shall be as shown** on the Contract Drawings. All panelboards shall be rated for the intended voltage.

B. **References - The panelboard (s) and circuit break (s) referenced** herein are designed and manufactured according to the latest revision of the following specifications.

1. NEMA PB 1 – Panelboards

2. NEMA PB 1.1 – Instructions for Safe Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or less.

3. NEMA AB 1 – Molded Case Circuit Breakers

4. UL 50 – Enclosures for Electrical Equipment

5. UL 67 – Panelboards

6. UL 489 – Molded-Case Circuit Breakers and Circuit Breaker Enclosures

7. CSA Standard C22.2 No. 29-M1989 – Panelboards and Enclosed Panelboards

8. CSA Standard C22.2 No. 5-M91 – Molded Case Circuit Breakers

9. Federal Specification W-P-115C – Type I Class 1

10. Federal Specification W-C-375B/Gen – Circuit Breakers, Molded Case, Branch Circuit and Service.

11. Federal Specification W-C-865C – Fusible Switches

12. NFPA 70 – National Electrical Code (NEC)

13. ASTM – American Society of Testing Materials

2.3 LIGHTING AND APPLIANCE PANELBOARD TYPE - 120/208V

A. Interior

1. Continuous main current ratings, as indicated on the Drawings, not to exceed 600 amperes maximum.

2. Minimum short circuit current rating as indicated or as required to meet the short circuit study criteria specified elsewhere.

3. Provide one (1) continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors suitable for plug-on or bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67. Bussing rated 100-400 amperes shall be plated copper. Bussing rated for 600 amperes shall be plated copper as standard construction. Bus bar plating shall run the entire length of the bus bar. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and -G.

4. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength thermoplastic.

5. A solidly bonded copper equipment ground bar shall be provided. Where indicated, an additional copper isolated/insulated ground bar shall also be provided.

6. Split solid neutral shall be plated and located in the mains compartment up to 225 amperes so all incoming neutral cable may be of the same length. UL Listed panelboards with 200% rated solid neutral shall be plated copper for non-linear load applications. Panelboards shall be marked for non-linear load applications.

7. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trim shall have pre-formed twistouts covering unused mounting space.

8. Nameplates shall contain system information and catalog number of factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label and short circuit current rating shall be displayed on the interior or in a booklet format.

9. Interiors shall be field convertible for top or bottom incoming feed. Main circuit breakers in 100A interiors shall be horizontally or vertically mounted. Main circuit breakers over 100A shall be vertically mounted. Sub-feed circuit breakers shall be vertically mounted. Main lug interiors up to 400 amperes shall be convertible to main breaker. Interior leveling provisions shall be provided for flush mounted applications.

B. **Main Circuit Breaker**

1. Main circuit breakers shall have an overcenter, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be true RMS sensing and be factory calibrated to operate in a 40° C ambient environment. Thermal elements shall be ambient compensating above 40° C.

2. Two- and three-pole circuit breakers shall have common tripping of all poles. Circuit breakers frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker that allows the user to simultaneously select the desired trip level of all poles. Circuit breakers shall have a push-to-trip button for maintenance and testing purposes.

3. Breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL Listed for reverse connection without restrictive line or load markings.

4. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position.

5. Lugs shall be UL Listed to accept solid or stranded copper and aluminum conductors. Lugs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating per NEC Table 310-16. Lug body shall be bolted in place; snap-in designs are not acceptable.

6. The circuit breakers shall be UL Listed for use with the following accessories: Shunt Trip, Under Voltage Trip, Ground Fault Shunt Trip, Auxiliary Switch, Alarm Switch, Mechanical Lug Kits, and Compression Lug Kits.

C. **Branch Circuit Breakers**

1. Circuit breakers shall be UL Listed with amperage ratings, interrupting ratings, and number of poles as indicated on the Drawings.

2. Molded case branch circuit breakers shall have bolt-on type bus connectors.

3. Circuit breakers shall have an overcenter toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.

4. There shall be two forms of visible trip indication. The breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red indicator appearing in the clear window of the circuit breaker housing.

5. The exposed faceplates of all branch circuit breakers shall be flush with one another.

6. Lugs shall be UL Listed to accept solid or stranded copper and aluminum conductors. Lugs shall be suitable for 90° C rated wire.

7. Breakers shall be UL Listed for use with the following factory installed accessories: Shunt Trip, Auxiliary Switch, and Alarm Switch.

D. **Enclosures**

1. Type 1 Boxes

   a. Boxes shall be galvanized steel constructed in accordance with UL 50 requirements.
   b. Boxes shall have removable endwalls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.
   c. Box width shall be 26” wide maximum.

2. Type 1 Fronts

   a. Front shall meet the strength and rigidity requirements per UL 50 standards. Front shall have an ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
   b. Fronts shall be 1-piece with door. Mounting shall be flush or surface as indicated on the Drawings.
   c. Panelboards shall have fronts with concealed door hinges and mounted with trim screws. Front shall not be removable with the door locked. Doors on front shall have rounded corners and edges shall be free of burrs.

d. Front shall have cylindrical tumbler type lock with catch and spring-loaded stainless steel door pull. All lock assemblies shall be keyed alike. A clear plastic directory cardholder shall be mounted on the inside of door.

3. Type 4 and 4X

a. Enclosures shall be constructed of 304 stainless steel, or fiberglass-reinforced polyester where indicated. The enclosure shall be water-tight, dust-tight, and corrosion resistant.
b. The door shall be furnished with a locking handle, with all lock assemblies keyed alike.
c. A clear plastic directory card holder shall be mounted on the inside of the door.

PART 3 – EXECUTION

3.1 INSTALLATION/APPLICATION/ERECTION

A. **Boxes for surface mounted panelboards** shall be mounted so there is at least 2 inch air space between the box and the mounting surface.

B. **Circuit directories shall be typed** giving location and nature of load served.

C. **Each panelboard shall be nameplated** with plastic engraved nameplates stating the panel's name, voltage, and the name of panel serving the panel. Nameplates shall be secured by use of stainless steel screws.

D. **Provide the owner with five (5) keys** for each type lock furnished.

END OF SECTION

SECTION 26 29 13

ENCLOSED CONTROLLERS

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. **The Contractor shall furnish and install** separately mounted, individual motor controllers for 120 volt single phase, and 208 and 480 volt three phase motors as specified herein and indicated on the Drawings. Individual motor controllers specified in this Section include individual magnetic motor starters.

1.2 TESTING

A. **All tests shall be performed** in accordance with the requirements of the General Conditions and Division 01. The following tests are required

B. **Witnessed Shop Tests**

1. None required.

2. Field Tests

a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and NETA acceptance testing specifications referenced in Section 26 01 26 – Testing of Electrical Systems.

1.3 SUBMITTALS

A. **In accordance with the procedures** and requirements set forth in the General Conditions and Section 01 33 00 - Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following

1. Shop Drawings

2. Spare Parts List

B. **Each submittal shall be identified** by the applicable specification section.

1.4 SHOP DRAWINGS

A. **Each submittal shall be complete** in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. **Partial, incomplete, or illegible submittals** will be returned to the Contractor without review for resubmittal.

C. **Shop drawings shall include** but not be limited to:

1. Product data sheets

2. Complete layout and installation drawings with clearly marked dimensions and weights for each type/size/rating of individual motor controller including conduit entry locations where applicable

3. Custom wiring diagrams for each individual motor controller. Standard wiring diagrams that are not custom created by the manufacturer for the individual motor controllers for this project are not acceptable. One wiring diagram which is typical for an equipment group (e.g. reuse water pump) is not acceptable. Each wiring diagram shall include wire identification and terminal numbers. Indicate all devices, regardless of their physical location, on the diagrams. Identify on each respective wiring diagram specific equipment names and equipment numbers consistent with those indicated on the Drawings.

4. Bill of material list for each individual motor controller

5. Nameplate schedule for each individual motor controller

6. Manufacturer's installation instructions

7. Time-current curves for each type and size protective device if requested by the Engineer

D. **The shop drawing information** shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items that the Contractor intends to provide are acceptable and shall be submitted.

E. **Prior to completion and final acceptance** of the project, the Contractor shall furnish and install "as-built" wiring diagrams for individual motor controller. These final drawings shall be plastic laminated and securely placed inside each individual motor controller unit door and included in the O&M manuals.

1.5 OPERATION AND MAINTENANCE MANUALS

A. **The Contractor shall submit** operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

1.6 TOOLS, SUPPLIES, AND SPARE PARTS

A. **The equipment shall be furnished** with all special tools necessary to disassemble, service, repair and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.

B. **The Contractor shall furnish** the following minimum spare parts:

1. One (1) solid state overload relay for each type, size, and rating used

2. One (1) motor circuit protector & motor contactor for each type, size, and rating used

3. One (1) spare control power transformer for each type and size used

4. Two (2) spare fuses for each size and type used

C. **The spare parts shall be packed** in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

D. **Spare parts shall be delivered** at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.

E. **Spare parts lists, included with** the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

F. **Parts shall be completely identified** with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.7 **IDENTIFICATION**

A. **Each equipment item shall be identified** with a nameplate. The nameplate shall be engraved indicating the circuit number and equipment name with which it is associated.

PART 2 – PRODUCTS

2.1 **MANUFACTURERS**

A. **The equipment covered by this Specification** is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. **Individual motor controllers specified** in this section shall be as manufactured by Allen-Bradley.

2.2 **INDIVIDUAL MAGNETIC MOTOR STARTERS**

A. **Individual magnetic motor starters** shall be combination type complete with motor circuit protectors (MCP's). Starters shall be rated 480 VAC, 3-pole, sized

for the intended load unless otherwise indicated. In no case shall a starter smaller than a NEMA Size 1 be used. Each starter shall be furnished with a minimum of two spare auxiliary contacts and 120VAC coils.

B. **Provide starters in NEMA 1A (gasketed) enclosures** when located in clean, dry, conditioned spaces only. NEMA 1A (gasketed) enclosures shall be finished with corrosion resistant epoxy or acrylic paint. Starters to be furnished and installed in indoor damp or wet areas and outdoor locations shall be in NEMA 4X Type 304 stainless steel enclosures. Individual motor starters located in hazardous areas shall be suitable for the Class, Division, and Group to suit the application.

C. **Furnish and install adjustable electronic overload relays** with trip range in accordance with the NEC providing Class 10, 15, 20, and 30 overload protection. The overload relay shall be furnished with a remotely-resettable overload relay and an Ethernet IP communication accessory for connection to the Owner's SCADA PLC. Shall be able to communicate to the Allen Bradley control system without converters or special software. A data base address table shall be furnished for Owner's use defining the memory locations of monitoring, control, and alarm parameters.

D. **A control power transformer** shall be furnished and installed for each motor controller. The minimum control power transformer VA requirements are as follows:

Size 1 75 VA
Size 2 75 VA
Size 3 200 VA
Size 4 300 VA
Size 5 500 VA

Additional transformer capacity shall be provided when required. The motor controller manufacturer is advised to review the total Contract Documents for additional requirements for space heaters, power factor correction capacitors, and similar equipment which may not be specified in this Division or shown on the Drawings.

E. **Unless otherwise indicated, the pilot devices** shall be mounted on the covers of the respective enclosures as shown on the Drawings. Pushbuttons, selector switches, and pilot lights shall be 30.5 mm, heavy-duty, oil tight type with provisions to maintain the NEMA ratings of starter enclosures. Legend plates indicating switch positions shall be provided for each pilot device. Pilot lights shall be LED push to test type.

F. **All control wiring shall be** No. 14 AWG (minimum) labeled at each end in accordance with the wiring numbers shown on the accepted shop drawings. Power wiring shall be sized to suit the maximum horsepower rating of unit; No. 12 AWG (minimum). Wiring shall be type MTW rated for 105ºC.

G. **Each motor starter coil shall be equipped** with a surge-suppression device for protection of the solid state equipment (e.g. programmable logic controller) wired as part of the control circuit.

H. **Where specified in these Contract Documents,** indicated on the Drawings, or as required, control relays, timers, terminal blocks, SCADA interface signaling, and other controls hardware shall be furnished for the motor control circuits. Coil voltage shall be as specified, indicated on the Drawings, or as required. The contact ratings of the relays shall be coordinated with the burden of the motor starter coil. If the burden or other electrical requirements exceed the contact rating of general purpose, plug-in relays, machine tool type relays with adequate contact ratings shall be provided**.**

I. **Acceptable manufacturers:**

1. Individual magnetic motor starters shall be Bulletin 509 with E1 Plus overload relay with 20- COMM-E Ethernet and 193-ERR Remote Reset side modules as manufactured by Allen-Bradley.

2. Or equivalent

2.3 MISCELLANEOUS MOTOR CONTROL DEVICES

A. **General**

1. All motor control equipment shall be new and the product of 1 manufacturer. Equipment specified below applies to applications where mounting individually or in a custom control panel. Starters which are mounted individually or in a custom control panel.

2. Where equipment is mounted in a hazardous area, enclosure types shall be NEMA 7 or NEMA 9 as applicable, in lieu of the enclosure specified herein. Where equipment is mounted in flood areas or floodplains, enclosures shall be NEMA 6P.

B. **Auxiliary Control Relays**

1. Provide auxiliary control relays as required to suit the application and as shown on the Drawings. The number of contacts shall be as shown and as required to suit the application.

C. **Pilot Devices**

1. Pilot lights shall be NEMA style, 30.5, oiltight, heavy duty, push-to-test, with LED lamp.

2. Elapsed time meters shall be six-digit, reading in hours and tenths of hours. Numbers shall be 5/32” high minimum. Meters shall be non-reset-able. Enclosure shall be polycarbonate, weatherproof.

3. Control Stations

   a. General - Control stations shall be heavy duty, maintained or momentary contact type, as noted on the Contract Drawings. Contacts shall be silver alloy, double break type. The number and marking of controls shall be as shown on the Contract Drawings. Enclosures shall be NEMA 4X for indoor and outdoor mounting, unless otherwise noted on the Contract Drawings. All control stations shall operate on 120 volt, a-c maximum, unless otherwise designated on the Contract Drawings.
   b. Maintained Contact - Maintained contact control switches shall be marked as shown on Drawings. The button pushed shall remain in and push the other button out until the other button is pushed.
   c. Momentary Contact - Momentary contact control push-button switches shall be marked "start" and stop". Pushbuttons shall be NEMA style, 30.5, spring out whenever pushed. If the circuit is dropped for any reason, operation cannot be resumed until a "start" push-button is pushed. In general, they are to be used for hand control of motors which are desired to operate intermittently in the presence of the operator and stop and start independently from more than one parallel control location.
   d. Pendent Stations - Pendent stations shall have momentary control stations for up-down, start-stop, or as indicated. Pushbutton operators shall have interchangeable legend inserts. Enclosure shall be NEMA 4X thermoplastic with internal strain relief. N.O./N.C. contact blocks shall be provided.
   e. Emergency Stop Stations - Emergency stop stations shall be mushroom head, maintained type, with red pushbutton operator. The operator shall reset by pulling to release.

D. **Circuit Breakers**

1. Circuit breakers shall be molded case type. Trip elements of multi-pole breakers shall be effectively insulated from one another. Multi-pole breakers shall be designed so that an overload on any one pole shall open all poles simultaneously.

2. The breaker operating mechanism shall be the quick-make, quick-break type and shall be entirely trip free to prevent the contacts being held in a closed position against a short circuit.

3. Breakers not used with motor starters shall be of the thermal magnetic type with a thermal bimetallic element for time delayed overload protection and a magnetic element for short circuit protection.

4. The breaker shall be trip indicating with the trip position midway between the "On" and "Off" positions.

5. Breakers for combination starters shall be 100 amp frame or larger. All breakers for combination starters shall have an adjustable magnetic trip

element of the motor circuit protector type. Breakers shall include accessory for “breaker off” and “breaker tripped.”

6. Breakers for combination starters shall be F frame or larger. All breakers shall have adjustable magnetic trip elements. Circuit breakers K frame and larger shall have interchangeable thermal-magnetic trip elements.

E. **Safety Switches**

1. Safety switches shall be of the heavy duty industrial, quick make, quick-break type. Ratings shall correspond to that of the equipment in which circuit it is used, fuses sized as shown on the Contract Drawings. All safety switches at motor locations are of the nonfused type unless otherwise noted.

2. Safety switches shall have a mechanical door interlock to prevent the door from being opened with the switch in the on position and facilities for locking it in the closed or open position. Enclosures for outside installation shall be NEMA 4X and inside installation, NEMA 1, unless otherwise designated on the Contract Drawings.

3. Safety switches shall be UL listed and shall conform to NEMA Standards. NEMA 4X enclosed safety switches where called for shall be stainless steel, or fiberglass.

4. NEMA 1 enclosed switches shall be phosphate coated or equivalent, code gauge steel with baked enamel finish.

F. **Selector Switches**

1. Hand-off-automatic type selector switches shall be NEMA style, 30.5, oil-tight construction and shall have number of positions shown on Drawings. The switch must not have a spring loaded return. It shall be of the “quick-make”, “quick-break” type.

G. **Phase Volt Monitors**

1. Phase volt monitors shall detect undervoltage, overvoltage, phase loss, and phase imbalance. Trip thresholds shall be adjustable for each. Output relay shall be DPDT, rated 8 amps at 120V. An adjustable time delay shall be provided for relay operation.

H. **Alarm Beacons**

1. Alarm lights shall have rotating beacons, with globe color as indicated. Enclosure shall be NEMA 4X. Lamp shall be 25 watt incandescent. Where shown to be wall mounted, provide wall mount bracket.

I. **Alarm Horns**

1. Alarm horns, where called for on the Contract Drawings, shall be weatherproof, suitable for surface mounting and shall be provided with a

silence button. Alarm horn shall be Edwards 876 series with 103dB at 10 feet, Federal, Signal, or equal.

J. **Plug-in Relays and Timers**

1. General purpose relays shall be plug-in type, 3 PDT, 11-pin with blade type sockets, with the number of contacts shown or required for correct operation (N.O. and N.C.). On-delay relays shall be 2 PDT, 8-pin tube-base w/adjustment knob. General purpose on-delay, off-delay, and interval timers shall be plug-in type with the number of contacts shown or required for correct operation (N.O. and N.C.). Contacts shall be rated minimum 10 amps at 120V. A manual test button and pilot light shall be included to indicate power to the coil.

2. Timers shall utilize a five position rotary switch to select the timing range. Three position thumbweels shall be provided for selecting the time value.

K. **Terminal Blocks**

1. All starter units shall be provided with unit control terminal blocks.

2. Terminal blocks shall be the pull-apart type 600 volt and rated at 25 amps. All current carrying parts shall be tin plated. Terminals shall be accessible from inside the unit when the unit door is opened. Terminal blocks shall be DIN rail mounted with the stationary portion of the block secured to the unit bottom plate. The stationary portion shall be used for factory connections, and shall remain attached to the unit when removed. The terminals used for field connections shall face forward so they can be wired without removing the unit or any of its components.

L. **Limit Switches**

1. Where limit switches are called for in these Specifications, they shall be the double pole, oil-tight type, suitable for the type mounting required.

M. **Timers**

1. Timers for various services required in the motor control equipment shall be Paragon, Tork or equal as indicated in control circuits shown on the Drawings.

2. Timers requiring tripping pins shall be supplied with enough pins to completely fill all locations on the dial face.

2.4 **ENCLOSURES**

A. **The enclosure shall be as indicated** on the Contract Drawings.

PART 3 – EXECUTION

3.1 INSTALLATION

A. **All individual motor starters** shall be installed as indicated on the Drawings and as recommended by the equipment manufacturer.

B. **A manufacturer's field rep** shall provide a minimum of one (1) eight-hour day of programming, startup, and checkout services concurrent with startup services of the equipment controlled by the starter.

C. **Individually Mounted Motor Control Devices (480 or 120 Volt)**

1. Each motor disconnect shall be located as near as possible to its respective motor.

2. Remote control station at or near motor shall be mounted near its respective motor, adjacent to the motor disconnect.

3.2 EXTRA STOCK/SPARE PARTS

A. **Provide the following spare parts**:

1. 10 fuses of each type/amperage used

2. 1 pilot light lamp for each pilot light socket assembly provided

3. 1 control transformer for each size utilized

END OF SECTION

SECTION 26 29 23

VARIABLE FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. **The Contractor shall furnish, install,** connect, test and place in satisfactory operating condition all variable frequency drives (VFD's) as specified herein and indicated on the Drawings.

1.2 REFERENCES

A. **The drive shall be designed** to meet the following specifications:

1. NFPA 70 – US National Electrical Code
2. NEMA ICS 7.1 – Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems
3. NEMA 250 – Enclosures for Electrical Equipment
4. UL 508 – Industrial Control Equipment
5. UL 508C – Power Conversion Equipment
6. CAN/CSA-C22 No.14-M91 – Canadian Standards Association
7. IEC 146 – International Electrical Code
8. IEC 61000 – Electromagnetic Compatibility

1.3 REGULATORY REQUIREMENTS

A. **The drive shall conform** to the following requirements:

1. FPA 70
2. IEC 146
3. EN Standard/CE marked for EMC directives

Emissions	Immunity
EN 50081-1	EN 50082-1
EN 50081-2	EN 50082-2
EN 55011 Class A	IEC 801-1,2,3,4,6,8
EN 55011 Class B	(per EN 50082-1,2

4. EN Standard/CE marked for Low Voltage directives

5. EN 60204-1

6. PREN 50178

7. IEC 801

8. C-UL marking to provide an approved listing for both United States and Canadian users.

1.4 QUALIFICATIONS

A. **Manufacturer: The drive manufacturer shall have been** in the drive business continuously for a minimum of 15 years and specialize in the design and manufacturing of PWM Adjustable Frequency Drives.

B. **Support: The drive manufacturer shall maintain** factory trained and authorized service facilities for their drives within 100 miles of the project and have a demonstrated record of service for at least the previous three years. Full-time support personnel shall be employed by the drive manufacturer.

C. **Certification: All drives must be assembled** at locations that are certified to the ISO-9001 Series of Quality Standards. This insures all quality and corrective action procedures are documented and implemented with a goal of Total Customer Satisfaction.

1.5 START-UP AND TESTING

A. **All tests shall be performed** in accordance with the requirements of the General Conditions and Division 1. The following tests are required

1. Witnessed Shop Tests

   a. None required.

2. Certified Shop Tests and Reports

   a. Submit description of proposed testing methods, procedures, and apparatus.
   b. Submit notarized and certified copies of all test reports.
   c. Submit factory bench-test data to indicate that the manufacturer's proposed equipment has been tested in the specified arrangement and found to achieve specified accuracy.

3. Field Tests

   a. Field tests shall be performed in accordance with requirements specified in the General Conditions, Division 1, and Section 26 01 26 - Testing of Electrical Systems.

B. **Start-up of the variable frequency drives** shall be coordinated with the start-up of the driven equipment, and other related equipment which may pertain to drive settings. The VFD field service representative shall be available during the entire start-up procedure to adjust VFD settings as required for the entire system operation.

C. **VFD settings shall be modified** as required from the factory settings for the actual motor nameplate data, and any other settings as required for proper operation (i.e., ramp time during start-up, etc.)

D. **Acceptance of a shop test** does not relieve Contractor from requirements to meet field installation tests under specified operating conditions, nor does the inspection relieve the Contractor of responsibilities.

E. **Submit signed and dated certification** that all of the factory inspection and testing procedures described herein have been successfully performed by the Contractor prior to shipment.

1.6 SUBMITTALS

A. **In accordance with the procedures** and requirements set forth in General Conditions and Section 01 33 00 - Submittal Procedures, the Contractor shall obtain from the equipment manufacturer and submit the following

1. Shop Drawings
2. Harmonic Study Report
3. Programming Guides/Manuals
4. Operation and Maintenance Manuals
5. Spare Parts List
6. Special Tools List
7. Reports of Certified Shop and Field Tests

B. **Each submittal shall be identified** by the applicable specification section.

1.7 SHOP DRAWINGS

A. **Each submittal shall be complete** in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. **Partial, incomplete, or illegible submittals** will be returned to the Contractor without review for resubmittal.

C. **Drawings submitted by the manufacturer** shall be complete and documented to provide the Owner with operations and maintenance capabilities.

D. **Shop drawings <u>for each VFD</u>** shall include but not be limited to:

1. Layout drawings of the variable frequency drive system that include all cabinet or enclosure dimensions, access details, and weights.

2. Layout drawings of panels or enclosures showing size, arrangement, color, and nameplates. Drawings shall include the physical arrangement of door mounted devices located on the variable frequency drive enclosure. Sufficient detail shall be provided for locating conduit stub-ups. General "catalog data sheet" layout drawings which are not specific to the systems specified herein are not acceptable.

3. Custom schematic and interconnection wiring diagrams of all electrical work, including terminal blocks and identification numbers, wire numbers and wire colors. Standard schematics and wiring diagrams that are not custom created by the manufacturer for the variable frequency drives for this project are not acceptable. These drawings shall be circuit specific for each motor-load combination. Indicate all devices, regardless of their physical location, on these diagrams. Specific equipment names consistent with the Drawings shall appear on each respective diagram.

4. Complete three-line diagrams indicating all devices comprising the variable frequency drive system including, but not limited to, circuit breakers, motor circuit protectors, contactors, instrument transformers, meters, relays, timers, control devices, and other equipment comprising the complete system. Electrical ratings of all equipment and devices shall be clearly indicated on these single line diagrams.

5. Complete Bills of Material and catalog data sheets for all equipment and devices comprising the variable frequency drive system.

6. A complete list of recommended spare parts, including item descriptions, recommended quantities, and unit costs. The recommended list should be based on a maintenance plan where the Owner will remove and replace failed items to the lowest replaceable module/component level.

E. **The shop drawing information** shall be completed and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "Soft Cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are to provide are acceptable and shall be submitted.

F. **Prior to completion and final acceptance** of the project, the Contractor shall furnish and install "<u>as-built</u>" wiring diagrams for each VFD. These final drawings shall be plastic laminated and securely placed inside each VFD and starter door and included in the O&M manuals.

G. **Product Data shall include,** but not be limited to

1. Functional diagrams that identify major system functional blocks and interfaces.

2. Special requirements or restrictions of the motor-load combination that may result from operation on the variable frequency drive system.

H. **Harmonic Study and Data** shall include but not be limited to:

1. Report of Harmonic Study to determine the harmonic distortion present in the voltage and current waveforms in the electrical distribution system(s) caused by the variable frequency drive system as specified herein.

2. Voltage and current waveforms supplied by variable frequency drive at the motor leads.

3. Necessary descriptions regarding calculation method, assumptions, values and notations, basis for input information, manufacturer's harmonic content data, and calculation results interpretation.

I. **Programming Guides and Manuals** shall be submitted. If the variable frequency drive systems require computer software or configuration, provide copies of all programming guides/manuals.

1.8 OPERATIONS AND MAINTENANCE MANUALS

A. **The Contractor shall submit operation** and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions, Section 01 33 00, Submittal Procedures

B. **Operation and Maintenance Manuals** shall also be provided in electronic format on CDROM.

1.9 TOOLS, SUPPLIES, AND SPARE PARTS

A. **The VFD's and accessories shall be furnished** with all special tools necessary to disassemble, service, repair, and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished by the Contractor to the Owner.

B. **The Contractor shall furnish** the following spare parts for each VFD:

1. One set of all power and control fuses for each variable frequency drive.

C. **The spare parts shall be packed** in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

D. **Spare parts shall be delivered** at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the Work, at which time they shall be delivered to the Owner.

E. **Spare parts lists, included with** the shop drawing submittal shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

F. **Parts shall be completely identified** with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.10 **SERVICES OF MANUFACTURER'S REPRESENTATIVE**

A. **The Contractor shall provide** the services of a qualified manufacturer's technical representative who shall adequately supervise the installation and testing of all equipment furnished under this Contract and instruct the Contractor's personnel and the Owner's operating personnel in its maintenance and operation. The services of the manufacturer's representative shall be provided for a period of not less than as follows:

1. One trip of one (1) working day during start-up/configuration of the equipment.

2. One trip of one (1) working day after acceptance of the equipment.

B. **Any additional time required** to achieve successful installation and operation shall be at the expense of the Contractor. The manufacturer's representative shall sign in and out at the office of the Resident representative on each day he is at the project.

1.11 **IDENTIFICATION**

A. **Each VFD shall be identified** by the circuit number and equipment name as indicated on the Drawings. A nameplate shall be securely affixed in a conspicuous place on each VFD.

1.12 **TRAINING**

A. **The Contractor shall provide training** for Owner personnel. Training shall be conducted by the manufacturer's factory trained specialists who shall instruct Owner personnel in operation and maintenance of all equipment provided under this Section.

B. **Provide the services of an experienced,** factory trained technician or service engineer of the variable frequency drive manufacturer at the jobsite for minimum of 1 day for training of Owner personnel, beginning at a date mutually agreeable to the Contractor and the Owner. The technician shall be on duty at the site for at least 8 hours per day.

C. **Include in the bid the training of personnel** in the operation and maintenance of each furnished variable frequency drive pump control system. For the purpose of this training section of the Specifications, a system is by definition a group of pumps or equipment which all serve a common function (e.g. dewatering pumps). Training shall include at least one session for 2 designated employees for each system.

1.13 **WARRANTY**

A. **Contractor shall warrant that the material** and workmanship of all components and the operation of the variable frequency drive system and auxiliary equipment is in accordance with the latest design practices and meets the requirements of this Specification.

B. **Warranty work shall include,** but not be limited to, the following:

1. Replace components found to be faulty and make changes in equipment arrangement or adjustments necessary to meet the equipment or functional requirements or this Specification.

2. Warranty shall include system rewiring and substitution and rebuilt or additional equipment required during trial operation or subsequent operation of the unit during the period of this warranty.

3. Warranty duration and terms shall be as defined in the General Conditions for the project warranty.

PART 2 - PRODUCTS

2.1 **MANUFACTURERS**

A. **The equipment covered by this Specification** is intended to be standard equipment of proven performance. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. **It is the intent of these specifications** that the VFD's be provided as individually-enclosed VFDs. The Contractor shall obtain the VFD's from one manufacturer who shall also manufacture the enclosure and major equipment components.

C. **The manufacturer shall have** a minimum of five years experience in the manufacture of similar units and shall have a general distribution to the electrical trade. Subcontracting of wiring will not be acceptable.

D. **Acceptable manufacturers**

1. PowerFlex 755 as manufactured by Allen-Bradley, no exceptions.

E. **Motor control circuits shall be** wired in accordance with the requirements specified herein or indicated on the Drawings.

F. **Mechanical equipment manufacturer** shall be responsible for the successful application and operation of the entire drive and control system serving the motor and driven equipment. This includes the responsibility for providing all load, torque, speed and performance requirements from the respective sources and integrating these into a variable frequency drive system that fulfills the requirements of this Specification.

G. **The Contractor and variable frequency** drive system manufacturer are cautioned regarding the review and compliance with the total Contract Documents. Typical examples are circuit breakers, motor circuit protectors, magnetic starters, relays, timers, control and instrumentation products, pilot devices including pushbuttons, selector switches and pilot lights, enclosures, conduit, disconnect switches, terminal boxes, and other equipment.

2.2 PRODUCT REQUIREMENTS

A. **Variable speed drives** shall be adjustable frequency, adjustable voltage, pulse width modulated (PWM) design. The units shall be microprocessor controlled, fully digitally programmable, and capable of precise and repeatable speed regulation of three phase 480 volt AC NEMA Design B induction motors. Variable frequency drives for other than NEMA Design B induction motors (e.g. NEMA Design C) shall be coordinated with the requirements of that respective load.

Drive units shall perform continuous self diagnostics as well as load and drive self check on startup.

B. **All drives shall have** permanently mounted programming and display modules. These modules shall provide programming access to all drive parameters, display all fault codes to assist with diagnostics and provide a display of output speed in percent or load.

C. **This specification describes** variable speed motor control which includes the design, fabrication, testing, installation and support requirements for variable frequency drive systems for 3-phase, squirrel cage rotor, induction motors driving pumps or other equipment.

D. **Each variable frequency drive** to be a complete alternating current electric drive system including hardware, software, technical data, and spare parts necessary to accomplish variable speed operation of an induction motor and load combination in accordance with the requirements as indicated on the Drawings and as described in these Specifications.

E. **Variable frequency drive system manufacturer** shall be responsible for the design and performance of the entire drive system and shall either manufacture all items of equipment or supply them using coordinated specifications furnished to the original equipment manufacturers to insure compatibility and performance in accordance with this Specification.

F. **Variable frequency drive system** shall be suitable for operation as part of a 208 VAC, 3-phase, 60 Hertz power distribution system. The complete variable

frequency drive system shall withstand the mechanical forces exerted during short circuit conditions when connected directly to a power source having available fault current of 65,000 amperes symmetrical at rated voltage.

G. **The variable frequency drive system** shall be suitable to operate on a limited power source engine-generator set. The system shall be provided with equipment and devices to prevent waveform distortion as specified herein.

H. **Provide control and sequence logic** as specified herein and indicated on the Drawings. Control and sequence logic shall be designed such that the motor-load combination can be operated in the manual mode upon control and sequence logic failure, including all necessary personnel and equipment safety interlocks.

2.3 **DESIGN REQUIREMENTS**

A. **Each variable frequency drive system** shall meet the requirements of this Specification without derating any of the induction motor operating parameters including service factor and nameplate horsepower. The variable frequency drive system manufacturer shall specifically identify special requirements or restrictions of the motor-load combination that may result from operation on the variable frequency drive system.

B. **The variable frequency drive shall** consist of a 6 pulse diode semiconductor rectifier system, direct current link, and pulse width modulated inverter. The inverter shall invert the direct current voltage into an alternating current voltage at a frequency which shall be proportional to the desired speed. This alternating current voltage and frequency shall both vary simultaneously at a constant "Volts-Per-Hertz" ratio to operate the induction motor at the desired speed.

C. **For AC Drives rated up to 500 horsepower**, the AC Drive manufacturer shall use a 6-Pulse bridge rectifier design with input line reactors for effective harmonic mitigation as required to meet IEEE 519. The power section shall be insensitive to phase rotation of the AC line.

D. **Diode rectifiers shall convert** fixed voltage and frequency, AC line power to fixed DC voltage.

E. **Variable frequency drive shall** operate from fixed frequency power supply and convert this input power into variable speed induction motor shaft power as required by this Specification. Provide each variable frequency drive with a motor circuit protector or disconnect switch as indicated on the Drawings which shall be padlockable. Provide each 6-pulse variable frequency drive with 5% line reactors at the input. Include the necessary drive controllers and output contactors to accomplish the intended control of the variable frequency drive system.

F. **The drive shall operate the motor** and produce full rated nameplate horsepower at the motor output shaft without exceeding motor nameplate full load current and with the motor not exceeding rated total temperature not including the additional temperature increment that constitutes the motor service factor. Motor shall retain its service factor when operated by the variable frequency drive.

G. **The overall drive system efficiency** shall be a minimum of 95 percent when operating the specified motor-load combination at rated voltage, frequency, and current.

H. **Variable frequency drive shall** provide smooth, stepless changes in motor speed and acceleration over the entire operating speed range from minimum to maximum speed (revolutions per minute). The variable frequency drive shall be provided with maximum and minimum frequency limits.

I. **Variable frequency drive system** to maintain a desired output frequency (setpoint) with a steady state accuracy of 0.5 percent of rated frequency of 60 Hertz for a 24 hour period.

J. **Variable frequency drive to have** an automatic current limit feature to control motor currents during startup and provide a "soft start" torque profile for the motor-load combination. The variable frequency drive shall also limit current due to motor winding or motor lead phase-to-phase short circuit or phase-to-ground short circuit. The current limit protection setting shall be field adjustable.

K. **Variable frequency drive shall** be furnished with programmable electronic overload and torque limits.

L. **Drive system shall achieve** a desired output frequency (setpoint) with a repeatability of 0.1 percent of rated frequency of 60 Hertz.

M. **Drive system to be capable of** operating the specified load continuously at any speed within the operating speed range of 10 percent to 100 percent of rated speed. The minimum and maximum continuous operating speeds shall each be adjustable within this speed range. The variable frequency drive shall provide for field adjustment of these setpoints.

N. **Drive system controls** to be microprocessor-based and have controlled linear acceleration capability to ramp up the speed, revolutions per minute, of the motor-load combination from the minimum selected operating speed to the maximum selected operating speed in a minimum of 30 seconds. Provide two (2) field-adjustable speed setpoints for the variable frequency drive to skip equipment resonant frequencies. Provide controlled linear deceleration capability. The acceleration and deceleration time limits shall be field adjustable to values up to 120 seconds.

O. **Voltage or current unbalance** between phases of the variable frequency drive output voltage shall not exceed 3 percent of the instantaneous values. The variable frequency drive system shall continuously monitor the output voltages and generate an alarm condition when the unbalance exceeds 3 percent. The system shall detect and generate a separate alarm for loss of any output phase voltage (single phasing). Phase unbalance shall be as defined by NEMA Standard MG-1.

P. **Variable frequency drive system** to operate continuously without interruption of service or damage to equipment during transient input voltage variations of plus or minus 10 percent for a duration of 15 cycles. Unacceptable voltage fluctuations on the supply bus shall cause under or overvoltage protection to trip

and remove supply voltage from the drive system. Variable frequency drive output voltage regulation shall be plus or minus 2 percent.

The variable frequency drive system shall be furnished with line surge protection.

Q. **If deemed necessary by the mechanical equipment** and variable frequency drive suppliers for the installation, the variable frequency drives shall be provided with output reactors or filters to prevent elevated voltage levels at the motor terminals.

2.4 OPERATING CONDITIONS

A. **The following operating conditions** are applicable for all equipment of this Specification.

1. Humidity: 0-95 percent

2. Ambient Temperature: Minus 20 degrees Celsius to plus 50 degrees Celsius

3. Altitude: up to 3,300 feet

4. Power Supply: 208 volts, 3-phase, 60 Hertz

5. Available Short Circuit Duty: as specified herein

6. The AC Drive shall meet IEC 60664-1 and NEMA ICS-1 Annex A standards.

7. The maximum relative humidity shall be 95 percent at 40 degrees C non-condensing or dripping water conforming to IEC 60068-2-3.

8. The AC Drive shall conform to IEC 600721-3-3-3M3 amplitude for Operational Vibration Specifications.

2.5 SYSTEM FEATURES AND CHARACTERISTICS

A. **Controls and indicators to accomplish** operation and maintenance shall be located on the variable frequency drive equipment assembly as specified herein and indicated on the Drawings.

B. **Variable frequency drive system** shall provide a 4-20 mADC output signal that is proportional to the drive output frequency for use as speed feedback or control and remote speed indication.

C. **Variable frequency drive system** shall accept a 4-20 mADC input command signal to control the output frequency in the automatic and/or manual control modes as specified herein or indicated on the Drawings. The system shall accept the input increase/decrease command with a resolution that permits incremental changes in speed, revolutions per minute, equal to or less than 0.1 percent of rated speed.

D. **Variable frequency drive shall** be furnished with a multiple attempt restart feature.

E. **Provide variable frequency drive system** with transmitted and received radio interference protection.

F. **In addition, provide protection** against starting a rotating motor, both directions (coasting to zero speed and backspin). In the event that a motor automatic restart feature (catch the motor "on-the-fly") is provided in the drive controller as standard, this feature shall be capable of being disabled.

G. **Variable frequency drive design** shall include on-line diagnostics, with an automatic self-check feature that will detect a variable frequency drive failure which in turn affects motor operation and generates an alarm contact output rated for 125 VAC suitable for interfacing with the control system.

1. Diagnostics shall operate a visual alarm indicator that is visible on the variable frequency drive equipment cabinets without opening the cabinet doors.

2. Diagnostics shall provide an easily readable output that will isolate a failure.

3. Provide an event and diagnostic recorder to printout in narrative English of the specific fault(s) and the sequence in which the faults occurred. An indication of the "First Out" failure is a minimum for fault sequence detection.

4. Provide a normally open dry contact for each alarm function to enable remote indication.

5. A 20-COMM-E Ethernet communication port shall be provided. Database addresses of monitoring, control, and alarm parameters shall be provided for interface with Owner’s SCADA system.

2.6 PROTECTION

A. **Upon power-up shall automatically test** for valid operation of memory, option module, loss of analog reference input, loss of communication, dynamic brake failure, DC to DC power supply, control power and the pre-charge circuit.

B. **UL 508C listed for use on distribution systems** with 100,000A available fault current. The AC Drive shall have a coordinated short circuit rating designed to UL 508C and listed on the nameplate.

C. **Protection against short circuits,** between output phases and ground; and the logic and analog outputs.

D. **Minimum AC undervoltage power loss ride-through of 200 milliseconds.** The AC Drive shall have the user-defined option of frequency fold-back to allow motor torque production to continue to increase the duration of the powerloss ride-through.

E. **Selectable ride through function** that will allow the logic to maintain control for a minimum of one second without faulting.

F. **For a fault condition other than a ground fault,** short circuit or internal fault, an auto restart function will provide programmable restart attempts. The programmable time delay before restart attempts shall be unlimited.

G. **Deceleration mode programmable** for normal and fault conditions. The stop modes shall include free-wheel stop, fast stop and DC injection braking.

H. **Upon loss of the analog process follower reference signal,** shall fault and/or operate at a userdefined speed set between software programmed low-speed and high-speed settings.

I. **Solid state I2t protection that is UL listed** and meets UL 508C as a Class 10 overload protection and meets IEC 60947. The minimum adjustment range shall be from 20 to 150 percent of the nominal output current rating of the AC Drive.

J. **Thermal switch with a user selectable pre-alarm** that will provide a minimum of 60 seconds delay before overtemperature fault.

K. **Use bonded fin heatsink construction** for maximum heat transfer.

L. **Fold-back function that will automatically anticipate** a controller overload condition and fold back the frequency to avoid a fault condition.

M. **The output frequency shall be software enabled** to fold back when the motor is overloaded.

N. **There shall be three skip frequency ranges** with hysteresis adjustment that can each be programmed independently, back to back or overlapping.

2.7 ADJUSTMENTS AND CONFIGURATIONS

A. **The AC Drive shall self-configure** to the main operating supply voltage and frequency. No operator adjustments will be required.

B. **Upon power-up, automatically send a signal** to the connected motor. The stator resistance data will be measured at rated current. The AC Drive will automatically optimize the operating characteristics according to the stored data.

C. **A choice of four types of acceleration and deceleration ramps** will be available in the AC Drive software; linear, S curve, U curve, and custom.

D. **The acceleration and deceleration ramp times** shall be adjustable from 0.01 to 9,000 seconds.

E. **The volts per frequency ratios** shall be user selectable to meet variable torque loads, normal and high-torque machine applications.

F. **The memory shall retain and record run status** and fault type of the past eight faults.

G. **Slip compensation** shall be adjustable from 0 to 150%.

H. **The software shall have an "Energy Saving" function** that will reduce the voltage to the motor when selected for variable torque loads. A constant volts/Hertz ratio will be maintained during acceleration. The output voltage will then automatically adjust to meet the torque requirement of the load.

I. **The AC Drive shall offer programmable DC injection braking** that will brake the AC motor by injecting DC current and creating a stationary magnetic pole in the stator. The level of current will be adjustable between 10 and 110 percent of rated current and available from 0.1 to 30 seconds continuously. For continuous operation after 30 seconds, the current shall be automatically reduced to 50 percent of the nameplate current of the motor.

J. **Sequencing logic will coordinate** the engage and release thresholds and time delays for the sequencing of the AC Drive output, mechanical actuation and DC injection braking in order to accomplish smooth starting and stopping of a mechanical process.

2.8 GRAPHIC TERMINAL DISPLAY INTERFACE

A. **The graphic display terminal will provide** 8 lines of 240 by 160 pixels in plain English to control, adjust and configure the AC Drive. All electrical values, bar charts, configuration parameters, I/O assignments, application and activity function access, faults, local control, adjustment storage, self-test and diagnostics. There shall be a standard selection of six additional languages built-in to the operating software as standard.

B. **The AC Drive model number, torque type,** software revision number, horsepower, output current, motor frequency and motor voltage shall all be listed on the drive identification display as viewed on the graphic display terminal.

C. **As a minimum the selectable outputs** shall consist of speed reference, output frequency, output current, motor torque, output power, output voltage, line voltage, DC voltage, motor thermal state, drive thermal state, elapsed time, motor speed, machine speed reference and machine speed.

D. **The graphic display terminal will consist of** programmable function keys. The functions will allow both operating commands and programming options to be preset by the operator. A hardware selector switch will allow the graphic display terminal to be locked out from unauthorized personnel.

E. **The graphic display terminal will offer** a simply smart to advanced user menu consisting of parameter setting, I/O map, fault history, and drive configuration. A software lock will limit access to the main menu.

F. **The navigation wheel will provide** the ability to scroll through menus and screens, select or activate functions or increase the value of a selected parameter.

G. **An escape key will allow a parameter** to return the existing value if adjustment is not required and the value is displayed. The escape function will also return to a previous menu display.

H. **A STOP key will command 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 graphic terminal display

J. **The keypad and all door mounted controls** shall be furnished as required to meet the enclosure rating.

2.9 **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 shall be software assignable. Other devices shall be provided as shown on the control circuits or specifically called for on the Drawings.

B. **2-wire or 3-wire control strategy** shall be defined within the software. 2-wire control allows automatic restart of the AC Drive without operator intervention after a fault or loss of power. 3-wire control requires operator intervention to restart the AC Drive after a fault or loss of power.

C. **The control power for the digital inputs** and outputs 120VAC.

D. **The internal power supply incorporates** an automatic current fold-back that protects the internal power supply if incorrectly connected or shorted. The transistor logic outputs will be current limited and not be damaged if shorted or excess current is pulled.

E. **All logic connections shall be furnished** on pull apart terminal strips.

F. **There shall be (2) two software assignable analog inputs** with interference filtering. The analog inputs will be software selectable and consisting of user defined configurations: x-y mA or x-y V.

G. **There shall be five software assignable logic inputs** that will be selected and assigned in the software. The selection of assignments shall consist of forward, reverse, jog, plus/minus speed (2 inputs required), setpoint memory, preset speeds (up to 8 inputs), auto/manual control, controlled stop, terminal or keypad control, output contactor (2 inputs required), motor switching, and fault reset.

H. **There shall be two software assignable analog outputs** with interference filtering. The analog outputs can be selected and assigned in the software. The analog output assignments shall be proportional to the following motor characteristics: frequency, current, power torque, voltage and thermal state. The output signal will be user defined configurations: x-y mA or x-y V.

I. **Two voltage-free Form C relay output contacts** shall be provided. One of the contacts shall indicate AC Drive faults status. The other contact shall be user assignable.

J. **There shall be a hardware input/output extension module** that also provides interlocking and sequencing capabilities. The module shall be fully isolated and housed in a finger-safe enclosure with pull apart terminal strips. The module shall add four logic inputs, two analog inputs, two relay outputs, and one analog output. All of the I/O shall be user assignable in the software as previously defined.

K. **The combination enclosure shall have as a minimum,** the following 22mm door-mounted operators:

1. Power on pilot light (red)

2. Drive run pilot light (green)

3. Drive fault pilot light (red)

4. Stop push button

Other devices shall be provided as shown on the control circuits or specifically called for on the Drawings.

2.10 MISCELLANEOUS

A. **Encapsulate critical components** in ceramic or metal.

B. **Auxiliaries, including fans,** that are required for rated load operation at maximum ambient temperature, shall be 100 percent redundant. A new and unused spare replacement fan(s) or air conditioning unit(s), shipped in original carton, may be acceptable.

C. **Circuit boards and electrical components** shall meet the corrosion protection requirements specified in these Specifications. Varnished or epoxy encapsulated circuit boards and tropicalized contactors suitable for corrosive environments shall be furnished where the VFDs are not located in climate controlled areas.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **Anchor all cabinetry firmly** to the foundation.

B. **Verify that the location is ready to receive work** and the dimensions are as indicated.

C. **Do not install AC Drive equipment** until the building environment can be maintained within the service required by the manufacturer.

D. **Before and during the installation, the AC Drive equipment** shall be protected from site contaminants.

E. **The VFD's shall be installed** as shown on the Drawings and in accordance with the manufacturer's installation instructions.

F. **Install VFD's to allow** complete door swing required for component removal. This is specifically required where a VFD is set in the corner of a room.

G. **Include in the bid a factory-trained service personnel,** other than sales representatives, to supervise field installation, inspect, make final adjustments and operational checks, make functional checks of spare parts, and prepare a final report for record purposes. Adjust control and instrument equipment until this equipment has been field tested by the Contractor and the results of these tests have been accepted by the Engineer.

3.2 TOOLS AND SPARE PARTS

A. **Any special tools required for normal operation** and maintenance shall be provided by the equipment manufacturer.

B. **Furnish the following spare parts:**

1. Ten fuses for each type used.

2. Ten lamps for each type used.

3. One spare VFD for each model provided.

END OF SECTION

SECTION 26 43 00

SURGE PROTECTION DEVICE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. **General: Drawings and general provisions of the Contract,** including General and Supplementary Conditions and Division 1 Specification sections apply to this section.

1.2 DESCRIPTION

A. **General: Surge protection device (SPD)** is the description and equipment required for the protection of all AC electrical circuits and electronic equipment from the effects of lightning induced voltages, external switching transients and internally generated switching transients.

1.3 REFERERENCE STANDARDS AND PUBLICATIONS

A. **General: The latest edition of the following standards** and publications shall comply to the work of this section:

1. ANSI/IEEE C84.1-1989, American National Standard for Electric Power Systems and Equipment - Voltage Ratings (60 Hertz)

2. ANSI/IEEE C62.41-1991, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

3. ANSI/IEEE C62.45-1992, IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits

4. The SPD units and all components shall be designed, manufactured and tested in accordance with the latest applicable UL standard (UL 1449, 2nd Edition dated February 5, 2005, compliance required February 9, 2007), UL 1283 and CSA certified per CSA 22.2.

5. SPD units shall be listed by Underwriters Laboratories and covered by Underwriters Laboratories Certification and Follow up services. Testing or listing to the UL 1449 standard by laboratories other than Underwriters Laboratories is not acceptable.

6. The UL 1449 suppression voltage ratings (SVR) and CSA label shall be permanently affixed to the Series Surge Protective Device (SPD).

7. Underwriters Laboratories, UL 1283, Standard for Safety - Electromagnetic Interference Filters

8. National Fire Protection Association, NFPA 780 - National Electrical Code

9. IEEE Standard 142-1991, IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems (IEEE Green Book)

10. ANSI/IEEE Standard 141-1999, IEEE Recommended Practice for Electric Power Distribution for Industrial Plants (IEEE Red Book)

11. IEEE Standard 1100-1999, IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment (IEEE Emerald Book)

12. FIPS Pub 94, Federal Information Processing Standards Publication - Guideline on Electrical Power for ADP Installations

13. National Electrical Manufacturer's Association LS-1, 1992 (NEMA LS-1)

14. MIL Standard 220A Method of Insertion-loss Measurement

15. ISO 9001:1994, Quality Systems - Model for Quality Assurance in Design, Development, Production, Installation and Servicing

1.4 MANUFACTURER QUALIFICATIONS

A. **Square D, Siemens, General Electric, or equal.**

1.5 WARRANTY

A. **The SPD and supporting components shall be guaranteed** by the manufacturer to be free of defects in material and workmanship for a period of ten (10) years from the date of substantial completion of service and activation of the system to which the suppressor is attached.

B. **An SPD that shows evidence of failure or incorrect operation** during the warranty period shall be replaced free of charge. Since "Acts of Nature" or similar statements typically include the threat of lightning to which the SPDs shall be exposed, any such clause limiting warranty responsibility in the general conditions of this specification shall not apply to this section. That is, the warranty is to cover the effects of lightning, single phasing, and all other electrical anomalies. The warranty shall cover the entire device, not just various components, such as modules only.

C. **The installation of SPDs in or on electrical distribution equipment** shall in no way compromise or violate equipment listing, labeling, or warranty of the distribution equipment.

1.6 SUBMITTALS

A. **The transient voltage surge suppression submittals** shall include, but shall not be limited to, the following information:

1. Data for each suppressor type indicating conductor sizes, conductor types, and connection configuration and lead lengths.

2. Manufacturer's certified test data indicating the ability of the product to meet or exceed requirements of this specification.

3. Drawings, with dimensions, indicating SPD mounting arrangement and lead length configuration, and mounting arrangement of any optional remote diagnostic equipment and assemblies.

4. List and detail all protection systems such as fuses, disconnecting means and protective materials.

5. SPD wiring, bonding, and grounding connections shall be indicated on the wiring diagrams for each system. Include installation details demonstrating mechanical and electrical connections to equipment to be protected.

6. Provide verification that the SPD device complies with the required UL 1449 2nd edition. At a minimum, the complete UL File number covering the submitted TVSS devices shall be provided.

PART 2 – PRODUCTS

2.1 PERFORMANCE

A. General

1. SPDs shall be listed in accordance with UL 1449 Second Edition, Standard for Safety, Transient Voltage Surge Suppressors and UL 1283, Standard for Safety, Electromagnetic Interference Filters.

2. The SPD shall protect all modes and there shall be seven discrete suppression circuits: 3 modes connected Line to Ground, 3 modes connected Line to Neutral, and 1 mode connected Neutral to Ground for a 3-phase, 4-wire, plus ground voltage system. Line to Neutral to Ground is not an acceptable substitute for Line to Ground. Line to Neutral to Line and Line to Ground to Line (in combination) will be acceptable for Line to Line protection.

3. All SPDs must have passed the UL 1449 Second Edition Fault Current Test with a Rating of 200,000 AIC. Documentation substantiating this claim must be provided.

4. SPDs shall use a separate path to building ground; the equipment safety ground is not to be used as a transient ground path.

5. All SPDs are to be an MOV-based design and are not to include SAD technology as a means of suppression.

6. The maximum continuous operating voltage (MCOV) of all components shall not be less than 125% for a 120V system and 115% for 220, 240, 277, and 480V systems.

7. Standard diagnostic features are to include green LEDs (one per phase - normally on) indicating power and suppression status and a set of normally open/normally closed Form C dry-relay contacts.

8. Extended diagnostics must include an audible alarm and surge counter to be displayed on an LCD display on the front of the suppressor. The surge counter must include a reset option. The audible alarm must include a mute option. Products requiring an optional diagnostic test kit to verify operational status are not acceptable.

B. **Service Entrance Protection**

1. The service entrance SPD equipment shall meet or exceed the minimum performance criteria as follows:

   a. The single-impulse surge-current rating shall be a minimum of 400,000 Amperes per phase (200,000 Amperes per mode).
   b. The UL 1449 Second Edition Suppressed Voltage Rating for the following configurations shall not exceed the following:

Voltage Configuration	L-G	L-N	N-G
120/208V (3Y101)	400V	400V	400V

   c. SPDs shall be of compact design. The mounting position of the SPD shall allow a straight and short lead-length connection between the SPD and the point of connection in the panelboard.
   d. Visual indication of proper SPD connection and operation shall be easily viewed on the front panel of the enclosure. The indicator lights shall indicate suppression circuit status, phase status, phase loss, reduced protection level and suppression fault.
   e. The SPD shall be equipped with an integral disconnect switch or be available as an option.
   f. A set of normally open/normally closed Form “C” dry contacts shall be provided for remote monitoring.
   g. SPDs shall have a diagnostics LCD panel display providing information on phase loss (specific to each phase), surge/transient event count, stored cumulative surge/transient event history, and technical support information.
   h. SPDs shall be equipped with an audible alarm with mute, reset and acknowledge features.
   i. The device must be certified to withstand a minimum of 20,000 Category C3 (Combination wave - 20,000 Volts - 1.2x50us OCV and 10,000 Amps - 8x20us SCC as defined by ANSI/IEEE C62.41-1991) impulses with less than 10% change in the baseline to final let-through voltage. This data must be submitted as an independently verified and certified test report.
   j. The maximum value for the attenuation for the suppressor must exceed a minimum of 33 dB. All measurements for this requirement must be taken using the MIL STD 220A method and

with only six (6) inches of lead length extending outside of the normal exit location of leads for the enclosure. Test results taken with leads extending past six (6) inches are not acceptable or compliant. Additional or excessive lead length used in the test setup is not acceptable.

C. **Lighting Panel Protection**

1. The distribution panel SPD equipment shall meet or exceed the minimum performance criteria as follows:

   a. The single-impulse surge-current rating shall be a minimum 80,000 Amperes per phase (40,000 Amperes per mode).
   b. The UL 1449 Second Edition Suppressed Voltage Rating for the following configurations shall not exceed the following:

Voltage Configuration	L-G	L-N	N-G
120/208V (3Y101) 120/240V	400V	400V	400V

   c. SPDs shall be of compact design. The mounting position of the SPD shall allow a straight and short lead-length connection between the SPD and the point of connection in the panelboard.
   d. Visual indication of proper SPD connection and operation shall be easily viewed on the front panel of the enclosure. The indicator lights shall indicate suppression circuit status, phase status, phase loss, reduced protection level and suppression fault.
   e. The SPD shall be equipped with an integral disconnect switch or be available as an option.
   f. A set of normally open/normally closed Form “C” dry contacts shall be provided for remote monitoring.
   g. SPDs shall have a diagnostics LCD panel display providing information on phase loss (specific to each phase), surge/transient event count, stored cumulative surge/transient event history, and technical support information.
   h. SPDs shall be equipped with an audible alarm with mute, reset and acknowledge features.
   i. The device must be certified to withstand a minimum of 15,000 Category C3 (Combination wave - 20,000 Volts - 1.2x50us OCV and 10,000 Amps - 8x20us SCC as defined by ANSI/IEEE C62.41-1991) impulses with less than 10% change in the baseline to final let-through voltage. This data must be submitted as an independently verified and certified test report.
   j. The maximum value for the attenuation for the suppressor must exceed a minimum of 33 dB. All measurements for this requirement must be taken using the MIL STD 220A method using and with six (6) inches of lead length extending outside of the normal exit location of leads for the enclosure. Test results

taken with leads extending past six (6) inches are not acceptable or compliant. Additional or excessive lead length used in the test setup is not acceptable.

PART 3 – EXECUTION

3.1 INSTALLATION

A. **The installing contractor shall install** the parallel SPD with short and straight conductors as practically possible.

B. **The contractor shall follow the SPD manufacturer's recommended installation practice** as found in the equipment installation instructions.

C. **SPD shall be mounted inside** the panelboard or switchboard enclosure where indicated.

D. **The installation shall apply** to all applicable codes.

END OF SECTION

SECTION 26 50 00

LIGHTING

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. **The specific characteristics of the light fixtures** to be furnished and installed shall be as detailed in the light fixture schedule on the Contract Drawings. Should a fixture of a different type or manufacturer than that specified be submitted for the Engineer's review, it will be compared to that specified on: construction, dimensions, and photometrics. Failure to compare equally to what was specified will be grounds for rejection.

B. **The Contractor shall be prepared to submit** sample equipment for appraisal when requested by the Engineer, and shall assume all transportation costs involved in the shipment and return of samples. All sample fixtures submitted shall be provided with lamps and shall be wired with cord and plug, to facilitate lighting for appraisal.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. **Subject to compliance with the Contract Documents**, the following manufacturers are acceptable:

1. Lighting fixtures: See Fixture Schedule.

2. Solid State Light Sources:

   a. Cree.
   b. Xicato.
   c. Luminaire manufacturer’s proprietary system.
   d. Or equal

3. LED Driver: Luminaire manufacturer's standard.

4. Emergency ballasts:

   a. Iota Engineering.
   b. Philips Bodine.
   c. Or equal

2.2 GENERAL REQUIREMENTS

A. **All lighting fixtures and electrical components**:

1. UL labeled.

2. Luminaires complete with LED modules and drivers.

B. **No live parts normally exposed to contact**.

C. **When intended for use in wet areas**: Mark fixtures "Suitable for wet locations."

D. **When intended for use in damp areas**: Mark fixtures "Suitable for damp locations" or "Suitable for wet locations."

2.3 LUMINAIRES

A. **All fixtures shall be delivered complete** with suspension and mounting accessories, drivers, diffusers, reflectors, etc., all wired and assembled. All accessory wiring shall be furnished and installed as shown on the Contract Drawings.

B. **All steel supports required for luminaires** in addition to that furnished under the general building construction shall be furnished and installed by the Contractor.

C. **When fixtures are noted to be installed flush,** they shall be complete with the proper accessories for installing in the particular ceiling involved. All flush mounted fixtures shall be supported from the structure and shall not be dependent on the hung ceilings for their support.

D. **Luminaires for vaults** shall be watertight and rustproof.

E. **Luminaire wire shall be fixture type** of non-asbestos construction.

2.4 DRIVERS

A. **All drivers shall have built in thermal protection** and be of the high power factor type built to conform to UL and ANSI standards (as attested by CBM certification).

B. **If a lighting fixture is furnished with a remote driver** that it not indicated on the Drawings, the Contractor shall make provisions for mounting the driver in a location acceptable to the Engineer, at no additional cost.

C. **Compatible with solid-state modules** and control devices specified.

D. **Operate from 60 Hz input source of 120V through 277V** with sustained variations of +/- 10 percent (voltage and frequency).

E. **Input current Total Harmonic Distortion (THD):** Less than 20 percent when operated at nominal line voltage.

F. **Power Factor:** Greater than 0.90.

G. **Avoid interference with infrared devices** and eliminate visible flicker.

H. **Comply with ANSI C62.41 Category A** for Transient protection.

I. **Comply with the requirements** of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).

J. **Dimmable drivers capable of continuous dimming** over a range of 100 percent to 1 percent of rated lumen output. Dimming controlled by a 0-10VDC signal, unless otherwise specified in Luminaire Schedule.

K. **Control device** must be compatible with type of driver, and coordinated prior to submission of Shop Drawings. List of compatible dimming controllers must include the range of perceived brightness. No visible flicker throughout the dimming range.

L. **Remote-mounting**:

1. Provide maximum allowable distances for secondary wire runs to luminaires.

2. Provide remote mounting hardware and enclosures as required.

M. **Operating temperature range** must be suitable for site temperature conditions within exterior and gasketed luminaires.

2.5 SOLID-STATE MODULES

A. **Minimum uniform color temperature of 4000K,** except as noted otherwise.

B. **Minimum color rendering index (CRI) of >70**.

C. **LEDs** shall be of the type that will not require starter switches.

D. **LED module light output and efficacy**: Measured in accordance with IES LM-79 standards.

E. **LED useful life and lumen maintenance**: Measured in accordance with IES LM-80 standards.

F. **Driver and LED module**: Minimum useful life of 50,000 HRS.

G. **Individual LEDs connected** such that a failure of one LED will not result in a light output loss of the entire luminaire.

2.6 EMERGENCY BATTERY DRIVER:

A. **UL 924**.

B. **Confirm compatibility** with LED modules utilized.

C. **Consist of a high temperature**, maintenance-free nickel cadmium battery, charger and electronic circuitry.

D. **A solid state charging indicator light** to monitor the charger and battery.

E. **Single-pole test switch**.

F. **Luminaire properly heat sinked** to assure LED junction temperature ratings are not exceeded.

1. Provide ambient operating temperature range for which product is warrantied.

2.7 EXIT SIGNS AND EMERGENCY LIGHTING UNITS

A. **Standards:**

1. UL 924.

2. NFPA 101.

3. Local State or City requirements.

B. **Exit Signs:**

1. Housing and finish: As indicated in the Luminaire Schedule.

2. LED illuminated with integral driver.

3. AC powered or AC and battery powered: As indicated in the Luminaire Schedule.

4. Battery powered units:

a. Battery type: As indicated in the Luminaire Schedule.
b. Self-testing/self-diagnostic.
1) Electronic circuitry automatically test emergency lighting for a minimum of 30 seconds every 30 days and 90 minutes once a year.

5. Consist of battery, charger and electronic circuitry.

6. Solid state charging indicator light to monitor the charger and battery.

7. Single-pole test switch.

C. **Emergency Lighting Units:**

1. Housing: As indicated in the Luminaire Schedule.

2. Lamps: As indicated in the Luminaire Schedule.

3. Battery type: As indicated in the Luminaire Schedule.

4. Self-testing/self-diagnostic.

a. Electronic circuitry automatically test emergency lighting for a minimum of 30 seconds every 30 days and 90 minutes once a year.

5. Consist of battery, charger and electronic circuitry.

6. Solid state charging indicator light to monitor the charger and battery.

7. Single-pole test switch.

2.8 OCCUPANCY CONTROL SENSORS

A. General

1. Products supplied shall be from a single manufacturer that has been continuously involved in manufacturing of occupancy sensors for a minimum of five (5) years. Mixing of manufacturers shall not be allowed.

2. All components shall be U.L. listed, offer a five (5) year warranty and meet all state and local applicable code requirements.

3. Products shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.

4. Wall switch products must be capable of withstanding the effects of inrush current. Submittals shall clearly indicate the method used.

5. System Description

   a. The objective of this section is to ensure the proper installation of the occupancy sensor based lighting control system so that lighting is turned off automatically after reasonable time delay when a room or area is vacated by the last person to occupy said room or area.
   b. The occupancy sensor based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits.

6. Submittals

   a. Manufacturer shall substantiate conformance to this specification by supplying the necessary documents, performance data and wiring diagrams. Any deviations to this specification must be clearly stated by letter and submitted.
   b. Submit a lighting plan clearly marked by manufacturer showing proper product, location and orientation of each sensor.
   c. Submit any interconnection diagrams per major subsystem showing proper wiring.
   d. Submit standard catalog literature which includes performance specifications indicating compliance to the Specification.

e. Catalog sheets must clearly state any load restrictions when used with electronic ballasts.

7. Occupancy sensors and related products shall be Wattstopper, or Hubbell.

B. **Sensors**

1. All products shall be as indicated in occupancy sensor schedule.

2. Passive infrared sensors shall utilize Pulse Count Processing and Digital Signature Analysis to respond only to those signals caused by human motion.

3. Passive infrared sensors shall provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line).

4. Passive infrared sensors shall have a multiple segmented Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.

5. Dual technology sensors shall be either wall mounted, corner mounted or ceiling mounted in such a way as to minimize coverage in unwanted areas.

6. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.

7. Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.

8. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within ± 0.005% tolerance, 32 kHz within ± 0.002% tolerance, or 40 kHz ± 0.002% tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.

9. All sensors shall be capable of operating normally with electronic ballasts, LED, and PL lamp systems and rated motor loads.

10. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.

11. When specified, sensors shall utilize SmartSet™ technology for automatically adjustable time delay and sensitivity settings.

12. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.

13. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.

14. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

15. All sensors shall have UL rated, 94V-0 plastic enclosures.

C. **Circuit Control Hardware - Cu**

1. Control Units – For ease of mounting, installation and future service, control unit(s) shall be able to externally mount through a ½" knock-out on a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Control unit shall provide power to a minimum of two (2) sensors.

2. Relay Contacts shall have ratings of:

   a. 13A – 120 VAC Tungsten
   b. 20A – 120 VAC Ballast

3. Control wiring between sensors and controls units shall be Class II , 18-24 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.

PART 3 – EXECUTION

3.1 INSTALLATION/APPLICATION/ERECTION

A. **General**

1. The Contractor shall furnish all light fixtures, lighting equipment, components, hangers, etc., as shown on the Contract Drawings and shall install them at the locations shown on the Contract Drawings.

2. All fixture wiring shall be in conformance with the latest revision of the NEC and UL standards.

3. Lamps of the proper type, wattage and voltage rating shall be delivered to the project in the original cartons and installed in the fixtures just prior to the completion of the project, with spare lamps as listed on the Contract Drawings.

B. **Luminaires**

1. Similar fixtures in each room or area shall be installed with bottom of fixtures at same elevation, unless otherwise noted.

2. Minimum wire size shall be AWG No. 10 for runs over 75 feet.

3. Outlets shall be as specified herein and shall be suitable for the installation conditions encountered.

4. Conduit run in areas with hung ceilings shall be installed in the space above the hung ceiling as close to the structure as possible. Conduits and junction boxes shall be supported from the structure.

5. No light fixtures shall be hung or installed until after painting is completed, however, temporary lighting shall be provided by the Contractor. Fixtures in suspended ceilings shall be fastened to the main tees of the ceiling grid.

6. All fixtures shall be left in a clean condition, free of dirt and defects, before acceptance by the Engineer.

C. **Occupancy Sensors**

1. It shall be the Contractor's responsibility to make all proper adjustments to assure Owner's satisfaction with the occupancy system.

2. It shall be the Contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have ninety (90) to one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The Contractor shall provide additional sensors if required to properly and completely cover the respective room.

3. It is the Contractor's responsibility to arrange a pre-installation meeting with manufacturer's factory authorized representative, at Owner's facility, to verify placement of sensors and installation criteria.

4. Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. The Contractor shall also provide, at the Owner's facility, the training necessary to familiarize the Owner's personnel with the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing devices and systems.

END OF SECTION

SECTION 27 13 13

COMMUNICATION SYSTEMS

PART 1–GENERAL

1.1 SUMMARY

A. **Work Included: This specification contains the requirements** for communications cable as opposed to electrical power wire and cable.

B. **Related Sections and Divisions:** Applicable provisions of Division 1 shall govern work in this section.

1.2 QUALITY ASSURANCE

A. **Standards: Comply with standards specified** in this section as listed in Division 1.

B. **Qualifications of Installers: Use skilled workers** who are thoroughly trained and experienced in the necessary crafts, and who are completely familiar with the specified requirements and the methods needed for proper performance of the work.

1.3 PRODUCT HANDLING

A. **Communications cable shall be furnished** in lengths as necessary.

B. **Reels, coils, or package rolls of communications cable** shall be identified with the project name and other tagging identification as called for.

1.4 SUBMITTALS

A. **Submit shop drawings and product data** in accordance with provisions of Section 01 33 00–Submittals.

PART 2–PRODUCTS

2.1 GENERAL

A. **All materials of construction for cable and wire** shall be compatible and noncontaminating.

B. **Unless otherwise noted in these specifications,** the requirements herein listed shall be strictly adhered to.

2.2 INDUSTRIAL ETHERNET CABLE

A. **For communication with plant SCADA systems** and equipment in supervisory control centers, variable frequency drives (VFDs), switchboards, control panels, etc., and areas with 480-volt power, provide 600 V-rated, 4-pair unshielded twisted-pair cabling meeting EIA/TIA Category 6A requirements. Transmission characteristics of the cables shall meet full Category 6A performance criteria as

defined by the referenced TIA/EIA documents and this specification. Jacket color shall be coordinated during Shop Drawing review.

B. **Industrial Ethernet cable shall be minimum 24 AWG** with PVC jacket and foil. The cable outer jacket shall be industrial-grade PVC with a nominal overall cable diameter of 0.32 inches. Cable shall be nonplenum rated, UL listed, 600 V UL AWM rated, and be as manufactured by, Belden 10GX33, or equal.

C. **Patch cables shall be provided premanufactured** by the cable manufacturer or connector manufacturer in sufficient length to connect associated equipment to any port on the patch panel or switch. Field-attached plugs shall be insulation displacement type and be by the same manufacturer as the cable or connector.

D. **Connectors shall be RJ45, Category 6A, Leviton 6AUJK series, or equal.** Color shall be coordinated during Shop Drawing review.

2.3 MULTIMODE FIBER OPTIC CABLE AND CONNECTORS

A. **Fiber optic cable shall be Indoor/Outdoor listed type OFNR** and shall be suitable for use inside building and outside plant applications, including duct and conduit installation in accordance with ICEA S-104-696. Installation in building risers shall be in accordance with NEC 770. Cable shall be DX-###-D-ALT-9-K-R as manufactured by Optical Cable Corporation, ###-T-8F-311-80-29 as manufactured by Corning, or equal. Fiber Optic Cable sizing (fiber count) shall be as shown on the drawings.

B. **Individual fibers shall be multimode 62.5/125 microns** meeting TIA/EIA 492AAAC and ISO/IEC 11801 type OM1 standards for laser-optimized fibers. Primary fiber coating diameter 250 um±15 and the secondary tight buffer-coating diameter shall be 900 microns (nominal). All coatings shall be mechanically strippable without damaging the optical fiber. Optical performance shall meet the following requirements:

Wavelength	850 nm	1300 nm
100 Mb Fast Ethernet	300 m	2000 m
Gigabit Ethernet Distance	1000 m	600 m
10-Gigabit Ethernet Distance	300 m	300 m
Maximum Attenuation	3.0 dB/km	1.0 dB/km
Minimum Laser Bandwidth EMB	2000 MHz-km	500 MHz-km
Minimum LED Bandwidth OFL	1500 MHz-km	500 MHz-km

C. **Cable shall be all dielectric, tight-buffered,** dry water-blocking, gel-free, and shall meet UL 1666 and RoHS compliance. The PVC outer sheath shall be flame-retardant and marked with the manufacture’s name, date of manufacture, fiber type, flame rating, and sequential length information.

D. **Fiber shall be subjected to a minimum proof stress** of 100 kpsi. The minimum bend radius rating for the cable during installation shall not be more than 20 times the outside diameter of the cable, and during operation no more than 15 times the outside diameter of the cable. Cable shall withstand a minimum installation tensile load of 2700 N (600 lbf) and a minimum continuous tensile load of 600 N (135 lbf) for a 12-strand cable. The cable shall comply with the

optical and mechanical performance requirements as specified herein over the operating temperature range of -40°C to +70°C. The cable shall not be damaged in any way when exposed to the operating temperature range of -40°C to +70°C. The cable shall have an installation temperature range or -10°C to +60°C. Optical and mechanical performance shall not be degraded, and the cable shall not be damaged in any way by immersion in groundwater. The cable shall block water penetration without the use of gel-flooding compounds according to EIA-455-82B. The outer jacket material shall be suitable for long-term exposure to UV/sunlight and weather, with a life-expectancy in excess of 20 years.

E. **Fibers shall be terminated with connectors recommended** by the cable manufacturer. Connectors shall be provided on all fibers of each fiber optic cable. End connector styles (LC, Duplex SC or ST) shall be coordinated with the network switches and fiber termination panels or enclosures. The connector ferrule shall be ceramic of glass-in-ceramic, metallic, or equivalent. The optical connector within the connector ferrule shall be secured with an adhesive or mechanical process to prevent pistoning and other movement of the fiber strand. Provide heat-shrink tubing section where cable is broken out to protect jacketing end and minimize overflexing of the subcables. End connectors shall have integral strain relief and shall be designed to minimize losses. Attenuation per mated pair shall not exceed 0.5 dB (individual); 0.3 dB (average). These values shall hold throughout the cabling system. Connectors shall sustain a minimum of 200 mating cycles per EIA/TIA-455-21 without violating these specifications.

F. **Fiber patch panels or termination enclosures** shall be provided where indicated on the Drawings.

G. **Fiber optic patch cables shall be provided premanufactured** in sufficient length to connect associated equipment to any port on the patch panel or switch.

H. **All cables shall be installed in continuous lengths** from endpoint to endpoint. Splices in fiber optic cables shall be allowed only where specifically identified on drawings or specified herein.

PART 3–EXECUTION

3.1 INSTALLATION REQUIREMENTS AND TESTING

A. **Industrial Ethernet, and fiber optic cabling specified** in this section shall be installed in conduit, and may not be run free-air or in nonmetallic tubing such as innerduct.

B. **Since magnetic interference is produced by currents flowing** through conductors and electrical equipment, any communications run near electric motors, generators, transformers, induction heaters, circuit breakers, motor starters, power lines, or AC power and control cables may need additional magnetic shielding.

3.2 FIBER OPTIC CABLE INSTALLATION

A. **Provide minimum 30 feet of slack** in all cables within all electrical manholes. Manage slack on existing cable racks.

B. **Use cable tie tool to install cable ties** to manage cable slack. Cable tie tool shall apply appropriate pressure to the cable bundles so not to damage cable and provide a smooth cut of excess cable tie. Cable ties MUST be able to be turned freely around the bundle of cable. Cable bundles shall be limited to 3-inch diameter.

C. **Use Velcro bands to secure cable bundles** within interior pull boxes and fiber patch panels.

D. **Avoid excessive and sharp bends.** Ensure manufacturer's recommended bend radius and pulling tensions are not exceeded.

E. **Fittings or connections are allowed** only at the input and output of devices. Splicing shall not be accepted in any cable run. The entire cable run shall be replaced in all such instances.

F. **All cable shall be installed in conduit.** Underground installations shall include a 10 AWG tracer wire. Wire shall be orange and shall be XHHW-2. Wire shall terminate in junction boxes.

G. **Conduit, raceways, and outlet boxes** shall be provided as required.

H. **All station cables installed through and within process areas** shall be installed in conduit.

I. **Cable slack shall be provided at end of the fiber optic cable.** This slack is exclusive of the length of fiber that is required to accommodate termination requirements and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored in a fashion as to protect it from damage and be secured in the termination enclosure or a separate enclosure designated for this purpose. Multiple cables may share a common enclosure. A minimum of 15 feet of slack cable shall be coiled and secured at each end of the fiber optic cable. Exact cable termination locations shall be field verified with Owner and Engineer.

3.3 FIBER OPTIC TESTING

A. **The fibers utilized in the installed cable** shall be traceable to the manufacturer. Upon request by Owner, Contractor shall provide cable manufacturer's test report for each reel of cable provided. These test reports shall include (1) manufacturers on reel attenuation test results at the specified wavelengths for each optical fiber of each reel prior to shipment from the manufacture and, (2) on-the-reel bandwidth performance as tested at the factory.

B. **Prior to installation, Contractor shall perform tests** deemed necessary by Contractor to ensure integrity of all optical fiber. Tests may range from a simple "flashlight test" to an OTDR of each optical fiber of each cable reel prior to installation.

C. **Upon completion of cable installation and termination,** the fiber optic cabling shall be tested by a 3rd party. Testing shall include:

1. Optical Attenuation ("Insertion Loss" Method

2. Verification of Link Integrity (OTDR) if the cable has been spliced.

Contractor shall submit a link loss budget spreadsheet for each fiber optic strand prior to testing. Following testing, link loss budget spreadsheet shall be updated with measured OLTS attenuation results for the O&M manuals.

D. **Optical Attenuation shall be measured on all terminated optical fibers** in both directions of transmission using the "Insertion Loss" method. Measurement shall be inclusive of the optical connectors and couplings installed at the system endpoints. Access jumpers shall be used at both the transmit and receive ends to ensure that an accurate measurement of connector losses is made. Multimode fibers shall be tested in accordance with the IEC 61280-4-1, utilizing the appropriate cable reference 1, 2, or 3.

E. **Attenuation of optical fibers shall not exceed** the values calculated as follows: Attenuation (max.) = 2*C+L*F+S dB, where C is the maximum allowable connector loss (in dB), L is the length of the run (in kilometers), and F is the maximum allowable fiber loss (in dB/km). S is the total splice loss (number of splices* max. attenuation per splice).

F. **Fiber runs that contain splices shall be tested** for Verification of Link Integrity (OTDR). All fibers, even those that are left unterminated, shall be documented in one direction of transmission using an Optical Time Domain Reflectometer. Multimode fibers shall be tested at 850 nm (nominal). Single mode fibers (if applicable), shall be tested at 1300 (nominal). The OTDR(s) shall incorporate high-resolution optics optimized for viewing of short cable sections. Access jumpers of adequate length to allow viewing of the entire length of the cable, including the connectors at the launch and receive end, shall be used.

G. **OTDR traces revealing a point discontinuity** greater than 0.2 dB in a multimode fiber, or 0.1 dB in a single mode fiber (if applicable), at any of the tested wavelengths, or any discontinuity showing a reflection at that point shall be a valid basis for rejection of that fiber by Owner. The installation of that cable shall be reviewed in an effort to remove any external stress that may be causing the fault. If such efforts do not remove the fault, that cable and the associated terminations shall be replaced at the expense of Contractor.

H. **Upon completion of the installation, Contractor shall provide** three complete test reports to Engineer for review. Documentation shall include the following items:

1. Test results, submitted in hard copy or in electronic form (preferred). Where documentation provided in electronic form requires unique software for viewing test results, Contractor shall provide one licensed copy of the software along with the above documentation.

2. Insertion loss test data, including a record of test wavelengths, cable type, fiber and cable (or Outlet) I.D., measurement direction, test equipment type, model and serial number, date, reference setup, and crew member name(s).

3. OTDR traces (where applicable), including individual optical fiber "signatures" obtained as specified above. Trace files shall be so named as to identify each individual fiber by location in the cable system and fiber number or color. Where paper copy documentation of OTDR traces are provided, the vertical and horizontal scales shall be set so as to maximize the detail in each backscatter trace. The portion of the trace which depicts the fiber under test shall extend a minimum of 50% of the display area.

3.4 TELECOMMUNICATIONS CABLING FIELD TESTING

A. **Perform telecommunications cabling inspection,** verification, and performance tests in accordance with TIA/EIA-568.

B. **Inspection**

1. Visually inspect cabling jacket materials for UL or third party certification markings. Visually inspect UTP and OFO jacket materials for UL or other certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for tip and ring pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568. Visually confirm Category 6A (10 GBPS) marking of outlets, wallplates, jacks, and patch panels.

C. **Verification Tests**

1. UTP copper cabling shall be tested for DC loop resistance, shorts, opens, intermittent faults, near-end cross talk, proper pinning and termination and polarity between conductors, and between conductors and shield, if cable has overall shield. Test operation of shorting bars in connection blocks. Test cables after terminated but not cross connected. Perform 250 MHz near-end cross talk (NEXT), far-end cross talk (FEXT) return loss, propagation delay, delay skew requirements, and attenuation tests for Category 6A (10 GBPS) 100 ohm 4-pair systems installations.

2. Perform OFC testing using an optical time domain reflectometer (OTDR) and manufacturer's recommended test procedures. Perform tests in accordance with EIA/TIA-526-14, Method B for horizontal, multimode OFC and EIA/TIA-526-7, Method B for backbone, single mode OFC. Perform in factory acceptance tests and factory reel tests at jobsite prior to installation.

D. **Performance Tests**

1. Category 6A (10 GBPS) Links. Perform UTP link tests in accordance with ANSI/TIA-568-B.2-1. Tests shall include wire map, length, attenuation, NEXT, FEXT, return loss, and propagation delay.

E. **Final Verification Tests**

1. Perform verification tests for UTP and OFC systems after the complete telecommunications cabling and workstation jacks are installed. Connect

to the network interface device at the demarcation point. Verify communication to outlet.

END OF SECTION

SECTION 28 23 13

VIDEO SURVEILLANCE SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

A. Work Included: This section includes a complete and operational Video Surveillance System (VSS).

B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.2 SYSTEM DESCRIPTION

A. Provide a complete Operating Video Surveillance System (VSS). The system shall include fixed cameras, protective housings, Digital Video Recorder (DVR), monitor, keyboard and mouse, wiring, and all other equipment necessary for a complete and operational Video Surveillance System.

B. CONTRACTOR shall be responsible for providing final working drawings to be approved by ENGINEER and OWNER, based on the information described herein and shown on the drawings as well as by field observations. System design provided is not intended and does not show all details required for a complete system.

C. CONTRACTOR shall inspect all work. The Bid shall include everything necessary to obtain a complete installation operating in accordance with these specifications. All responsibility for these systems ultimately lies with CONTRACTOR.

D. CONTRACTOR shall be responsible for the placing of circuits and making of electrical connections in accordance with the manufacturer-furnished drawings, instructions, and field supervision to provide proper connection. The Contract shall include the services of the manufacturer's factory engineer to supervise making of connections to power supplies, communication circuits, and any other connections external to the new Video Surveillance equipment; to adjust the equipment; initiate and check operation; instruction of OWNER's staff on operation and maintenance of the equipment, and place the equipment in operation in a manner fully satisfactory to OWNER.

1.3 QUALITY ASSURANCE

A. Installer: A qualified security system contractor shall be one which has a minimum of 5 years experience with security systems of size and complexity as specified herein.

B. The System Supplier shall provide the final checkout and testing.

C. The complete installation is to conform to the applicable sections of the National Electric Code.

D. All items of the Video Surveillance System be listed under the appropriate category by Underwriters Laboratories, Inc. (UL), and shall bear the UL label.

1.4 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

B. Provide wiring diagrams, equipment ratings, dimensions and finishes for all proposed devices and equipment.

C. Provide a complete Surveillance System riser diagram including: Point of origin of each camera circuit, circuit type and labeling, area covered by each camera, wire/cable type and size, and locations of POE network switch.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01 33 00–Submittals.

B. Include source and current prices of replacement parts and supplies and recommended maintenance procedures and intervals.

C. Submit a record copy of site-specific computer software of software-based Video Surveillance System.

1.6 DELIVERY, STORAGE, AND HOLDING

A. Store in a clean, dry space. Maintain factory wrapping or provide additional plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer’s written instructions.

1.7 VIDEO SURVEILLANCE SYSTEM SUPPLIER AND GENERAL REQUIREMENTS

A. This specification, along with the Contract drawings, defines the requirements of a computer-based Video Surveillance System. Video Surveillance System supplier shall construct a surveillance system specifically for the demanding requirements of a closed-circuit television system.

B. It is the intent of this specification to define a fully integrated surveillance system, tested, delivered to the site, ready to function upon connection of power source and field wiring. Components, peripherals, interconnections, cabling, power supplies, software, and services necessary to form a complete, integrated system shall be identified and provided by CONTRACTOR. CONTRACTOR shall be responsible for reviewing the wiring diagrams and control sequences for equipment provided under other sections of this specification and coordinating all interface requirements. CONTRACTOR shall submit to ENGINEER in writing

any deficiencies noted during this review. Any changes required by CONTRACTOR due to failure to complete this review shall be the responsibility of CONTRACTOR at no increase in cost to OWNER.

C. To provide a complete and totally integrated system, a single manufacturer who has experience in furnishing similar video surveillance systems of the same complexity and size shall provide specified equipment and services. The system proposed to meet this specification shall be of field-proven design, incorporating manufacturer's standard equipment and software. Service of all peripheral devices shall be provided by the manufacturer of the Video Surveillance System.

D. Design and specification of devices and completed system shall conform to applicable portions of latest edition of National Electrical Code (NEC).

E. Training Program:

1. Submit training plan including course syllabus, personnel who will be conducting the training, and schedule.

2. Provide materials, instructors, and workbooks to complete the training.

3. Training courses shall include: Operator training: Course length minimum 1 day. Training shall utilize equipment specified herein following installation and field testing. (Two half-day sessions with four personnel each shall be provided. Training sessions shall occur at a minimum of 1-month intervals.)

4. Manufacturer's training shall be directed to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas.

5. Training shall conform to the requirements in Sections 01 43 23 and 01 91 13.

F. Post start-up support shall include replacements of defective equipment, as well as additional training, software modifications, and control configurations as requested by OWNER. This shall include an allowance of 16 hours for work on-site other than warranty repair or replacement of defective equipment. This time shall be used for software enhancements and modifications to improve the operation of the system. It shall be assumed that this 16 hours includes two trips to the site.

G. Video surveillance supplier shall meet the following minimum requirements:

1. Video surveillance supplier shall have a full-time staff of qualified technicians who are knowledgeable in the configuration of networked systems and the equipment being provided.

2. Video surveillance supplier shall have a minimum of one Microsoft Certified Engineer.

3. Video surveillance supplier shall have training capabilities and shall have conducted training courses in setup and operation.

4. Video surveillance supplier shall have an adequate inventory of spare parts.

5. Video surveillance supplier shall have a full-time staff of qualified service technicians.

6. Video surveillance supplier shall be responsible for start-up and documentation of the system.

7. Video surveillance supplier shall be responsible for all details that may be necessary to properly install, wire, adjust, and place in operation a complete and working system.

8. Video surveillance supplier shall be responsible for all coordination between the system and the field devices furnished with other divisions of this specification.

H. All components are to be standard make acceptable to OWNER, with one manufacturer to provide all similar components.

1.8 **WARRANTY**

A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established or the date specific equipment or process is considered substantially complete and placed into beneficial service.

PART 2 – PRODUCTS

2.1 FIXED CAMERAS

A. All cameras shall be of the same manufacturer unless noted otherwise.

B. The network camera system shall offer two simultaneous video streams with up to 2 MPx,1920 by 1080 resolution, auto iris, and varifocal lens capabilities.

C. The network camera system shall possess the following primary characteristics:

1. H.264 High or Main profiles; and MJPEG compression.

2. 2 megapixels.

3. Dual streaming (two independent IP video streams).

4. Day/night operation with IR cut filter.

5. Wide Dynamic Range (WDR): 75 dB minimum.

6. PoE+ Class 4, 24 VAC and PoE+.

7. Pelco Smart Compression Technology.

8. Multicast or unicast capable with unlimited H.264 viewers.

9. Unicast capable with up to 20 simultaneous viewers.

10. Local storage via SD card.

11. Audio input and output.

12. Alarm input and output.

13. IP66 rated housing.

D. Imaging Device:

Model	Sensor	Maximum Resolution
2 MPx	1/2.8-inch	1920 x 1080 (2.1 MPx)

E. Imager Type: CMOS

F. Electronic Shutter Range:

Model	Range
2 MPx	1/5 – 1/25,000 sec

G. Minimum illumination:

1. Color mode:

Model	Sensitivity
2 MPx	0.25 lux (33 ms, F1.2), 0.03 lux (200 ms, F1.2)

2. Black & white mode:

Model	Sensitivity
2 MPx	0.10 lux (33 ms, F1.2), 0.02 lux (200 ms, F1.2)

H. Scanning: Progressive

I. Image Control Settings

1. White balance range: 2,000º to 10,000ºK

2. Adaptive IR Illumination

3. Day and night settings

4. Privacy zone definition: up to 8 zones of window blanking

5. 3D noise reduction

J. Lens:

1. Built-in, varifocal

2. Focal Length: F1.4, 3 ~ 10.5 mm

3. Zoom: Remote

4. Auto Iris: DC drive lens

5. Auto Focus: Automatically focuses during runtime operation

6. Field of view:

	2 MPx
Diagonal	116º ~ 35º
Horizontal	100º ~ 31º
Vertical	54º ~ 17º

K. Video:

1. The network camera system shall support up to 2 simultaneous streams; the secondary stream is variable based on the setup of the primary stream.

2. Compression type: H.264 High or Main profiles; and MJPEG

3. Corridor Mode: Electronic image flip and mirror: 180°, 90° 270° (H.264 only)

4. Service Stream: 640 x 480 or 640 x 352; 2 ips, JPEG

5. Available resolutions:

Model	Width x Height	Aspect Ratio
2.1	1920 x 1080	16:9

6. Constant bit rate (CBR), constrained variable bit rate (CVBR) with configurable maximum value.

7. Frame rate:

MPx	Images per Second (ips)
2	30, 25, 20, 16.67, 15, 12.5, 10, 7.5, 5, 3, 2, 1

8. Video streams shall support ONVIF profile S.

9. Pelco's Smart Compression Technology lowers bandwidth and storage requirements by up to 70%. Our technology allows the user to make intelligent decisions regarding storage savings and image quality.

10. Low resolution JPEG stream for configuration of camera settings.

L. Storage and Recording

1. The network camera system control shall have onboard SD card storage.

   a. Card type: Micro SD
   b. Capacity: up to 64 GB

2. The local SD storage shall have the ability to be backed up to alternate media without removal of the SD card from the camera.

3. Local recording on the SD card shall commence upon loss of network connectivity, based on a pre-programmed schedule.

4. The network camera system shall record video continuously in the case of network outage.

5. Alarm recording: The network camera system shall capture selectable 1, 5, or 10 second video clips on camera sabotage, motion detection, or alarm input.

6. Video recording and storage shall support ONVIF profile G.

M. Manual Pan Tilt

1. Pan Range: 370º

2. Tilt Range: +1º –90º

3. Rotate Range: 355

N. Simple motion and sabotage analytics.

O. Connectivity: 100 BASE-TX Ethernet with RJ-45 connector

P. Protocols supported

1. Transmission Control Protocol (TCP), Internet Protocol (IP) v4 and v6, User Datagram Protocol (UDP)

2. Configuration: Dynamic Host Configuration Protocol (DHCP)

3. Web services: Hypertext Transfer Protocol (HTTP), Secure HTTP (HTTPS)

4. Network services: Domain Name System (DNS), Network Time Protocol (NTP), Internet Control Message Protocol (ICMP), Simple Network Management Protocol (SNMP) v2c/v3, Universal Plug and Play (UPnP)

5. Media: Real-Time Transport Protocol (RTP), Real-Time Streaming Protocol (RTSP)

6. Multicast: Internet Group Management Protocol (IGMP)

7. Notifications: File Transfer Protocol (FTP), Simple Mail Transfer Protocol (SMTP)

8. Remote Access: Secure Shell (SSH)

9. Security: Secure Sockets Layer (SSL), IEEE 802.1x (EAP-MD5, EAP-TLS, EAP-TTLS, EAP-PEAP and EAP-FAST)

10. Quality of Service: IEEE 802.1p Layer 3 Differentiated Services Code Point (DSCP)

11. DDNS–The network camera system shall support DDNS services offered by the Manufacturer and other publicly available service offerings.

Q. Q. Security

1. The network camera system shall support IP address filtering whereby users can enter a list of allowed or blocked IP addresses for viewing video and configuring camera settings

2. The network camera system shall provide three levels of user access with password protection.

3. User authentication shall be available through a Lightweight Directory Access Protocol (LDAP) server.

R. The network camera system shall have a built in web server which supports browser-based configuration.

S. The camera's web server shall allow access to camera information and all primary software functions.

T. The Manufacturer shall offer video viewer and configuration to implement the following actions:

1. Camera discovery

2. Live Video

a. Video stream selection
b. Video stream configuration
    1) Use preset video setting configurations
    2) Configure custom video setting configurations
    3) Multicast
    4) Unicast
    5) JPEG frame rate
c. Maximize view area of video to full size of browser
    1) Revert to normal view
d. Open stream in new window
e. Capture and save image as .jpg file

f. Resize viewing area

3. Image Settings

a. image quality
b. exposure
c. focus
d. white balance
e. window blanking
f. digital zoom
g. lighting mode
h. video noise reduction
i. digital processing (color and detail adjustment)
    1) image enhancement
    2) quick setup preset modes
    3) sharpness
    4) saturation
    5) contrast
    6) brightness
j. exposure modes

4. Recording

a. Initiate instant record and playback
b. Manage SD card storage

5. Events

a. configure event sources:
    1) external alarm events
    2) analytic events
b. e-mail setup
c. define web addresses for notifications

6. Camera network settings

7. System

a. firmware upgrade
b. reset to factory default
c. set date, time, and NTP server synchronization
d. user access control
e. view and export camera settings
f. view system logs

U. Acceptable Web Browsers:

1. Microsoft® Internet Explorer® 9.0

2. Apple® Safari® 7.0.6

3. Mozilla® Firefox® 31.0

4. Google® Chrome™ 37.0.2032.124 m and later

V. The Manufacturer shall offer a mobile application with the capability to access live video from up to 500 cameras.

W. The Manufacturer shall support integrations as follows:

1. Video Management: VideoXpert™; Endura® 2.0 (or later); Digital Sentry® 7.3 (or later); Third-party system through Pelco API/SDK, ONVIF Profile S, Profile G, and Profile Q

2. Mobile Application

3. Camera Discovery and Firmware: Discover cameras upgrade firmware upgrade

X. Power

1. Source Options

a. 24 VAC and PoE+
b. PoE+ Class 4
c. 18 to 32 VAC range, 12 VDC

2. Power Consumption: <16 W (with heater ring)

Y. Connectors:

1. Ethernet: RJ-45 connector

2. External power: 2-conductor power to terminal block

Z. Construction Material: Aluminum body and trim ring, polycarbonate bubble

AA. Finish: RAL 7047

BB. Impact Resistance: IK10 (20J)

CC. Temperature:

1. Operating: -40°C to 55°C (-40°F to 131°F)

2. Storage: -40°C to 60ºC (-40°F to 140ºF)

DD. Ingress Protection: IP66

EE. NEMA Type 4X

FF. Exterior Environmental Mini Dome fixed camera with Day/Night standard resolution type model IMP321-1RS as manufactured by Pelco, or equal. System supplier shall provide camera lenses as required per camera location. Camera

lens shall be Varifocal, 1/3-inch format, Auto Iris, and IR corrected. Coordinate exact lens type with camera coverage area shown on drawings.

2.2 COMPUTER MONITOR

A. Minimum 17-inch (viewable) SVGA, color, 1920 by 1440 pixel, noninterlaced, dot pitch 0.31 inch maximum. Monitor shall be flat LCD type. Monitor shall have BNC and VGA inputs. Monitor shall be capable of having two independent input sources. Monitor shall be capable of toggling between sources. Monitor shall be connected to the video surveillance VMS.

2.3 ENHANCED KEYBOARD

A. The keyboard must be compatible with all distributed, network video management systems.

B. The keyboard must support USB 2.0 protocol, and the USB must operate at full-speed.

C. System Requirements

1. Windows Vista, Windows 7, or Windows 8/8.1

2. Two (2) USB ports

3. 70 MB of available hard disk space

2.4 MOUSE CONTROLLERS

A. The 3D Mouse must be compatible with all distributed, network video management components.

B. Patented six-degrees-of-freedom (6DoF) sensor–Intuitively and precisely navigate digital models or camera positions in 3D space.

C. Advanced ergonomic design–The full-size, soft-coated hand rest positions the hand comfortably, and 15 large, soft-touch, function keys allow quick access to frequently used commands.

D. QuickView Keys–Fingertip access to 12 views makes it easier to switch cameras.

E. Intelligent Function Keys–Easy access to 4 application commands for an optimized workflow.

F. On-Screen Display–Provides a visual reminder of function key assignments on your computer screen.

G. 3D Space Mouse Modifiers–Fingertip access to Ctrl, Shift, Alt and Esc keys saves time by reducing the need to move your hand between mouse and 3D Mouse.

H. Virtual NumPad–Allows direct numerical input into your application using your standard mouse rather than the 3D Mouse.

I. The 3D Mouse must be part of an integrated system and shall be configured so any number can be added to the system. When combined with user interfaces (UIs), network storage managers (NSMs), encoders, IP cameras, and video consoles, the 3D Mouse forms an integral part of a complete network-based video control system.

J. Hardware

1. Power Supply

a. Input Connector Type Universal, interchangeable

2. Connectivity

a. 3D Space Mouse Interface USB 2.0
b. Cable USB

3. Module Specifications

a. 3D Space Mouse Keypad
b. Joystick Fully proportional PTZ, variable speed; with zoom, iris, and focus controls

4. Physical

a. Dimensions 204 x 142 x 58 cm (8.0" D x 5.6" W x 2.3" H)
b. Unit Weight 665 g (1.47 lbs)

5. Environmental

a. Ambient Temperature 21° to 23°C (70° to 74°F)

K. Operating Temperature 0° to 40°C (32° to 104°F) air intake of unit

PART 3 – EXECUTION

3.1 CAMERA MOUNTING

A. Wall-Mounted Camera:

1. The wall mount shall be designed specifically for mounting camera on a wall, along with any accessories that may be required for a complete camera mount.

2. The camera mount shall be a manually adjustable tilt table extending up from the horizontal arm. The mount shall be supplied with a manually adjustable tilt table capable of unlimited 360 degrees pan adjustment and ±90 degrees tilt adjustment.

3. Provide stainless steel mounting hardware for supporting outdoor camera mounts.

3.2 WIRING AND INSTALLATION

A. All wiring shall be in conduit.

B. Identify all wire and cable at terminations and at every junction box. Identification shall be made as specified in previous sections.

C. Inspect areas to receive camera to verify suitability of application. Contact ENGINEER for any conflict that may present itself. Camera mounts shall be rigidly attached to structural members. All cameras and monitors are to be installed per the manufacturer's requirements.

D. All camera views shall be reviewed with OWNER and adjusted as requested.

3.3 TESTS

A. Completely test and adjust all camera locations to demonstrate complete operation of the system.

END OF SECTION

SECTION 33 32 16

SLUDGE TRANSFER PUMPS

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. Provide all labor, tools, equipment, and materials necessary to furnish and install the duplex vertical permanent nonclog dry pit pumping systems in accordance with the drawings and specifications.

1.3 **QUALITY ASSURANCE**.

A. **Materials and workmanship shall be** in accordance with the following standards as referenced herein.

1. ASTM. American Society for Testing and Materials.
2. ANSI. American National Standards Institute.
3. AWWA. American Water Works Association.

B. **Perform all work to furnish** and install the duplex vertical permanent nonclog dry pit pumping system in compliance with applicable requirements of governing agencies having jurisdiction.

1. **Underwriters' Laboratories, Inc. (UL)** and National Electrical Manufacturers Association (NEMA) Compliance. Provide electric motors and electrical components required as part of the sewage lift station equipment which have been listed and labeled by UL and comply with NEMA standards.
2. **National Electric Code (NEC) Compliance**. Comply with National Fire Protection Agency (NFPA) 70 "National Electric Code" as applicable to installation and electrical connections of ancillary electrical components of the lift station equipment.

1.4 **SUBMITTALS**. Submit the following submittal packages in accordance with the Division 1 Submittal requirements.

A. **Package Contents**.

1. **Product Data**. Including installation and start-up instructions, furnished specialties and accessories, and current pump characteristic performance curves.
2. **Shop Drawings**. Manufacturer's assembly-type shop drawings indicating dimensions, weights, required clearances, and methods of assembly of components for the sludge transfer pumps and appurtenances.

3. **Electrical and Wiring Diagrams**. Manufacturer's electrical requirements for the components, and ladder-type wiring diagrams for interlock and control wiring, clearly indicating required field electrical connections.
4. **Maintenance Data**. Maintenance data and parts list for the sludge transfer pumps, accessories, including troubleshooting guide. Include this product data, shop drawings, and wiring diagrams in an operation and maintenance manual.

1.5 **JOB CONDITIONS** (Not used)

1.6 **DELIVERY, STORAGE, AND HANDLING.** In accordance with the manufacturer's instructions and recommendations.

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 SLUDGE TRANSFER PUMPS

A. General

1. Furnish the pumping equipment as a complete system, as specified.
2. The equipment shall include all special castings and equipment capable for automatic start, stop, and alternation of pumps.
3. Pumps shall be capable of handling settled sludge with up to 5% solids with a flooded suction in the sediment tanks. Typical solids concentration anticipated is 2% solids.

B. Pumps

1. Centrifugal, nonclog. Installed T – Vertical in a dry pit. Flanged vertical bottom suction and flanged horizontal discharge.

2. Pumps shall be Flygt or approved equal.

   Basis of design:

   Sludge Transfer Pump – Flygt, Model NT 3102 MT 3 ~ 465

3. Provide two pumps.

4. Supply all pumps from the same manufacturer.

5. Pumps shall be centrifugal, nonclog sludge type units, in vertical dry pit arrangement.

6. Pass 3” solids.

7. Pumps shall be self-cooling (Self-contained cooling jackets are acceptable as required by the pump manufacture).

8. Materials:

Part	Material
Pump and Motor Casing	Cast iron
Casing Wear Rings	Type 316 stainless steel
Impeller	Hard Iron [ASTM A-532 (Alloy III A) 25% chrome cast iron]
Impeller Wearing Ring	Stainless steel dissimilar to casing wear ring
Shaft	Type 420 stainless steel

9. Casings.

   a. Pumps and motor casings shall have "O" ring gaskets at all casing and motor cover joints.
   b. Suction and discharge openings shall be not less than 3 inches in diameter.
   c. Provide the casing with a replaceable wearing ring.

10. Impellers.

   a. Single-suction, one- or two-vane, enclosed type designed with large, smoothly contoured passages capable of passing the solid size as listed herein (or a recessed/vortex impeller type).
   b. Provide with repelling vanes on the back of the shroud to prevent collection of solids and to reduce the pressure on the seals.
   c. Provide with replaceable wearing rings.

11. Seals.

   a. Equip the pump with two independent mechanical seals separated by an oil reservoir.
   b. The lower seals shall be tungsten carbide.

12. Motor.

   a. Motor types: Inverter duty call suitable for variable frequency drive (variable torque).
   b. Motor Speed: 1,800 RPM max.
   c. Motor Horsepower: 5 HP max.
   b. Motor shall be Design B with class F insulation with moisture resistant windings.
   c. Motor ratings: 200V, 3phase.

13. Power Cable.

    a. The pump motor power and control cable shall be a single unit of adequate length to reach the control panel and suited for submersible pump applications, which shall be indicated by a code embossed on the cable.
    b.
    c. Size power cable in conformance with National Electrical Code (NEC).

14. Pump Schedule.

Pump Designation	No. of Pumps Required	Minimum Performance Criteria
Sludge Transfer Pump	2	250 gpm at 23ft. TDH Minimum efficiency 60%

C. **Cable**. Furnish a pump power and control cable with motor connection and of adequate continuous length to extend to the pump control panel. Provide cable strain relief assemblies.

D. **Thermal Protection and Moisture Detection**. Build thermal overload protection and moisture detection systems into the motor.

E. **Piping and Fittings**

1. Pipe.

    a. Ductile iron pipe shall conform to ANSI A21.51 (AWWA C151) and ASTM A 536.
    b. Unless otherwise noted on the plans, the minimum thickness of the barrel of the pipe shall be Class 53.

2. Fittings.

    a. Ductile iron fittings shall conform to ANSI A21.10 (AWWA C110).
    b. Flanged fittings shall have a minimum working pressure of 250 psi; all other fittings shall have a minimum working pressure of 350 psi.
    c. Gray iron fittings may be used in lieu of ductile iron fittings.
    d. Pump suction and discharge connections shall be flanged fittings.

3. Coatings and Linings.

    a. Paint. The outside of all ferrous pipe and fittings shall be shop-primed and field-finished as specified under Section 09 90 00, "Painting."

b. Bituminous Coal Tar. Coat the inside of ferrous pipe and fittings with a bituminous material in accordance with ANSI A21.6 (AWWA C106) for iron pipe.

F. **Valves**

1. Plug Valves.

a. Manufacturers.
Full Port Plug Valves. Subject to compliance with the specifications, provide the full port plug valves from one of the following manufacturers.

Clow/M&H (3 inches – 12 inches).
DeZurik (3 inches – 72 inches).
Milliken (3 inches – 72 inches).
Pratt (1/2 inch – 36 inches).
Val-Matic (1/2 inch – 36 inches).

b. Description. Nonlubricated, eccentric-type plug valves.

1) All plug valves, for whatever service, shall be capable of passing "pigging" cleaning equipment in either direction and without the use of special equipment.
2) Valve Design Pressure - 175 pounds per square inch (psi).
3) Full Port Plug Valves. Port clear areas shall be a minimum of 100 percent port.
4) Materials

Part	Material
Body	ASTM* A 126, Class B cast iron or ASTM A 536 ductile iron
Seat Overlay	Not less than 90% nickel or Type 316 stainless steel
Plugs	One-piece ductile or cast iron
Sealing Surface	BUNA-N or chloroprene
Grit Seals	PTFE

*ASTM – American Society for Testing and Materials

5) Fabrication and Assembly

a) In conformance with AWWA C517 except where noted below.
b) Furnish valves with a welded-in overlay seat. Overlay thickness shall be not less than 0.125 inch. Sprayed, plated, or screwed-in seats are not acceptable.

c) Equip valve plug with grit seals on the upper and lower bearing journals to reduce torque and prevent dirt from entering bearing and seal area.

6) Valve Shaft Seals.

a) Dual "U" cup type in accordance with AWWA C517-05, Section 4.4.7 or a multiple V-ring and installed on the upper and lower plug shafts.
b) Seals shall be self-adjusting and re-packable without removing the bonnet from the valve.
c) Furnish valves with a spacer bonnet to allow for visual inspection for shaft leakage.

7) Valve Shaft Packing.

a) Packing adjustment shall not result in an increase in plug friction or resulting torque.
b) Packing replacement shall be achieved without need to cut packing during reinstallation and not require cap removal.

8) Valve Bearings. Furnish valves with replaceable sleeve-type bearings. The bearings shall be of sintered, oil-impregnated Type 316 stainless steel ASTM A 743, Grade CF8M.

2. External Weight and Lever Swing Check Valves.

a. Nonslamming, externally balanced type.
b. Cast iron valve body with bronze seat.
c. Valves 4 inches through 12 inches rated for 175 psi working pressure.
d. Valves 14 inches and larger shall be rated 150 psi working pressure.
e. Attach the seat with screws.
f. Seat easily replaced without removing the valve from the line.
g. Cast iron valve disc suspended from a Type 316 stainless steel shaft connected so as to prevent rotation.
h. Bronze disc seat ring.
i. 316 stainless steel fasteners.

3. Coatings.

a. Buried Valves, Operators, and Accessories. Coat all buried valve operators and accessories with a bituminous material in conformance with ANSI A21.10 (AWWA C110).
b. Painted Surfaces. Unless noted otherwise, prime and finish-paint all interior and exterior ferrous surfaces of all valves, operators, and accessories in the factory. Interior and exterior surfaces to

be coated with a fusion-bonded epoxy according to Section 09 90 00.

G. **Miscellaneous Components**. Anchors and connection hardware shall be Type 316 stainless steel.

H. **Pump Control Panel**. Refer to Specification Section 40 95 13.

I. **Level Sensors.** Refer to Specification Section 40 91 02.02.

J. **Spare Parts**. Provide one complete set of seals for the pumps.

PART 3 - EXECUTION

3.1 INSTALLATION.

A. **Placement.** Carefully set the pump to the lines and grades specified and in accordance with the manufacturer's instructions and recommendations. New pumps will be supported and anchored by support stands provided by the pump manufacture and anchored to new reinforced concrete equipment pads per the pump manufactures' instructions and recommendations.

B. **Install equipment** in accordance with equipment manufacturer's written instructions and with recognized industry practices to ensure that pumps and piping comply with requirements and serve intended purposes. Comply with requirements of governing agencies as required.

1. Remove debris from inside piping system before installation.
2. Install plumb and level.
3. Install free from distortion.
4. Install with proper support and restraint.
5. Coordinate valve mounting position with respect to operating convenience, maintenance access, and safety.
6. Remove and reinstall valves which are installed with improper orientation at no additional cost to the Owner.

C. **Sludge Transfer Pump Operation**

1. Sludge Transfer Pumps will operate as a constant speed duplex station alternating lead pump. The pumps shall not operate simultaneously. The pumps shall operate automatically based on existing level sensor(s) in the sedimentation tanks and PLCs utilized for existing operation. Pumps shall include alarms for temperature and leakage. Pump controls and alarms shall be integrated into existing SCADA system.

3.2 FIELD QUALITY CONTROL

A. **Manufacturer's Representative**. A qualified representative of the equipment manufacturer shall inspect the completed installation, service the equipment, operate the equipment under all design conditions, instruct the Owner's personnel in proper operation and maintenance procedures, and provide the Owner with a written certificate of approval of the completed installation. The representative

shall spend at least one 8-hour day performing these required start-up and training services.

B. **Defective Work**. If defects are detected, correct them.

3.3 **DEMONSTRATION**. Prior to substantial completion, demonstrate that the pumps can operate at design performance to the written satisfaction of the Owner.

END OF SECTION

SECTION 40 60 00

PROCESS CONTROL AND ENTERPRISE MANAGEMENT SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

A. **Section Includes**

1. Basic requirements for complete instrumentation system for process control

B. **Related Specification Sections** include but are not necessarily limited to

1. Section 40 67 00 – Control System Equipment Panels and Racks

2. Section 40 70 00 – Instrumentation for Process Systems

3. Division 26 - Electrical

1.2 QUALITY ASSURANCE

A. **Referenced Standards**

1. **Canadian Standards Association (CSA)**

2. **FM Global (FM)**

3. **The Instrumentation, Systems, and Automation Society (ISA)**
   a. 7.0.01, Quality Standard for Instrument Air
   b. S5.1, Instrumentation Symbols and Identification
   c. S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems
   d. S5.4, Standard Instrument Loop Diagrams
   e. S20, Standard Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves

4. **National Electrical Manufacturers Association (NEMA)**
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum)

5. **National Fire Protection Association (NFPA)**
   a. 70, National Electrical Code (NEC)

6. **National Institute of Standards and Technology (NIST)**

7. **Underwriters Laboratories, Inc. (UL)**

a. 913, Standard for Safety, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations

B. **Qualifications**

1. **System integrator**
   a. Experience

      1) Have ten (10) years of experience in water treatment controls and instrumentation projects.

1.3 SPECIFIED EQUIPMENT AND "OR EQUAL"

A. **Instrumentation and control components** have been identified on the Drawings by manufacturer name and model number or type along with important features. The components identified imply the required level of quality regardless of whether or not all features, materials of construction, etc. of said components are expressed explicitly. The substitution of alternatives will be evaluated by comparison to the explicit, or implicit, requirements represented by the models specified. The acceptability of submitted alternatives shall be at the sole discretion of the Engineer. All risk associated with alternative equipment shall be borne by the Contractor.

1.4 DEFINITIONS

A. **Architecturally finished area:** Offices, laboratories, conference rooms, restrooms, corridors and other similar occupied spaces.

B. **Non-architecturally Finished Area**: Pump, chemical, mechanical, electrical rooms and other similar process type rooms.

C. **Hazardous Areas:** Class I, II or III areas as defined in NFPA 70.

D. **Highly Corrosive and Corrosive Areas:** Rooms, wells, or areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater or chemical solutions; or chronic exposure to corrosive, caustic or acidic agents, chemicals, chemical fumes or chemical mixtures.

E. **Outdoor Area:** Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.

F. **Instrument Air Header**: The segment of air supply piping and tubing which transports air from the compressed instrument air source through the branch isolation valve of any takeoff (branch) line.

G. **Branch Line:** The segment of air supply piping and tubing which transports air from the outlet of the air header branch isolation valve through an air user's isolation valve.

H. **Intrinsically Safe Circuit:** A circuit in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under test conditions as prescribed in UL 913.

I. **Calibrate:** To standardize a device so that it provides a specified response to known inputs.

J. **System Integrator: Contracting** or subcontracting entity responsible for the furnishing, fabricating, installing, programming, calibrating, testing, and commissioning process instrumentation, control, and monitoring equipment, and interfacing with the same such equipment provided from 3rd parties, as required in these Contract Documents.

1.5 SYSTEM DESCRIPTION

A. **Control System Requirements**

1. **This Specification Section provides** the general requirements for the instrument and control system.

2. **The instrument and control system consists** of all primary elements, transmitters, switches, controllers, computers, graphic displays, networking hardware, recorders, indicators, panels, signal converters, signal boosters, amplifiers, special power supplies, special or shielded cable, special grounding or isolation, auxiliaries, relays and timers, terminal blocks, software, wiring, and other devices required to provide complete control of the plant as specified in the Contract Documents.

B. **All signals shall be directly linearly proportional** to measured variable unless specifically noted otherwise.

C. **Single System Integrator**

1. **Furnish and coordinate instrumentation** system through a single System Integrator.
   a. The System Integrator shall be responsible for functional operations of all systems, performance of control system engineering, supervision of installation, final connections, calibrations, preparation of Drawings and Operation and Maintenance Manuals, start-up, training, demonstration of Substantial Completion and all other aspects of the control system.
   b. Programming of all programmable logic controllers and human-machine interface devices, except those furnished with the flushing system, will be performed by the Owner.

2. **Ensure coordination of instrumentation** with other work to ensure that necessary wiring, conduits, contacts, relays, converters, and incidentals are provided in order to transmit, receive, and control necessary signals to other control elements, to control panels, and to receiving stations.

1.6 SUBMITTALS

A. **Shop Drawings**

1. **Contractor shall submit shop drawings** for PLC-based SCADA control panels no later than 60 days after Notice to Proceed. Control panel(s) shall be fabricated, factory witness tested, delivered to the project site, installed, and powered by July 1, 2018. In no case shall control panel installation extend beyond July 31, 2018.

2. **Submittals shall be original** printed material or clear unblemished photocopies of original printed material.

3. **Limit the scope of each submittal** to one (1) Specification Section.
   a. Each submittal must be submitted under the Specification Section containing requirements of submittal contents.

4. **Product technical data including**
   a. Equipment catalog cut sheets
   b. Instrument data sheets
      1) ISA S20 or approved equal
      2) Separate data sheet for each instrument
   c. Materials of construction
   d. Minimum and maximum flow ranges
   e. Pressure loss curves
   f. Physical limits of components including temperature and pressure limits
   g. Size and weight
   h. Electrical power requirements and wiring diagrams
   i. NEMA rating of housings
   j. Submittals shall be marked with arrows to show exact features to be provided

5. **Comprehensive set of wiring diagrams** as specified in Specification Section 40 67 00 -Control System Equipment Panels and Racks

6. **Panel fabrication drawings** as specified in Specification Section 40 67 00 – Control System Equipment Panels and Racks

7. **PLC/DCS equipment drawings**

8. **HMI graphics**

9. **Nameplate layout drawings**

10. **Drawings, systems, and other elements** are represented schematically in accordance with ISA S5.1 and ISA S5.3
    a. The nomenclature, tag numbers, equipment numbers, panel numbers, and related series identification contained in the Contract Documents shall be employed exclusively throughout submittals.

11. **All Shop Drawings** shall be modified with as-built information/corrections prior to inclusion in the O&M manual.

12. **All panel and wiring drawings** shall be provided in both hardcopy and softcopy.
    a. Furnish electronic files such as PLC and graphic display programming on CD-ROM or DVD-ROM media
    b. Drawings in AUTO CAD and PDF format

13. **Provide a parameter setting summary** sheet for each field configurable device.

14. **Certifications**
    a. Documentation verifying that calibration equipment is certified with NIST traceability
    b. Approvals from independent testing laboratories or approval agencies, such as UL, FM or CSA
        1) Certification documentation is required for all equipment for which the specifications require independent agency approval.

15. **Testing reports**: Source quality control reports

B. **Operation and Maintenance Manuals**

1. **Project coversheet denoting project name**, general contractor company name, system integrator company name, job number, phone number, and website address.

2. **Record drawings for wiring diagrams** and panel layouts, final bills of material, annotated component cutsheets denoting the equipment and accessories provided.

3. **Warranties:** Provide copies of warranties and list of factory authorized service agents.

1.7 DELIVERY, STORAGE, AND HANDLING

A. **Do not remove shipping blocks, plugs, caps, and desiccant dryers** installed to protect the instrumentation during shipment until the instruments are installed and permanent connections are made.

1.8 SITE CONDITIONS

A. **Unless designated otherwise on the Drawings**, area designations are as follows:

1. **Outdoor area**
   a. Wet
   b. Corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications
   c. Below grade vaults and manholes
      1) Subject to temporary but prolonged submergence of indefinite duration

2. **Architecturally finished area**
   a. Dry
   b. Noncorrosive unless designated otherwise on the Drawings or in the Specifications
   c. Nonhazardous unless designated otherwise on the Drawings or in the Specifications

3. **Non-architecturally finished area**
   a. Dry
   b. Noncorrosive unless designated otherwise on the Drawings or in the Specifications
   c. Nonhazardous unless designated otherwise on the Drawings or in the Specifications

PART 2 – PRODUCTS

2.1 NEMA TYPE REQUIREMENTS

A. **Provide enclosures/housing** for control system components in accordance with the following

1. **Areas designated as wet:** NEMA Type 4X

2. **Areas designated as wet and/or corrosive**: NEMA Type 4X

3. **Areas designated as Class I hazardous**, Groups A, B, C, or D as defined in NFPA 70
   a. NEMA Type 7 unless all electrical components within enclosure utilize intrinsically safe circuitry
      1) Utilize intrinsically safe circuits to the maximum extent practical and as depicted in the Contract Documents

4. **Either architecturally or non-architecturally finished areas** designated as dry, noncorrosive, and nonhazardous: NEMA Type 12

5. **Areas designated to be subject to temporary submersion**: NEMA 6P

2.2 ACCESSORIES

A. **Provide identification devices** for instrumentation system components.

B. **Provide corrosion resistant spacers** to maintain 1/4 IN separation between equipment and mounting surface in wet areas, on below grade walls and on walls

of liquid containment or processing areas such as Clarifiers, Digesters, Reservoirs, etc.

PART 3 – EXECUTION

3.1 INSTALLATION

A. **Wherever feasible, use bottom entry** for all conduit entry to instruments and junction boxes.

B. **Install electrical components** per Division 26.

C. **Panel-Mounted Instruments**

1. Mount and wire so removal or replacement may be accomplished without interruption of service to adjacent devices.

2. Locate all devices mounted inside enclosures so terminals and adjustment devices are readily accessible without use of special tools and with terminal markings clearly visible.

D. **See Specification Section 26 05 19** – Low-Voltage Electrical Conductors and Cables for wire installation.

3.2 FIELD QUALITY CONTROL

A. **Maintain accurate daily log** of all startup activities, calibration functions, and final setpoint adjustments.

1. **Documentation requirements** include the utilization of the forms located at the end of this Specification Section.
   a. Loop Check-out Sheet
   b. Instrument Certification Sheet

B. **Instrumentation Calibration**

1. **Verify that all instruments** and control devices are calibrated to provide the performance required by the Contract Documents.

2. **Calibrate all field-mounted instruments**, other than local pressure and temperature gages, after the device is mounted in place to assure proper installed operation.

3. **Calibrate in accordance** with the manufacturer's specifications.

4. **Check the calibration** of each transmitter and gage across its specified range at 0, 25, 50, 75, and 100 percent.
   a. Check for both increasing and decreasing input signals to detect hysteresis.

5. **Replace any instrument** which cannot be properly adjusted.

6. **Calibration equipment** shall be certified by an independent agency with traceability to NIST.
   a. Certification shall be up-to-date
   b. Use of equipment with expired certifications shall not be permitted

7. **Calibration equipment** shall be at least three (3) times more accurate as the device being calibrated.

C. **Loop check-out requirements** are as follows

1. **Check control signal generation**, transmission, reception and response for all control loops under simulated operating conditions by imposing a signal on the loop at the instrument connections.
   a. Use actual signals where available.
   b. Closely observe controllers, indicators, transmitters, HMI and operator displays, recorders, alarm and trip units, remote setpoints, ratio systems, and other control components.
      1) Verify that readings at all loop components are in agreement.
      2) Make corrections as required.
         a) Following any corrections, retest the loop as before.

2. **Check all interlocks** to the maximum extent possible.

3. **In addition to any other as-recorded documents**, record all setpoint and calibration changes on all affected Contract Documents and turn over to the Owner.

D. **Provide verification** of system assembly, power, ground, and I/O tests.

E. **Verify existence and measure adequacy** of all grounds required for instrumentation and controls.

END OF SECTION

SECTION 40 60 05

BASIC INSTRUMENTATION MATERIALS AND METHODS

PART 1 – GENERAL

1.1 WORK INCLUDED

A. **The CONTRACTOR shall furnish** all materials, labor, tools, equipment, supplies and services necessary to install all process control and instrumentation equipment complete as specified herein and shown on the Drawings. The CONTRACTOR shall be responsible for the expense of changing Drawings or structures, or any other expense necessitated by reason of installing alternative equipment. The CONTRACTOR will assume the responsibility for the satisfactory operation of any and all equipment offered.

B. **The following equipment specification** is included to establish the quality of equipment to be obtained. It is the intent of these Specifications to obtain industrial quality instrumentation and control equipment. Equipment furnished shall be accepted by the ENGINEER, prior to purchase by the CONTRACTOR.

C. **Auxiliary and accessory devices** necessary for system operation or performance, such as transducers or relays to interface with existing equipment or equipment provided under other Sections of this Specification, shall be included whether specified or not, at no extra cost.

D. **In order to ensure proper integration** and compatibility of the plant instrumentation and control systems, the systems must be supplied by a single provider of instrumentation and control equipment. This is not to say that all equipment being supplied shall be manufactured by a single manufacturer, but rather that a single provider of instrumentation and control equipment shall be responsible for supplying the complete system. To facilitate the OWNER'S future operation and maintenance, products performing the same function shall all be of the same manufacturer, type, and model number.

E. **In order to ensure the interchangeability** of parts, the maintenance of quality, the ease of interfacing between the various subsystems, and the establishment of minimums with regard to ranges and accuracy, strict compliance with the requirements herein shall be maintained. In order to ensure compatibility between all equipment, it shall be the responsibility of the system supplier hereunder to coordinate all interface requirements with mechanical and electrical system suppliers and furnish any signal isolation devices that might be required.

F. **Equipment shall be fabricated,** assembled, installed, and placed in proper operating condition in full conformity with detail drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer as accepted by the ENGINEER.

G. **The instrument supplier for this Contract** shall be responsible for making the modifications shown on the Drawings and for recalibrating all instruments (existing and new) and placing them in proper working order.

H. **The Contractor, through the use of a pre-approved instrumentation** and control system supplier and qualified electrical and mechanical installers, shall be responsible to the Owner for the implementation of the instrumentation and control system, and the integration of the control system, and all the appurtenant work, being provided under this Section of these Specifications and the integration of the instrumentation and control system and control devices provided under this project all in accordance with the requirements of the Contract Documents. In addition, the instrumentation system supplier shall install and place into service the PLC based control system specified herein.

I. **Due to the complexities associated** with the interfacing of numerous control system devices, it is the intent of these specifications that the instrumentation system supplier be responsible to the Contractor for the integration of the instrumentation and control system with devices provided under other sections with the objective of providing a completely integrated control system free of signal incompatibilities. The instrumentation system supplier shall be responsible for coordinating the networked components furnished throughout the project, to confirm compatibility and consistency. The instrumentation supplier shall be responsible for connectivity of the system, and shall field verify that equipment has been properly installed, set-up, and connected prior to Owner programming.

1.2 RELATED WORK

A. **Other Divisions of these Specifications** contain requirements on equipment furnished by other suppliers that must interface with the instrument system, or on methods and materials to be performed/used in the installation and/or wiring of the instrumentation system.

1.3 QUALITY ASSURANCE

A. **The system supplier shall be required** to demonstrate a minimum of 5 years recent, past experience in the design, manufacture, and commissioning of instrumentation and control systems of comparable size, type, and complexity to the proposed project. Further, the manufacturer must have at least 10 similar systems in operation currently. The system supplier shall be required to have his own in-house capability to handle complete system engineering, fabrication, and testing. In lieu of 5 years experience, system suppliers shall provide direct to the CONTRACTOR a 5 year performance bond in an amount equal to the installed cost of the system. The CONTRACTOR shall include a copy of the executed bond in the shop drawings submittal books.

B. **The system supplier shall have** in his employ the capable personnel for detail engineering, coordination, drafting, procurement and expediting, scheduling construction, testing inspection, installation, start-up service for calibration and commissioning, and warranty compliance for the period specified.

1.4 **REFERENCES**

A. **The CONTRACTOR is referred to** Standards and Practices for Instrumentation published by the Instrument Society of America (latest edition), for terminology, symbols, methods and practices used or described herein or on the Drawings.

1.5 **SUBMITTALS**

A. **Detailed Requirements** - Instruments/Hardware

1. Detailed information for each instrument or control device shall be submitted, including manufacturer's descriptive literature and a specific data sheet for each device which shall include as a minimum:

   a. Tag number assigned by the manufacturer.
   b. Product (item) name used herein and on the Contract Drawings.
   c. Manufacturer's complete model number.
   d. Location of the device.
   e. Input - output characteristics.
   f. Range, size, and graduations.
   g. Physical size with dimensions, enclosure NEMA classification, and mounting details.
   h. Materials of construction of all components.
   i. Instrument or control device sizing calculations where applicable.
   j. Certified calibration data on all flow metering devices.

2. Submit a detailed loop diagram, for each monitoring or control loop, each on a single 8 ½ in. X 11 in. sheet. The format shall be the Instrument Society of America, Standard for Instrument Loop Diagrams, ISA-S5.4.

3. The data sheets shall be provided with an index and proper identification and cross-referencing. Partial submittals will be rejected.

4. Submit detailed drawings concerning control panels and/or enclosures including:

   a. Cabinet assembly and layout drawings to scale.
   b. Fabrication and painting specifications.
   c. Point to point wiring diagrams depicting wiring within the panel as well as connections to external devices.
   d. Color samples for paint selection by the ENGINEER and/or OWNER.

5. Exceptions to the Specifications or Drawings shall be clearly defined by the system supplier. Data shall contain sufficient details so a proper evaluation may be made by the ENGINEER.

6. Prior to final acceptance, the final shop drawing submittal, which is to include Installation, Operation, and Maintenance instructions, shall be

updated to reflect "As Constructed" status, and shall provide at least the following as a minimum:

a. A comprehensive index.
b. A complete "As Constructed" set of accepted shop drawings.
c. A complete list of the equipment supplied, including serial numbers, ranges, and pertinent data.
d. Full specifications on each item.
e. System schematic drawings "As Constructed", illustrating all components, piping and electrical connections of the systems supplied under this Section.
f. Detailed service, maintenance, and operation instructions for each item supplied.
g. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
h. The operating instructions shall also incorporate a functional description of the entire system, with reference to the systems schematic drawings and instructions.
i. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Shipping Precautions:

1. After completion of shop assembly, factory test, and acceptance, all equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the job site.

2. Special instructions for proper field handling, storage and installation required by manufacturer for proper protection, shall be securely attached to each piece of equipment proper to packaging and shipment.

B. Identification:

1. Each component shall be tagged to identify its location, tag number and function in the system. Identification shall be prominently displayed on the outside of the package.

2. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as given in the tabulation, shall be provided on each piece of equipment supplied under this Section.

C. **Storage:**

1. Equipment shall not be stored out-of-doors. Equipment shall be stored in dry permanent shelters including in-line equipment, and shall be adequately protected against mechanical injury. If any apparatus has been damaged, such damage shall be repaired by the CONTRACTOR at his own cost and expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such tests as directed by the ENGINEER. This shall be at the cost and expense of the CONTRACTOR, or the apparatus shall be replaced by the CONTRACTOR at his own expense.

1.7 **WARRANTY**

A. **A written total instrument warranty** shall be provided to the OWNER, executed by the system supplier as a part of the work under this Section. The warranty shall include all labor, parts, and emergency calls providing on-site response within 48 hours, to provide complete instrument system maintenance for a period of one year after the date of final acceptance of the system. The system supplier shall have full responsibility for the preventive and corrective maintenance including replacing of defective components, maintaining sufficient spare parts on-site, and complete calibration of all components under this section, all at no cost to the OWNER. The warranty shall not begin until both the instrumentation training course and the system acceptance test have been successfully completed, at which time the OWNER shall be capable of performing necessary preventive maintenance, and all instruments shall be functional.

B. **During the one-year warranty period,** observation of maintenance operations by designated OWNER personnel, and the instruction of said personnel in the details of the maintenance work being performed shall be provided.

C. **A complete written report** shall be furnished the ENGINEER and OWNER after each visit, giving problems corrected, systems needing recalibration, and recommendations to prevent recurrence, if applicable.

D. **The costs for the one-year warranty** shall be included in the Contract price.

1.8 **TRAINING**

A. **A training program shall be set up** and conducted by the major equipment manufacturer furnishing the instrumentation package. The training session shall be for a minimum period of four hours uninterrupted and shall be conducted at the pump station.

B. **A course outline showing the material** to be covered shall be submitted to the ENGINEER for review. The training program shall include both classroom and “hands-on” instruction for each instrument supplied under this group of the Specifications and shall furthermore include operational training, maintenance training, and training on use of calibration equipment.

C. **As the equipment installed at the plant** shall be used for the "hands-on" training, the training program shall not be conducted until all of the systems are operational, and operational related "punch list" items are corrected.

D. **Training on equipment supplied** by a manufacturer other than the major equipment manufacturer shall be by the original equipment manufacturer, and shall be scheduled in the training programs by the major equipment manufacturer. Exceptions may be granted if the instructor demonstrates adequate knowledge on the care and operation of the other manufacturers' equipment.

E. **The training programs shall be conducted** at a time mutually agreeable to the ENGINEER, OWNER, CONTRACTOR, and Supplier. The OWNER shall decide how many of his personnel shall attend the training. A representative of the ENGINEER may observe the training in progress. The OWNER shall have the right to videotape all training as it is conducted.

F. **The supplier shall provide the OWNERS staff** his undivided attention (i.e., shall not conduct his company business during training hours) for the training session. The supplier shall furnish training participants with written handouts, preferably copies of the shop drawing submittal books, up to a maximum of 6 copies, for purposes of familiarization with the shop drawings, and to assist in explanation.

PART 2 – PRODUCTS

2.1 GENERAL

A. **All instrumentation supplied** shall be of the manufacturer's latest design and shall produce or be activated by signals which are established standards for the water industry.

B. **All electronic instrumentation** shall be of the solid-state type and shall utilize linear transmission signals of 4 to 20 mAdc (milliampere direct current), however, signals between instruments within the same panel or cabinet may be 0-10 V.d-c (volts direct current), or other manufacturer standard.

C. **Outputs of equipment** that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero based signals will be allowed for remote transmission.

D. **All instruments shall be provided** with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings or as required.

E. **All indicators and LED readouts** shall be linear, direct reading in process units, unless otherwise noted. Percentage scales and indicators are prohibited.

F. **All transmitters shall be provided** with either integral indicators or conduit mounted indicators in process units, accurate to two percent, unless otherwise noted.

G. **Electronic equipment shall be of the manufacturer's latest design,** utilizing printed circuitry and suitably coated to prevent contamination by dust, moisture and fungus. Solid state components shall be conservatively rated for their purpose, to assure optimum long term performance and dependability over ambient atmosphere fluctuations and 0 to 95 percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid, and slightly corrosive service conditions.

H. **All equipment, cabinets and devices furnished** hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, in-so-far as possible, and shall consist of equipment models which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

I. **All equipment shall be designed to operate** on a 60 Hertz alternating current power source at a nominal 115 volts, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

J. **All analog transmitter and controller outputs** shall be 4-20 milliamperes into a load of 0-750 ohms, unless higher load capacity is required.

K. **All switches shall have double-pole double-throw contacts** rated at a minimum of 600 VA, unless specifically noted otherwise.

L. **Materials and equipment used** shall be UL listed (or other independent lab listed) wherever such listed equipment and materials are available.

M. **All equipment shall be designed and constructed** so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored.

N. **All circuit boards in instruments mounted** in damp locations or mounted outdoors shall be fungus proofed. All field transmitters mounted outside shall be equipped with sunshields and shall be capable of operation to -20^{o} Fahrenheit.

O. **Equipment installed in a hazardous area** shall meet Class, Group and Division as shown on the contract drawings, to comply with the National Electrical Code. All power supply and signals coming from and going to hazardous areas shall have intrinsic safety barriers provided.

2.2 INSTRUMENTS AND ACCESSORY EQUIPMENT

A. **Refer to other Division 40 Instrumentation Specification Sections** for equipment requirements for field mounted primary devices, transmitters and secondary instruments, receivers and central control equipment.

PART 3 – EXECUTION

Not Applicable.

END OF SECTION

SECTION 40 63 43

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 – GENERAL

1.1 SUMMARY

A. **Section Includes**

1. **Programmable logic controller (PLC)** control system(s) and local operator displays

B. **Related Sections** include but are not necessarily limited to

1. Section 40 60 00 – Process Control and Enterprise Management Systems

2. Section 40 67 00 – Control System Equipment Panels and Racks

3. Section 26 05 19 – Low-Voltage Electrical Conductors and Cables

1.2 QUALITY ASSURANCE

A. **Referenced Standards**

1. **Institute of Electrical and Electronics Engineers, Inc. (IEEE)**
   a. C37.90.2, Trial-Use Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers
   b. C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

2. **National Electrical Manufacturers Association (NEMA)**
   a. ICS 1, General Standards for Industrial Control and Systems

B. **Qualifications**

1. Installation supervisor shall have had experience in control panel fabrication of at least three (3) similar installations in size and scope

1.3 SUBMITTALS

A. **Shop Drawings**

1. See Section 40 60 00 – Process Control and Enterprise Management Systems

2. PLC product technical data including

a. Drawings containing the following information to be submitted as part of Section 40 67 00 – Control System Equipment Panels and Racks submittals
   1) Arrangement drawings for PLC system components
   2) Panel and enclosure plans, sections and details
   3) Access opening locations and required clearances for each panel and enclosure
   4) Enclosure internal wiring and terminal blocks
b. Catalog cut sheets containing information on PLC components to be submitted as part of this Specification Section submittals

B. **Operation and Maintenance Manuals**

1. No operation and maintenance information required for the equipment specified in this section.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. **Subject to compliance with the Contract Documents**, the following manufacturers are acceptable

1. Rockwell Automation, Allen-Bradley. No Exceptions.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. **See Section 40 60 00** – Process Control and Enterprise Management Systems

B. **The PLC system** shall operate in ambient conditions of 32 to 140 deg F temperature and 5 to 95 percent relative humidity without the need for purging or air conditioning.

C. **Environmental Controls**

1. Furnish circulation fans in solid state control system enclosures.

2. Over-temperature switches shall be utilized to provide special cooling if required to maintain operating temperatures within the manufacturer's specified range.

3. Air conditioning applications shall include means of preventing moisture condensation.

D. **All PLC control system components** shall be capable of meeting or exceeding electromagnetic interference tests per IEEE C37.90.2.

E. **Incorporate the following minimum safety measures**

1. **Design PLC system** with high noise immunity to prevent occurrence of false logic signals resulting from switching transients, relay and circuit breaker noise or conducted and radiated radio frequency interference.

2. **Operator intervention**
   a. Logic system failure shall not preclude proper operator intervention.
   b. Safety shutdown of equipment or a system shall require manual operator intervention before the equipment or system operation may be reestablished.

2.3 PLC COMPONENTS

A. PLC System Central Processor Unit (CPU)

1. Provide Allen-Bradley Model 1769-L33ER CPU, no exceptions. See Drawings.

B. Input/output (I/O) Modules

1. **Discrete input:** Allen-Bradley Model 1769-IA16, no exceptions

2. **Discrete output**: Allen-Bradley Model 1769-OA16, no exceptions

3. **Analog input:** Allen-Bradley Model 1769-IF8, no exceptions

4. **Analog output**: Allen-Bradley Model 1769-OF8, no exceptions

C. Power Supply Units

1. Provide Allen-Bradley Model 1769-PA4 power supply, no exceptions. See Drawings.

D. PLC System Enclosure

1. In accordance with Section 40 67 00 – Control System Equipment Panels and Racks

2. Component placement
   a. Mount all controller components vertically within the enclosure to allow maximum convection cooling.
   b. Either install power supplies above all other equipment with at least 10 IN of clearance between the power supply and the enclosure top, or adjacent to other components, but with sufficient spacing for circulation of cooling air.
   c. Do not place I/O racks directly above the CPU or power supply.
   d. Locate incoming line devices (isolation or constant voltage transformers, local power disconnects, surge suppressors, etc.) so

as to keep power wire runs within an enclosure as short as possible.

e. If items such as magnetic starters, contactors, relays, and other electromagnetic devices must be located within the same enclosure as the PLC system components, place a barrier with at least 6 IN of separation between the magnetic area and the control area.

f. Place circulating fans close to major heat generating devices.

g. Segregate input/output modules into groups of identical type.

3. **Wiring and grounding** to be in accordance with Section 40 67 00 – Control System Equipment Panels and Racks.

4. **Termination requirements**

a. In accordance with Section 40 67 00 – Control System Equipment Panels and Racks

b. Make connections to I/O subsystem by terminating all field wiring on terminal blocks within the enclosure

c. Prewire I/O modules to terminal blocks

d. Size terminals to accommodate all active database points and spares

e. Provide terminals for individual termination of each signal shield

f. Field wiring shall not be disturbed when removing or replacing an I/O module

2.4 FIELD MOUNTED OPERATOR DISPLAYS

A. **Acceptable Manufacturers**

1. Allen-Bradley Panel View Plus 6, 2711P-T10C4D8, no substitutions. See Drawings.

2.5 ACCESSORIES

A. Provide all accessories required to furnish a complete PLC control system to accomplish the requirements of the Drawings and Specifications.

2.6 NETWORKING DEVICES

A. **Ethernet Switches**

1. Acceptable Manufacturers

a. Allen-Bradley Stratix 2000 series, no exceptions. See Drawings. Provide SFP ports where indicated.

B. **Lap Top Access Port**

1. Acceptable Manufacturers

a. Graceport

b. Or equivalent

C. **Motor Controllers**

1. Acceptable Manufacturers
   a. Allen-Bradley 20-COMM-E Ethernet communications module, no exceptions. Communication module provided with motor control equipment by Allen-Bradley.

D. **Ethernet Communications Card**: For Allen Bradley 1769 (CompactLogix) PLC's, provide 1769-EBNT communications card, no exceptions.

2.7 SOFTWARE

A. No PLC, operator display, or Ethernet switch programming software is necessary for the Owner. Owner maintains licensed copies of all software necessary for these devices.

2.8 SOURCE QUALITY CONTROL

A. **Provide a performance test** after factory completion and prior to shipment.

1. Conduct a test where the system is operated continuously and checked for correct operation including loop controls, displays, printing, keyboard functions, alarm responses, and on/off sequencing control.

2. Conduct testing with dummy I/Os to verify each control loop operation.

3. Allow for Owner and Engineer representatives to witness testing program.
   a. Provide minimum of 15 days notice prior to testing.

4. Do not ship prior to successful completion of this testing program.

2.9 MAINTENANCE MATERIALS

A. **Furnish Owner with the following extra materials**

1. One (1) spare I/O card of each card type for every 10 cards or fraction thereof installed

2. One (1) spare communications card for each type used

3. One (1) spare operator display

4. One (1) spare power supply

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install PLC control system in accordance with manufacturer's written instructions.

3.2 FIELD QUALITY CONTROL

A. Contractor shall

1. Inspect equipment covered by these Specifications.

END OF SECTION

SECTION 40 67 00

CONTROL SYSTEM EQUIPMENT PANELS AND RACKS

PART 1 - GENERAL

1.1 SUMMARY

A. **Section Includes**

1. Requirements for control panels and enclosures utilized as follows
   a. Unless noted otherwise, all control panels and enclosures housing control components that are specified in Section 40 70 00, Section 40 78 00, Section 40 78 56 or Section 40 63.

B. **This Section is only applicable to panels furnished with Division 44** equipment packages when so stated in the applicable Division 44 Specification Section.

C. **This Section is only applicable to panels housing Division 26** specified equipment (e.g., motor starters, lighting controls, etc.) when so stated in the applicable Division 26 Specification Section.

D. **Related Sections include** but are not necessarily limited to

1. Section 40 60 00 – Process Control and Enterprise Management Systems
2. Section 40 70 00 – Instrumentation for Process Systems
3. Section 40 78 00 – Panel Mounted Instruments
4. Section 40 78 56 – Surge Suppressors
5. Section 40 63 43 – Programmable Logic Controllers
6. Division 26 - Electrical

1.2 QUALITY ASSURANCE

A. **Referenced Standards**

1. American National Standards Institute (ANSI)
2. ASTM International (ASTM)
   a. B75, Standard Specification for Seamless Copper Tube
3. National Electrical Manufacturers Association (NEMA)
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum)
   b. ICS 4, Industrial Control and Systems: Terminal Blocks

4. National Fire Protection Association (NFPA)
   a. 70, National Electrical Code (NEC)

5. Underwriters Laboratories, Inc. (UL)

6. 508A, Standard for Safety Industrial Control Panels

B. **Miscellaneous**

1. **Approved supplier of Industrial Control Panels** under provisions of UL 508A
   a. Entire assembly shall be affixed with a UL 508A label "Listed Enclosed Industrial Control Panel" prior to shipment to the jobsite
   b. Control panel(s) without an affixed UL 508A label shall be rejected and sent back to the Contractor's factory

1.3 DEFINITIONS

A. **The term "panel" refers to control panels** or enclosures listed in the schedule included in this Specification Section.

B. **Foreign Voltages**: Voltages that may be present in circuits when the panel main power is disconnected.

C. **Intrinsically Safe**

1. A device, instrument or component that will not produce sparks or thermal effects under normal or abnormal conditions that will ignite a specified gas mixture.

2. Designed such that electrical and thermal energy limits inherently are at levels incapable of causing ignition.

D. **Cable:** Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.

E. **Instrumentation Cable**

1. Multiple conductor, insulated, twisted or untwisted, with outer sheath.

2. Instrumentation cable is typically either TSP (twisted-shielded pair) or TST (twisted-shielded triad), and is used for the transmission of low current or low voltage signals.

F. **Ground Fault Circuit Interrupter (GFCI):** A type of device (e.g., circuit breaker or receptacle) which detects an abnormal current flow to ground and opens the circuit preventing a hazardous situation.

G. **Programmable Logic Controller (PLC):** A specialized industrial computer using programmed, custom instructions to provide automated monitoring and control functions by interfacing software control strategies to input/output devices.

H. **Remote Terminal Unit (RTU):** An industrial data collection device designed for location at a remote site, that communicates data to a host system by using telemetry such as radio, dial-up telephone, or leased lines.

I. **Input/Output (I/O):** Hardware for the moving of control signals into and/or out of a PLC or RTU.

J. **Supervisory Control and Data Acquisition (SCADA)**: Used in process control applications, where programmable logic controllers (PLCs) perform control functions but are monitored and supervised by computer workstations.

K. **Highway Addressable Remote Transducer (HART):** An open, master-slave protocol for bus addressable field instruments.

L. **Digital Signal Cable**: Used for the transmission of digital communication signals between computers, PLCs, RTUs, etc.

M. **Uninterruptible Power Supply (UPS):** A backup power unit that provides continuous power when the normal power supply is interrupted.

N. **Loop Calibrator:** Portable testing and measurement tool capable of accurately generating and measuring 4-20ma DC analog signals.

1.4 SUBMITTALS

A. **Shop Drawings**

1. **Contractor shall submit shop drawings** for PLC-based SCADA control panels no later than 90 days after the instrumentation supplier receives Notice to Proceed from the Design-Builder. The PLC and HMI shall be delivered to a secured location accessible to MSD prior to July 31 2018 to allow temporary installation for programming activity. The PLC and HMI shall be moved to its permanent location within 21 days of the control room being a suitable environment for the control panels (as defined in Specification 26 05 04). For those panels where System Integrator is performing programming services, the panels furnished by the equipment supplier shall be installed within 21 days of the control room being a suitable environment, and shall be ready for communication with the SCADA PLC.

2. **See Section 40 60 00** – Process Control and Enterprise Management Systems

3. **Prepared with computer aided design (CAD) software**

4. **Printed on 11 by 17 IN sheets**

5. **Drawings shall include a title block** containing the following
   a. Plant or facility name where panel(s) are to be installed
   b. Drawing title
   c. Drawing number
   d. Revision list with revision number and date
   e. Drawing date
   f. Drawing scale
   g. Manufacturer name, address, and telephone number

6. **Cover sheet** for each drawing set shall indicate the following
   a. Plant or facility name
   b. Project name
   c. Submittal description
   d. Revision number
   e. Issue date

7. **Table of contents sheet(s)** shall indicate the following for each drawing in the set
   a. Drawing number
   b. Drawing title
   c. Sheet number

8. **Legend and abbreviation** sheet shall indicate the following
   a. Description of symbols and abbreviations used
   b. Panel construction notes including enclosure NEMA rating, finish type and color, wire type, wire color strategy, conductor sizes, and wire labeling strategy
   c. Confirmation that the panel(s) are to be affixed with a UL 508A label prior to shipment from the factory

9. **Bill of Material** for each panel shall include the following component information
   a. Device tag number
   b. Quantity
   c. Functional name or description
   d. Manufacturer
   e. Complete model number
   f. Size or rating

10. **Panel exterior layout drawings** to scale and shall indicate the following
    a. Panel materials of construction, dimensions, and total assembled weight
    b. Panel access openings
    c. Conduit access locations
    d. Front panel device layout
    e. Nameplate schedule
       1) Nameplate location
       2) Legend which indicates text, letter height and color, and background color

11. **Panel interior layout drawings** shall be drawn to scale and shall indicate the following
    a. Sub-panel or mounting pan dimensions
    b. Interior device layouts
    c. PLC/RTU general arrangement layouts
    d. Wire-way locations, purpose, and dimensions
    e. Terminal strip designations
    f. Location of external wiring and/or piping connections
    g. Location of lighting fixtures, switches and receptacles

12. **Wiring diagrams** shall consist of the following
    a. Panel power distribution diagrams
    b. Control and instrumentation wiring diagrams
    c. PLC/RTU I/O information
        1) Model number of I/O module
        2) Description of I/O module type and function
        3) Rack and slot number
        4) Terminal number on module
        5) Point or channel number
        6) Programmed point addresses
        7) Signal function and type
    d. Wiring diagrams shall identify each wire as it is to be labeled

B. **Manufacturer catalog cut sheets** for enclosure, finish, panel devices, control auxiliaries, and accessories

C. **Electrical load calculations** for each panel

1. Total connected load

2. Peak electrical demand for each panel

D. **Climate control calculations** for each panel

1. Verify that sufficient dissipation and/or generation of heat is provided to maintain interior panel temperatures within the rated operating temperatures of panel components

E. **Miscellaneous**

1. Record Drawings
    a. Updated panel drawings delivered with the panel(s) from the Contractor's factory
    b. Drawings shall be enclosed in transparent plastic and firmly secured within each panel

F. **Operation and Maintenance Manuals**
1. See Section 40 60 00 – Process Control and Enterprise Management Systems

PART 2 -PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. **Subject to compliance with the Contract Documents**, the following manufacturers are acceptable

1. **Enclosures**
   a. Hoffman Engineering Co
   b. Rittal
   c. Or equivalent

2. **Panel heaters**
   a. Hoffman Engineering Co
   b. Or equivalent
   c. See Drawings

3. **Panel Lighting**
   a. Hoffman
   b. Or equivalent
   c. See Drawings

2.2 FABRICATION

A. **General**

1. **Provide panel(s) with the required enclosure rating** per NEMA 250 to meet classifications identified in the Contract Documents

2. **Devices installed in panel openings** shall have a NEMA enclosure rating at least equal to the panel enclosure rating
   a. Devices that cannot be obtained with an adequate NEMA rating shall be installed behind a transparent viewing window
   b. The window shall maintain the required NEMA rating of the enclosure

3. **Panel(s) shall be completely assembled** at the Contractor's factory
   a. No fabrication other than correction of minor defects or minor transit damage shall be performed on panels at the jobsite

4. **Painting**
   a. Panels fabricated from steel shall have their internal and external surfaces prepared, cleaned, primed, and painted.
      1) Mechanically abrade all surfaces to remove rust, scale, and surface imperfections.
      2) Provide final surface treatment with 120 grit abrasives or finer, followed by spot putty to fill all voids.
      3) Utilize solvent or chemical methods to clean panel surfaces.

4) Apply surface conversion of zinc phosphate prior to painting to improve paint adhesion and to increase corrosion resistance.
5) Electrostatically apply polyester urethane powder coating to all inside and outside surfaces.
6) Bake powder coating at high temperatures to bond coating to enclosure surface.
   a) Panel interior shall be white with semi-gloss finish.
   b) Panel exterior shall be ANSI #61 gray with flat finish.
7) Application of alkyd liquid enamel coating shall be allowed in lieu of polyester urethane powder for wall mounted NEMA 1 or NEMA 12 rated panels.

b. Panels fabricated from stainless steel, aluminum, or fiberglass shall not be painted.

5. **Finish opening edges of panel cutouts** to smooth and true surface conditions.
   a. Panels fabricated from steel shall have the opening edges finished with the panel exterior paint.

6. **Panel shall meet all requirements of UL 508A.**
   a. If more than one (1) disconnect switch is required to disconnect all power within a panel or enclosure, provide a cautionary marking with the word "CAUTION" and the following or equivalent, "Risk of Electric Shock-More than one (1) disconnect switch required to de-energize the equipment before servicing."

7. **Provide control panel in accordance with NEC Article 409** - Industrial Control Panels.
   a. In the event of any conflict between NEC Article 409 and UL 508A, the more stringent requirement shall apply.

B. **Wall Mounted Panels**

1. Seams continuously welded and ground smooth

2. Rolled lip around all sides of enclosure door opening

3. Gasketed dust tight

4. Three-point latching mechanism operated by oil tight key-locking handle

5. Hasp and staple for Owner’s padlock

6. Key doors alike

7. Continuous heavy GA hinge pin on doors
   a. Hinges rated for 1.5 times door plus instrument weight

8. Front full opening door

9. Brackets for wall mounting

C. **Internal Panel Wiring**

1. **Panel wire duct** shall be installed between each row of components, and adjacent to each terminal strip.
   a. Route wiring within the panel in wire-duct neatly tied and bundled with tie wraps.
   b. Follow wire-duct manufacturer's recommended fill limits.
   c. Wire-duct shall have removable snap-on covers and flexible fingers for easy wire entrance.
   d. Wire-duct shall be constructed of nonmetallic materials with rating in excess of the maximum voltage carried therein.

2. **Wiring shall be installed** such that if wires are removed from one (1) device, source of power will not be disrupted to other devices.

3. **Splicing and tapping of wires** permitted only at terminal blocks.

4. **Wire bunches to doors** shall be secured at each end so that bending or twisting will be around longitudinal axis of wire.
   a. Protect bend area with sleeve.

5. **Arrange wiring neatly**, cut to proper length, with surplus wire removed.
   a. Arrange wiring with sufficient clearance.
   b. Provide abrasion protection for wire bundles that pass through openings or across edges of sheet metal.

6. A**C circuits shall be routed separate** from analog signal cables and digital signal cables.
   a. Separate by at least 6 IN, except at unavoidable crossover points and at device terminations.

7. **Provide at least 6 IN of separation** between intrinsically safe devices and circuits and non-intrinsically safe devices and circuits.

8. **Wiring to pilot devices or rotary switches** shall be individually bundled and installed with a "flexible loop" of sufficient length to permit the component to be removed from panel for maintenance without removing terminations.

9. **Conductors for AC and DC circuits** shall be type MTW stranded copper listed for operation with 600 V at 90 DegC.
   a. Conductor size shall be as required for load and 16 AWG minimum.
   b. Internal panel wiring color code
      1) AC circuits
         a) Power wiring: Black

b) Control interconnections: Yellow
c) Neutral: White
d) Ground: Green
2) Low voltage DC circuits
a) Power wiring: Blue
b) Control interconnections: Violet
3) Foreign voltage circuits: Pink
4) Annunciator circuits: Red
5) Intrinsically safe circuits: Orange

10. **Analog signal cables** shall be of 600 V insulation, stranded copper, twisted-shielded pairs.
    a. Conductor size: 18 AWG minimum
    b. Terminate shield drain conductors to ground only at one (1) end of the cable

11. **Analog signals for devices** in separate enclosures shall not be wired in series
    a. Loop isolators shall be used where analog signals are transmitted between control enclosures

12. **Wire and cable identification**
    a. Wire and cables numbered and tagged at each termination
    b. Wire tags
        1) Brady Durasleeve wire markers shall be used for internal wire markers with the exception of termination at I/O cards where space limitations may prevent their use. Slide-on, machine-printed PVC wire markers are permitted at the I/O card end of internal panel wiring.
        2) Adhesive, snap-on, or adhesive type labels are not acceptable.
    c. Markings as identified in the Shop Drawings.

D. **Grounding Requirements**

1. **Equipment grounding conductors** shall be separated from incoming power conductors at the point of entry.

2. **Minimize grounding conductor length** within the enclosure by locating the ground reference point as close as practical to the incoming power point of entry.

3. **Bond electrical racks**, chassis and machine elements to a central ground bus.
    a. Nonconductive materials, such as paint, shall be removed from the area where the equipment contacts the enclosure.

4. Bond the enclosure to the ground bus.
    a. It is imperative that good electrical connections are made at the point of contact between the ground bus and enclosure.

5. **Panel-mounted devices** shall be bonded to the panel enclosure or the panel grounding system by means of locknuts or pressure mounting methods.

6. **Sub-panels and doors** shall be bonded to ground.

E. **Termination Requirements**

1. **Wiring to circuits** external to the panel connected to interposing terminal blocks.

2. **Terminal blocks rigidly mounted** on DIN rail mounting channels.

3. **Terminal strips located** to provide adequate space for entrance and termination of the field conductors.

4. **One (1) side of each strip of terminal blocks** reserved exclusively for the termination of field conductors.

5. **Terminal block markings**
   a. Marking shall be the same as associated wire marking.
   b. Legible, machine-printed markings.
   c. Markings as identified in the shop drawings.

6. **Terminal block mechanical characteristics**, and electrical characteristics shall be in accordance with NEMA ICS 4.

7. **Terminal blocks with continuous marking strips**.
   a. Each terminal block shall be identified with machine printed labels.

8. **Analog signal cable shield drain** conductors shall be individually terminated.

9. **Install minimum of 20 percent spare terminals.**

10. **Bladed, knife switch**, isolating type terminal blocks where control voltages enter or leave the panel.

11. **Fused terminal blocks** shall be provided with blown fuse indicators.

12. **When control circuits require more than one** (1) field conductor connected to a single wiring point, a sufficient number of terminal points shall be connected internally to allow termination of only one (1) field conductor per terminal block.

13. **DIN rail mounting channels** shall be installed along full length of the terminal strip areas to facilitate future expansion.

14. **Connections to devices** with screw type terminals shall be made using spade-tongue, insulated, compression terminators.

F. **Component Mounting and Placement**

1. **Components shall be installed** per manufacturer instructions.

2. **Control relays and other control auxiliaries** shall be mounted on DIN rail mounting channels where practical.

3. **Front panel devices** shall be mounted within a range of 40 to 70 IN above the finished floor, unless otherwise shown in the Contract Documents.

4. **PLC/RTU and I/O rack installation**
   a. Located such that the LED indicators and switches are readily visible with the panel door open.
   b. Located such that repair and/or replacement of component can be accomplished without the need to remove wire terminations or other installed components.

5. **Locate power supplies** with sufficient spacing for circulation of air.

6. **Where components such as magnetic starters**, contactors, relays, and other electromagnetic devices are installed within the same enclosure as the PLC/RTU system components, provide a barrier of at least 6 IN of separation between the “power area containing the electromagnetic devices” and the “control area”.

7. **Components mounted in the panel interior** shall be fastened to an interior sub-panel using machine screws.
   a. Fastening devices shall not project through the outer surface of the panel enclosure.

8. **Excess mounting space of at least 20 percent** for component types listed below to facilitate future expansion
   a. Fuse holders
   b. Circuit breakers
   c. Control relays
   d. Time delay relays
   e. Intrinsically safe barriers and relays

9. **Components installed on sub-panels** shall be provides with a minimum spacing between component and wire duct of 1 IN.
   a. Minimum of 2 IN separation between terminal strips and wire ducts.

G. **Power Distribution**

1. **Main incoming power circuits** shall be protected with a thermal magnetic circuit breaker.
   a. Limit load to maximum of 80 percent of circuit breaker rating.

2. **Component types listed below** shall be individually fused so that they may be individually de-energized for maintenance
   a. PLC/RTU power supply modules
   b. Single-loop controllers
   c. Recorders
   d. Alarm annunciators

3. **Each control panel with PLC/RTU** components shall be furnished with power protection in the form of a double conversion UPS.

4. **Equip each panel with necessary power supplies** with ratings required for installed equipment and with minimum 25 percent spare capacity.

5. **Constant voltage transformers**, balancing potentiometers, and rectifiers as necessary for specific instrument requirements.

H. **Internal Panel Lighting and Service Receptacles**

1. One (1) compact LED-type light fixture with automatic switch(es)

2. One (1) convenience receptacle

I. **Environmental Controls**

1. **Environmental control components**
   a. Panel heaters
      1) Thermostat controlled
      2) Designed for sub-panel mounting
      3) Powered from 120 Vac and protected with a dedicated circuit breaker

2.3 MAINTENANCE MATERIALS & SPARE PARTS

A. **Extra Materials**

1. One (1) complete set of replacement corrosion inhibitors in sealed packages for each panel

2. Five (5) spare fuses for each type and size of fuse provided

PART 3 -EXECUTION

3.1 FACTORY TESTING

A. **Scope:** Inspect and test entire panel assembly to verify readiness for shipment.

B. **Location**: Contractor's factory.

C. **Factory Tests**

1. **Tests shall be fully documented** and signed by the Contractor's factory supervisor.

2. **The panel shop shall fully test** the control panel for correct wiring.
   a. Each I/O point shall be checked by measuring or connecting circuits at the field terminal blocks.

3. **Burn-in test**: Panel(s) shall be fully energized for a minimum period of 48 HRS.

4. **A PLC Central Processing Unit (CPU**) shall be obtained and connected to the panel(s) if necessary for testing purposes.

5. **Testing equipment** (such as digital multi-meters, analog loop calibrators, and laptop computers with PLC programming software) shall be used as required for testing.

6. **The following functions** shall be tested as a minimum
   a. Demonstrate functions of the panel(s) required by the Contract Documents.
   b. Correctness of wiring from all panel field terminals to all I/O points and to all panel components.
   c. Simulate and test each discrete signal at the field terminal strips.
   d. Simulate and test each analog signal using loop calibrators.
   e. Correct operation of all digital communication devices.
   f. Demonstrate online and offline diagnostic tests and procedures.
   g. The Contractor shall notify the Owner in writing a minimum of 15 calendar days prior to the Factory Tests.
      1) Owner has the option to witness all required tests.
      2) Costs for travel, meals, and lodging shall be borne by the Owner.

7. **Make following documentation** available to the Engineer at test site during the tests
   a. Contract Documents.
   b. Factory Demonstration Testing procedures.
   c. List of equipment to be testing including make, model, and serial number.
   d. Shop Drawing submittal data for equipment being tested.

8. **Deficiencies shall be corrected prior to shipment** from the Contractor's factory.

3.2 INSTALLATION

A. **Anchor panels in a manner to prevent the enclosure** from racking, which may cause the access doors to become misaligned.

B. **Obtain approved panel layouts** prior to installation of conduits.

C. **Install products in accordance** with manufacturer's instructions.

END OF SECTION

SECTION 40 70 00

INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. **Section Includes**

1. Analytical components
2. Pressure components
3. Flow components

B. **Related Specification** Sections include but are not necessarily limited to

1. Section 40 60 00 – Process Control and Enterprise Management Systems

1.2 QUALITY ASSURANCE

A. **See Section 40 60 00** – Process Control and Enterprise Management Systems

B. **U.S. Department of Interior Bureau of Reclamation** (USDIBR)

1. Water Measurement Manual

1.3 SYSTEM DESCRIPTION

A. **The instruments specified in this Specification Section** are the primary element components for the control loops shown on the "I" series Drawings. The Contractor shall provide PLC and HMI programming necessary to execute the process control strategy based on process variables transmitted by instruments supplied and installed under this Contract.

1.4 SUBMITTALS

A. **Shop Drawings**

1. See Specification Section 40 60 00 – Process Control and Enterprise Management Systems

B. **Operation and Maintenance Manuals**

1. See Specification Section 01 33 00 – Closeout Submittals for requirements for
   a. The mechanics and administration of the submittal process
   b. The content of Operation and Maintenance Manuals

1.5 SPECIFIED EQUIPMENT AND "OR EQUAL"

A. **Instrumentation and control components** have been identified on the Drawings by manufacturer name and model number or type along with important features. The components identified imply the required level of quality regardless of whether or not all features, materials of construction, etc. of said components are expressed explicitly. The substitution of alternatives will be evaluated by comparison to the explicit, or implicit, requirements represented by the models specified. The acceptability of submitted alternatives shall be at the sole discretion of the Engineer. All risk associated with alternative equipment shall be borne by the Contractor.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. **Subject to compliance with the Contract Documents**, the manufacturers listed in the Articles describing the elements are acceptable.

2.2 PRESSURE INSTRUMENTS

A. **Pressure Switches**

1. **Pressure switches shall piston actuated with adjustable differential**. Sealed piston devices shall be provided to filter the piston assembly. Range shall be as indicated, or as required for the application. Range adjustment shall be accessible from the outside of the switch housing.

2. Housing and pistons shall be stainless steel. Diaphragms and o-ring seals shall be Viton. Retaining rings shall be Teflon.

3. Switches shall have SPDT contact outputs which shall provide one N.O. and one N.C. contact rated 10A continuous at 120VAC.

4. Switch housings shall be UL listed for NEMA 4, 4X, and 13 applications, except where shown in hazardous areas, in which case, enclosures shall be UL listed for NEMA 7 and 9 applications, for Class I or II, Division 1 or 2 hazardous areas.

5. Pressure switches shall be manufactured by Square D, Allen Bradley, or equal.

B. **Diaphragm**

1. Acceptable manufacturers
   a. Ashcroft Type 100
   b. Or equivalent

2. Design and fabrication
   a. Top housing: 316 stainless steel with fill connection
   b. Bottom housing: 316 stainless steel with flushing connection
   c. Diaphragm: 316 stainless steel
   d. Fill fluid: Glycerin
   e. Instrument connection: 1/4" FNPT

f. Process connection: 1-1/2” FNPT

C. **Isolation Rings**

1. Acceptable manufacturers
   a. Ashcroft Type 80 or 81
   b. Or equivalent

2. Design and fabrication
   a. Type: wafer or bolt-thru
   b. Flexible liner: Natural rubber
   c. Fluid temperature: -30 to 225 deg. F
   d. Flange material: 316L stainless steel
   e. Flange class (bolt-thru): equal to piping pressure class
   f. Body material: 316L stainless steel
   g. Instrument connection: 1/4" NPT
   h. Fill fluid: Glycerin
   i. Options
      1) Needle valve and safe quick release

D. **Pressure Gauge**

1. Acceptable manufacturer
   a. Ashcroft Duragage
   b. Or equivalent

2. Design and fabrication
   a. 4-1/2” face w/black pointer on white background with black figures and intervals
   b. Movement: 400 series stainless steel
   c. Bourdon tube: welded 316 stainless steel
   d. Case: Black phenolic plastic
   e. Process connection: 1/4"
   f. Fill fluid: Glycerin
   g. Accuracy: 1/2" full scale
   h. Micrometer adjustable pointer

2.3 FLOW INSTRUMENTS

A. **Magnetic Flow Meters**

1. **Acceptable manufacturers**
   a. Endress + Hauser Promag W300

2. **Sensor design and fabrication**
   a. Liner: Purfluoroalkoxy (PFA) resin
   b. Sensor housing: powder-coated die-cast aluminum
   c. Measuring tube: 304L stainless steel
   d. Electrodes: 316L stainless steel
   e. Flanges: carbon steel
   f. Ground disks: 316L stainless steel

g. Cabling: Factory-installed
h. Operating temperature: 14 to 140 deg. F
i. Fluid temperature: -4 to 350 deg. F
j. Enclosure rating
   1) NEMA 6P in underground vaults subject to flooding
   2) NEMA 4X all other locations

3. **Transmitter design and fabrication**
   a. Type: Remote, wall-mount, field housing
   b. Enclosure: NEMA 4X
   c. Adjustable low flow cutoff
   d. Flow totalizer
   e. Power supply: 85-260 VAC
   f. Output:
      1) Analog: (1) 0/4-20mA, active
      2) Discrete: (2) 30VAC/0.5A, 60VDC/0.1A, programmable normally-open or normally-closed
   g. Operator interface: Liquid crystal backlit display with navigation and selection keypad

2.4 IN-LINE SUSPENDED SOLIDS METER

A. **Manufacturer**

1. Specification is based on equipment manufactured by Cerlic Controls, AB, Model – ITXIL/BB2, P/N 24030 (single).

B. **Sensor**

1. The measuring principle is based on the transmission of a single NIR (Near Infra-Red) light beam generated by a light emitting diode (LED) and received by a silicon detector. NIR light is not sensitive to color and does not contribute to biological growth as with visible light.

2. Sensors shall be programmed and calibrated from the control box but retain all information internally rather than in the control box. Suspended solid concentrations are measured as a function of the ability of suspended materials to absorb and reflect NIR-light (near infra-red). Sensors based on “reflection” of light by particles are not adequate and therefore not acceptable.

3. The sensor housing shall be made of 316SS with glass lenses. Sensor shall be designed for 90 psig (6 bar) working pressure and supplied with integral built-in mechanical stop. Sensor shall have integral SS flushing nozzle with check valve. Sensor shall be designed to mount in a 1.5” npt female connection on pipe. Gap between lenses shall be to be 15mm. Liquid velocity shall be at least 4 fps in pipe to have turbulent flow. Fluid can flow in either direction. Sensor shall be supplied with shielded 4-conductor cable with polyurethane jacket and metallic M12-connector

with o-ring seal, length as required. The sensor shall have a measuring range of 30-30,000 ppm.

C. **Signal Processor Control Box**

1. Control box shall support two sensors, which can be either/or suspended solids, dissolved oxygen, pH, or open channel flow sensors and generate 2 independent and isolated 4-20 mA output signals. Control box shall be designed for future upgrade to commonly used fieldbus protocols by installing a protocol board. Microprocessor based control box with self-instructing menu, digital circuitry, and illuminated graphical LCD display. Graphical display shall show solids concentrations in ppm, mg/l or % solids and 0-100% of mA output. Graphical display shall show calibration points and current suspended solids concentration. The control box produces two linearized 4-20 mA, max 500 ohms galvanically isolated, output signals (12 bit resolution) proportional to suspended solids concentrations. Light on front panel shall indicate status of alarm. To avoid fluctuating output signal, the control box shall have a dampening feature or integration time, which can be set from 1 to 999 seconds. The enclosure shall be watertight molded polycarbonate box, NEMA 4X (IP65). The power supply shall be equipped with filter, fuse and varistors for protection against power surges. The control box shall have EEPROM memory. Following a power failure the control box shall start up and resume measuring without requiring recalibration. Power supply shall be 120/1/60. Control box shall be equipped with built-in heater on circuit board to maintain proper temperature inside control box down to –20 F outside temperature.

D. **Self-Diagnostics**

1. The software shall be of Multi-task design. It shall also contain a watchdog function connected to the microprocessor. The software shall inform the “watch-dog” at least once per second that the device is working properly. If it does not, then the “watch-dog” shall restart the processor in order for the unit to resume measuring.

E. **Programming Module**

1. All programming and settings are performed from the outside of the control box by using a self-instructing menu, controlled by just three touch pad keys. Special plug-in proms or manually adjustable potentiometers for programming are not acceptable. Tamperproof programming feature is required to keep settings from being changed, except by authorized personnel. In the case of power loss, an EEPROM memory shall save programming during power outages.

2. Zero point calibration shall be done using clean de-aerated water. The control box shall allow for calibration against suspended solids solutions

by calibrating to one point or up to five points for wide calibration range. Any of these five points may be entered and the unit shall calculate the correlation between the points. The values for the calibration points which are obtained from laboratory analysis, shall be able to be entered any time after calibration since the meter correlates these to light transmission values. Graph scale shall be adjustable by changing 4–20 mA output settings. Sample points shall not have to be re-entered to change scale. Programming menus shall be of a cursor type.

F. **Mounting**

1. Sensor shall be supplied with 1.5" npt 316 SS isolation valve assembly and male nipple to attach to 1.5" npt boss or saddle in pipe supplied by contractor. 1.5" connection shall be at 45° to 90° from bottom of pipe for horizontal pipes and minimum of 10 pipe diameters down stream of elbows and restrictions and 5 pipe diameters for recover after sensor. Sensor can also be mounted in vertical pipes with same downstream requirements. The transmitter shall have four (4) 3/16" holes for mounting to walls or mounting plates.

G. **Flushing System**

1. Sensor shall have integral SS flushing nozzle. Control box shall be supplied with solenoid flushing valve prewired to control box and mounted on a common aluminum sunshield mounting plate. Flushing cycle shall be control box program and should be field adjustable. Output signal must be held constant during flush cycle. Flushing liquid shall be 40-60 psig filtered reuse water or compressed air.

PART 3 – EXECUTION

3.3 INSTALLATION

A. **Install products** in accordance with manufacturer's instructions.

B. **Install instrument mounting** pipe stands level and plumb.

C. **Instrument Mounting**

1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.

2. Mount all local indicating instruments with face forward toward the normal operating area, within reading distance, and in the line of sight.

3. Mount instruments level, plumb, and support rigidly.

4. Mount to provide
   a. Protection from heat, shock, and vibrations
   b. Accessibility for maintenance
   c. Freedom from interference with piping, conduit and equipment

D. **Contractor shall certify the bottom of hydrostatic level transmitters i**s mounted 12" above the floor of the tank or pipe in which it is installed.

END OF SECTION

SECTION 40 78 00

PANEL MOUNTED INSTRUMENTS

PART 1 -GENERAL

1.1 SUMMARY

A. **Section Includes**

1. **Pilot devices**
   a. Selector switches
   b. Pushbuttons

2. **Relays/timers**
   a. Control relay
   b. Time delay relays
   c. Intrinsically-safe relays
   d. PLC output interposing relays

3. **Termination equipment**
   a. Terminal blocks
   b. Fuse holders

4. **Power supplies**
   a. DC power supplies
   b. Uninterruptible power supplies (UPS)

5. **Signal Conditioning**
   a. Analog signal splitters

B. **Related Specification Sections** include but are not necessarily limited to

1. Section 40 60 00 - Process Control and Enterprise Management Systems

1.2 QUALITY ASSURANCE

A. **Referenced Standards**

1. **The Instrumentation, Systems, and Automation Society** (ISA)
   a. S18.1, Annunciator Sequences and Specifications

2. **National Electrical Manufacturers Association (NEMA)**
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum)
   b. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts

3. **Underwriters Laboratories, Inc. (UL)**

B. **Miscellaneous**

1. Assure units comply with electrical area classifications and NEMA enclosure type shown on Drawings.

1.3 SPECIFIED EQUIPMENT AND "OR EQUAL"

A. **Instrumentation and control components have been identified** on the Drawings by manufacturer name and model number or type along with important features. The components identified imply the required level of quality regardless of whether or not all features, materials of construction, etc. of said components are expressed explicitly. The substitution of alternatives will be evaluated by comparison to the explicit, or implicit, requirements represented by the models specified. The acceptability of submitted alternatives shall be at the sole discretion of the Engineer. All risk associated with alternative equipment shall be borne by the Contractor.

1.4 SUBMITTALS

A. **Shop Drawings**

1. See Specification Section 40 60 00 - Process Control and Enterprise Management Systems

B. **Operation and Maintenance Manuals**

1. See Division 1 for requirements for
   a. The mechanics and administration of the submittal process
   b. The content of Operation and Maintenance Manuals

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. **Subject to compliance with the Contract Documents**, the manufacturers as listed in the articles describing the devices are acceptable.

B. **Provide similar components from the same manufacturer** for uniformity of appearance, operations, and maintenance.

2.2 PILOT DEVICES

A. **Selector switches**
1. Size: 30.5mm
2. Rating: NEMA 4/13, oil-tight
3. Operator: black, standard
4. Action: maintained
5. Positions: as required by Drawings
6. Contacts: A600, quantity and shelf state as required by Drawings

7. Acceptable manufacturers
    a. Allen-Bradley Bulletin 800-T
    b. Or equal

B. **Pushbuttons**
1. Size: 30.5mm
2. Rating: NEMA 4/13, oil-tight
3. Operator
    a. Flush mount
    b. Start: green
    c. Stop: red
    d. Reset/test: black
4. Action: momentary unless otherwise noted on Drawings
5. Contacts: A600, quantity and shelf state as required by Drawings
6. Acceptable manufacturers
    a. Allen-Bradley Bulletin 800-T
    b. Or equal

C. **Pilot Lights**
1. Size: 30.5mm
2. Rating: NEMA 4/13, oil-tight
3. Operator: push-to-test
4. Voltage: 120VAC
5. Lamp: LED
6. Lens color: as required by Drawings
7. Acceptable manufacturers
    a. Allen-Bradley Bulletin 800-T
    b. Or equal

2.3 RELAYS AND TIMERS

A. **Control Relays**

1. Acceptable manufacturers
    a. Allen-Bradley Bulletin 700-HA series
    b. Square D
    c. Idec
    d. Potter-Brumfield
    e. Or equivalent
    f. See Drawings

B. **Time Delay Relays**

1. Acceptable manufacturers
    a. Off delay: ATC Diversified Electronics TDT series
    b. On-delay: Allen-Bradley Bulletin 700-HT series
    c. Or equivalent
    d. See Drawings

C. **Intrinsically-safe Relays**

1. Acceptable manufacturers

a. ATC Diversified Electronics ISO series
b. Or equivalent
c. See Drawings

D. **PLC Output Interposing Relays**

1. Acceptable manufacturers
   a. Allen-Bradley Bulletin 700-HLT12 series
   b. Or equivalent
   c. See Drawings

2.4 TERMINATION EQUIPMENT

A. **Terminal Blocks**

1. Acceptable manufacturers
   a. Phoenix Contact Type UT
   b. Allen-Bradley Bulletin 1492-J series
   c. Weidmuller W series
   d. Or equal
   e. See Drawings

B. **Fuse Holders**

1. Acceptable manufacturers
   a. Phoenix Contact Type UT
   b. Allen-Bradley Bulletin 1492-H series
   c. Weidmuller W series
   d. Or equal
   e. See Drawings

2.5 POWER SUPPLIES

A. **DC Power Supplies**

1. Acceptable manufacturers:
   a. Sola Hevi-Duty SDN-C series
   b. Phoenix Contact Quint Power series
   c. Allen-Bradley Bulletin 1606 series
   d. Or equivalent
   e. See Drawings

B. **Uninterruptible Power Supply (UPS)**

2. Acceptable manufacturers
   a. Sola Hevi-Duty SDU series
   b. Allen-Bradley Bulletin 1609-U
   c. Or equivalent
   d. See Drawings

2.6 SIGNAL CONDITIONING

A. **Analog Signal Splitter**

1. Acceptable manufacturers:
   a. Moore Industries ECT-DIN
   b. Or equivalent

2.7 MAINTENANCE MATERIALS & SPARE PARTS

A. **Extra Materials**

1. One (1) spare intrinsically safe relay for each type used.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **Install products in accordance with manufacturer's instructions.**

END OF SECTION

SECTION 40 78 56

SURGE SUPPRESSORS

PART 1 - GENERAL

1.1 SUMMARY

A. **Section Includes**

1. Type IC1 SPD - Dedicated 120 Vac power source circuit, series connection, control panel mounted
2. Type IC2 SPD - Individual equipment plug-in device (point of use protection) (NOT USED)
3. Type IC3 SPD - Discrete 120 Vac control signal, control panel mounted
4. Type IC4 SPD - Analog instrumentation signal, field mounted
5. Type IC5 SPD - Analog instrumentation signal, control panel mounted
6. Type IC6 SPD - Combination 120 Vac circuit and analog signal, field mounted (NOT USED)
7. Type IC7 SPD - Discrete low voltage control signal, control panel mounted
8. Type IC8 SPD - Data line, control panel mounted

B. **Related Sections include** but are not necessarily limited to

1. Section 40 60 00 – Process Control and Enterprise Management Systems

1.2 QUALITY ASSURANCE

A. **Referenced Standards**

1. **Institute of Electrical and Electronics Engineers**, Inc. (IEEE)
   a. C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits
2. **National Electrical Manufacturers Association** (NEMA)
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum)
   b. LS 1, Low Voltage Surge Protection Devices
3. **Underwriters Laboratories, Inc.** (UL)
   a. 497B, Standard for Safety Protectors for Data Communications and Fire-Alarm Circuits
   b. 1283, Standard for Safety Electromagnetic Interference Filters

c. 1363, Standard for Safety Relocatable Power Taps
d. 1449, Standard for Safety Transient Voltage Surge Suppressors

B. **Qualifications**

1. **Provide devices for a manufacturer** who has been regularly engaged in the development, design, testing, listing and manufacturing of SPDs of the types and ratings required for a period of 10 years or more and whose products have been in satisfactory use in similar service.

2. **Upon request, suppliers or manufacturers** shall provide a list of not less than three (3) customer references showing satisfactory operation.

1.3 DEFINITIONS

A. **Clamping Voltage**: The voltage measured at the end of the 6 IN output leads of the SPD and from the zero voltage reference to the peak of the surge when the applied surge is induced at the 90 degree phase angle of the applied system frequency voltage.

B. **Let-Through Voltage:** The voltage measured at the end of the 6 IN output leads of the SPD and from the system peak voltage to the peak of the surge when the applied surge is induced at the 90 degree phase angle of the applied system frequency voltage.

C. **Maximum Continuous Operating Voltage (MCOV**): The maximum steady state voltage at which the SPD device can operate and meet it specification within its rated temperature.

D. **Maximum Surge Current**

1. The maximum 8 x 20 microsecond surge current pulse the SPD device is capable of surviving on a single-impulse basis without suffering either performance degradation or more than 10 percent deviation of clamping voltage at a specified surge current.

2. Listed by mode, since number and type of components in any SPD may vary by mode.

E. **Protection Modes**: This parameter identifies the modes for which the SPD has directly connected protection elements, i.e., line-to-neutral (L-N), line-to-line (L-L), line-to-ground (L-G), neutral-to-ground (N-G).

F. **Surge Current per Phase**

1. The per phase rating is the total surge current capacity connected to a given phase conductor.

2. For example, a wye system surge current per phase would equal L-N plus L-G; a delta system surge current per phase would equal L-L plus L-G.
   a. The N-G mode is not included in the per phase calculation

G. **System Peak Voltage**: The electrical equipment supply voltage sine wave peak (i.e., for a 120 V system the L-N peak voltage is 170 V).

1.4 SUBMITTALS

A. Shop Drawings

1. **For named products**, submit only a catalog cut sheet
   a. For all other products, submit the data required below

2. **See Section 40 60 00** - Process Control and Enterprise Management Systems

3. **Product technical data** for non-specified models
   a. Manufacturer's experience
   b. Standard catalog cut sheet
   c. Electrical and mechanical drawing showing unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit
   d. Create a Product Data Sheet for each different model number of SPD provided
      1) Data in the Product Data Sheet heading
         a) SPD Type per PART 2 of the Specification
         b) Manufacturer's Name
         c) Product model number
      2) Data in the Product Data Sheet body
         a) Column one: Specified value/feature of every paragraph of PART 2 of the Specification
         b) Column two: Manufacturer's certified value confirming the product meets the specified value/feature
      3) Data in the Product Data Sheet closing
         a) Signature of the manufacturer's official (printed and signed)
         b) Title of the official
         c) Date of signature

B. **Operation and Maintenance Manual**

1. See General Conditions for requirements for
   a. The mechanics and administration of the submittal process
   b. The content of Operation and Maintenance Manuals

1.5 WARRANTY

A. The manufacturer shall provide a minimum of a five (5) year Limited Warranty from date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. **Subject to compliance with the Contract Documents**, the manufacturers model numbers listed in the individual product paragraphs below are acceptable.

2.2 TYPE IC1 SPD

A. **Approved Products**

1. Allen-Bradley Bulletin 4983-DC series
2. Phoenix Contact SFP 1-20/120AC (2856702)
3. Or equivalent

B. **Standards: UL 1449**

C. **Design**

1. **General**
   a. Mounted internally to control panels for point-of-use loads
   b. MOV based or multi-stage hybrid solid state high performance suppression system
   c. Designed for series connection
   d. Enclosure: Metallic or plastic, flange or DIN rail mounting
   e. Field connection: Provide unit with external terminal screws for each phase, neutral and ground that will accept #14 through #12 conductors
   f. Device monitoring: Long-life, solid state, externally visible indicators that monitors the on-line status of the units suppression filter system or power loss in any of the phases
2. **Operating voltage:** 120 Vac
3. **Operating current:** 15 A minimum
4. **Operating frequency:** 45 to 65 Hz
5. **Modes of protection:** All modes, L-N, L-G and N-G
6. **Maximum continuous operating voltage:** Less than 130 percent of system peak voltage
7. **Maximum surge current**: 20,000A per phase, 10,000A per mode minimum
8. **Minimum repetitive surge current capacity**: 1000 impulses with no degradation of more than 10 percent deviation of the clamping voltage

9. **Fusing**: Optional integral unit level and/or component level short circuit and/or thermal overload protection
   a. External protection as recommended by manufacturer

10. **Maximum clamping voltages**, dynamic test with voltages measured from the zero voltage reference and 90 degree phase angle

System Voltage	Test Mode	IEEE C62.41 B Comb. Wave	IEEE C62.41 A Ring Wave	UL 1449
L-N = 120 V	L-N	400 V	300 V	330 V
	L-G	500 V	400 V	400 V
	N-G	500 V	400 V	400 V

2.3 TYPE IC3 SPD

A. **Approved Products**

1. EDCO DRS-130RMS

2. MTL MA-15/D/1/SI

3. MTL SD-150X

4. Phoenix Contact PT 2x1VA-120AC-ST (2839185) with PT BE/FM (2839282) base for non-isolated wiring

5. Phoenix Contact PT-2 PE/S-120 AC-ST (2839334 with PT-BE/FM (2839282) base for isolated wiring

6. Or equivalent

B. **Standards:** UL 497B or UL 1449

C. **Design**

1. **General**
   a. Mounted internally to control panels for point-of-use loads
   b. Multi-stage hybrid solid state high performance suppression system
   c. Designed for series connection
   d. Enclosure: Metallic or plastic, flange or DIN rail mounting
   e. Field connection: Provide unit with external terminal screws for each phase, neutral and ground that will accept #14 through #12 conductors
   f. Device monitoring: Long-life, solid state, externally visible indicators that monitors the on-line status of the units suppression filter system or power loss in any of the phases

2. **Operating voltage:** 120 Vac

3. **Operating current**: 3 A minimum

4. **Operating frequency:** 45 to 65 Hz

5. **Modes of protection**: L-N; when ground conductor is present L-G and N-G

6. **Maximum continuous operating voltage**: Less than 130 percent of system peak voltage

7. **Maximum surge current**: 6000 A per phase, 3000A per mode minimum

8. **Minimum repetitive surge current capacity**
   a. The SPD shall meet one (1) of the following
      1) 1000 occurrences of a 200A, 10x1000 microsecond waveform
      2) 400 occurrences of a 500A, 10x1000 microsecond waveform
      3) 100 occurrences of a 400A, 10x700 microsecond waveform
      4) 100 occurrences of a 2000A, 8x20 microsecond waveform

9. **Maximum clamping voltages**, measured from the zero voltage reference
   a. The SPD shall meet one (1) of the following
      1) 400A, 10x700 microsecond waveform: 200 percent of system voltage
      2) IEEE B3 combination wave: 250 percent of system voltage
      3) IEEE B3 ring wave: 200 percent of system peak voltage
      4) IEEE A3 ring wave: 200 percent of system peak voltage
      5) Mode N-G clamping voltage may be 175 percent higher than the L-G levels

2.4 TYPE IC4 SPD

A. **Approved Products**

1. Crouse-Hinds MTL SD32

B. **Standards**: None

C. **Design**

1. **General**
   a. For protection of field mounted equipment connected to 4-20mA analog signal loops
   b. Mounted directly to an unused conduit entry on a process transmitter housing

c. Multi-stage hybrid solid state high performance suppression system
d. Designed for series connection
e. Enclosure: 1/2 IN to 3/4 IN stainless steel conduit pipe nipple

2. **Operating voltage**: 24 Vdc or as indicated on the Drawings

3. **Modes of protection**: All modes, L-L and L-G

4. **Maximum continuous operating voltage**: Less than 130 percent of system peak voltage

5. **Maximum surge current**: 10,000 A

6. **Minimum repetitive surge current capacity**
   a. The SPD shall meet one (1) of the following
      1) 1000 occurrences of a 200A, 10x1000 microsecond waveform
      2) 400 occurrences of a 500A, 10x1000 microsecond waveform
      3) 100 occurrences of a 400A, 10x700 microsecond waveform
      4) 100 occurrences of a 2000A, 8x20 microsecond waveform
      5) 10 occurrences of a 10,000A, 8x20 microsecond waveform

7. **Maximum clamping voltages, L-L**
   a. The SPD shall meet one (1) of the following
      1) 400A, 10x700 microsecond waveform: 400 percent of system voltage
      2) 10,000A, 8x20 microsecond waveform: 400 percent of system voltage
      3) IEEE B3 combination wave: 250 percent of system voltage

8. **Maximum clamping voltages, L-G**
   a. The SPD shall meet one (1) of the following
      1) 400A, 10x700 microsecond waveform: 200 percent of system voltage
      2) 10,000A, 8x20 microsecond waveform: 200 percent of system voltage
      3) IEEE B3 combination wave: 300 percent of system voltage

2.5 TYPE IC5 SPD

A. **Approved Products**

1. Cutler Hammer DHW2P036

2. EDCO DRS-036 or PC642C-036 with PCB1B base

3. MTL SD32 or SD32X

4. Phoenix Contact PT 2x2-24DC-ST (2838228) with PT 2x2-BE (2838208) or PT 2x2+F-BE (2839224) base.

5. Or equivalent

B. **Standards: UL 497B**

C. **Design**

1. **General**
   a. Mounted internally to control panels for protection of equipment connected to analog signal loops
   b. Multi-stage hybrid solid state high performance suppression system
   c. Designed for series connection
   d. Enclosure: Metallic or plastic, flange or DIN rail mounting
   e. Field connection: The unit shall have external terminal screws for line and ground conductors

2. **Operating voltage**: 24 Vdc or as indicated on the Drawings

3. **Modes of protection:** All modes, L-L and L-G

4. **Maximum continuous operating voltage**: Less than 130 percent of system peak voltage

5. **Maximum surge current**: 10,000 A

6. **Minimum repetitive surge current capacity**
   a. The SPD shall meet one (1) of the following
      1) 1000 occurrences of a 200A, 10 x 1000 microsecond waveform
      2) 400 occurrences of a 500A, 10 x 1000 microsecond waveform
      3) 100 occurrences of a 400A, 10 x 700 microsecond waveform
      4) 100 occurrences of a 2000A, 8 x 20 microsecond waveform
      5) 10 occurrences of a 10,000A, 8 x 20 microsecond waveform

7. **Maximum clamping voltages, L-L**
   a. The SPD shall meet one (1) of the following
      1) 400A, 10x700 microsecond waveform: 400 percent of system voltage
      2) 10,000A, 8x20 microsecond waveform: 400 percent of system voltage

3) IEEE B3 combination wave: 225 percent of system voltage

8. **Maximum clamping voltages, L-G**
   a. The SPD shall meet one (1) of the following
      1) 400A, 10x700 microsecond waveform: 200 percent of system voltage
      2) 10,000A, 8x20 microsecond waveform: 200 percent of system voltage
      3) IEEE B3 combination wave: 300 percent of system voltage

2.6 TYPE IC7 SPD

A. **Approved Products**

1. Cutler Hammer DDIN Series
2. EDCO DRS Series
3. MTL SD Series
4. Phoenix Contact: PT Series

B. **Standards: UL 497B**

C. **Design**

1. **General**
   a. Mounted internally to control panels for protection of equipment connected to a discrete signal
   b. Multi-stage hybrid solid state high performance suppression system
   c. Designed for series connection
   d. Enclosure: Metallic or plastic, flange or DIN rail mounting
   e. Field connection: Provide unit with external terminal screws for line and ground conductors

2. **Operating voltage**: 24 Vdc or 24 Vac or as indicated on the Drawings

3. **Modes of protection: All modes**
   a. AC applications: L-N, L-G, N-G
   b. DC applications: Pos-Neg, Pos-Gnd, Neg-Gnd

4. **Maximum continuous operating voltage**: Less than 130 percent of system peak voltage

5. **Maximum surge current**: 10,000 A

6. **Minimum repetitive surge current capacity**
   a. The SPD shall meet one (1) of the following

1) 1000 occurrences of a 200A, 10 x 1000 microsecond waveform
2) 400 occurrences of a 500A, 10 x 1000 microsecond waveform
3) 100 occurrences of a 400A, 10 x 700 microsecond waveform
4) 100 occurrences of a 2000A, 8 x 20 microsecond waveform
5) 10 occurrences of a 10,000A, 8 x 20 microsecond waveform

7. **Maximum clamping voltages**, L-L (Pos-Neg)
   a. The SPD shall meet one (1) of the following
      1) 400A, 10x700 microsecond waveform: 400 percent of system voltage
      2) 10,000A, 8x20 microsecond waveform: 400 percent of system voltage
      3) IEEE B3 combination wave: 250 percent of system voltage

8. **Maximum clamping voltages, L-G**
   a. The SPD shall meet one (1) of the following
      1) 400A, 10x700 microsecond waveform: 200 percent of system voltage
      2) 10,000A, 8x20 microsecond waveform: 200 percent of system voltage
      3) IEEE B3 combination wave: 300 percent of system voltage

2.7 TYPE IC8 SPD

A. **Approved Products**

1. Eaton DHW2P Series
2. EDCO PC642 Series
3. MTL SD Series
4. Phoenix Contact: PT Series

B. **Standards: UL 497B**

C. **Design**

1. **General**
   a. Mounted internally to control panels for protection of equipment connected to data lines (RS485, RS232, telephone line, etc.)
   b. Multi-stage hybrid solid state high performance suppression system
   c. Designed for series connection

d. Enclosure: Metallic or plastic, flange or DIN rail mounting
e. Field connection: Provide unit with external terminal screws for line and ground conductors

2. **Operating voltage**: Nominal unit operating voltage and configuration as specified or as indicated on the Drawings

3. **Modes of protection**: All modes

4. **Maximum continuous operating voltage**: Less than 130 percent of system peak voltage

5. **Maximum surge current**: 10,000 A

6. **Minimum repetitive surge current capacity**
   a. The SPD shall meet one (1) of the following
      1) 1000 occurrences of a 200A, 10 x 1000 microsecond waveform
      2) 400 occurrences of a 500A, 10 x 1000 microsecond waveform
      3) 100 occurrences of a 400A, 10 x 700 microsecond waveform
      4) 100 occurrences of a 2000A, 8 x 20 microsecond waveform
      5) 10 occurrences of a 10,000A, 8 x 20 microsecond waveform

7. **Maximum clamping voltages**, L-L (Pos-Neg)
   a. The SPD shall meet one (1) of the following
      1) 400A, 10x700 microsecond waveform: 400 percent of system voltage
      2) 10,000A, 8x20 microsecond waveform: 400 percent of system voltage
      3) IEEE B3 combination wave: 250 percent of system voltage

8. **Maximum clamping voltages**, L-G
   a. The SPD shall meet one (1) of the following
      1) 400A, 10x700 microsecond waveform: 200 percent of system voltage
      2) 10,000A, 8x20 microsecond waveform: 200 percent of system voltage
      3) IEEE B3 combination wave: 300 percent of system voltage.

2.8 SOURCE QUALITY CONTROL

A. **Performance tests to be performed** or independently verified by a certified testing laboratory.

B. **The SPD are to be tested** as a complete SPD system including: Integral unit level and/or component level fusing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. **Install products** in accordance with manufacturer's instructions.

B. **Type IC1 SPD**

1. Provide on the following applications
   a. Incoming 120 V power to all control panels
2. Connected in series with the panel's or equipment’s branch circuit
3. Provide fuse protection as recommended by manufacturer
4. Flange mount or DIN rail mount in control panel
5. Connect all SPDs in the panel to the same grounding point

C. **Type IC3 SPD**

1. Provide on the following applications
   a. 120 V discrete RTU signals into a control panel from float switches, position switches, etc., where the device is mounted outdoors or in a remote building or structure from the control panel and where the control conductors are routed above grade or underground.
   b. 120 V discrete RTU signals into a control panel from float switches, position switches, etc., where both the device and control panel are mounted outdoors and the control conductors are routed above grade or underground.
2. Connected in series with the equipment
3. Provide fuse protection as recommended by manufacturer
4. Flange mount or DIN rail mount in control panel
5. Connect all SPDs in the panel to the same grounding point

D. **Type IC4 SPD**

1. Provide on the following applications
   a. Loop powered transmitter (flow, level, etc.) where the transmitter is mounted outdoors or in a remote building or structure from the control panel and the signal conductors are routed above grade or underground.

b. Loop powered transmitter (flow, level, etc.) where both the transmitter and control panel are mounted outdoors and the signal conductors are routed above grade or underground.

2. Connect in series with the equipment

3. Attach to spare conduit entry of transmitter or inline of conduit at the transmitter

4. Bond transmitter to a grounded structure or provide a ground rod

5. Ground shield at control panel end

6. Verify SPDs series resistance and capacitance does not interfere with the transmitters signal

E. **Type IC5 SPD**

1. Provide on the following applications
   a. Incoming 4-20mA signals into a control panel from transmitters (flow, level, etc.) where the transmitter is mounted outdoors or in a remote building or structure from the control panel and the signal conductors are routed above grade or underground.
   b. Incoming 4-20mA signals into a control panel from transmitters (flow, level, etc.) where both the transmitter and control panel are mounted outdoors and the signal conductors are routed above grade or underground.

2. Connect in series with the equipment

3. Flange mount or DIN rail mount in control panel

4. Connect all SPDs in the control panel to the same grounding point

5. Verify SPDs series resistance and capacitance does not interfere with the transmitters signal

F. **Type IC7 SPD**

1. Provide on the following applications
   a. Low voltage (e.g., 24 Vac, 24 Vdc) discrete {PLC} {RTU} {DCS} signals into a control panel from float switches, position switches, etc., where the device is mounted outdoors or in a remote building or structure from the control panel and where the control conductors are routed above grade or underground.
   b. Low voltage (e.g., 24 Vac, 24 Vdc) discrete {PLC} {RTU} {DCS} signals into a control panel from float switches, position switches, etc., where both the device and control panel are mounted outdoors and the control conductors are routed above grade or underground.

2. Connect in series with the equipment

3. Flange mount or DIN rail mount in control panel

4. Connect all SPDs in the control panel to the same grounding point

G. **Type IC8 SPD**

1. Provide on the following applications
   a. On both ends of data lines that interconnect devices that are locked outdoors or in remote buildings or structures where the conductors are routed above grade or underground.
      1) PLC network (e.g., RS-485)
      2) Fieldbus (e.g., Profibus)
      3) Telephone modem

2. Connect in series with the equipment

3. Flange mount or DIN rail mount in control panel

4. Connect all SPDs in the control panel to the same grounding point

5. Verify SPDs series resistance and capacitance does not interfere with the data line signal

END OF SECTION

SECTION 40 96 00

MEASUREMENT AND CONTROL COMMISSIONING

PART 1 – GENERAL

1.1 WORK INCLUDED

A. **The CONTRACTOR shall furnish and install** all instrumentation equipment and accessory items as shown on the Contract Drawings and as specified herein.

1.2 RELATED WORK

A. **Additional Division 40 Sections of this Specification** contain requirements on instrumentation and control equipment and software which are considered to be covered by applicable requirements of this section (and shall be included in the bid by a single Instrumentation Supplier for this Project).

B. **The following Divisions of these Specifications** contain requirements on equipment furnished by other suppliers that must interface with the instrument system, or on methods and materials to be performed/used in the installation and/or wiring of the instrumentation system.

DIVISION 1 - GENERAL REQUIREMENTS

DIVISION 43 -PUMPING EQUIPMENT

DIVISION 46 - EQUIPMENT

DIVISION 26 - ELECTRICAL

PART 2 – PRODUCTS

Not Applicable.

PART 3 – EXECUTION

3.1 SEQUENCE OF CONSTRUCTION

A. **Installation of instrumentation and control equipment** shall be coordinated with the general construction to permit startup of the pump station with all required control components.

B. **The Contractor shall be responsible** for performing I/O testing prior to system programming. A test report shall be provided to the Owner and Engineer for review.

C. **Startup activities shall be coordinated** such that representatives from the equipment supplier, control system supplier, and Owner are present.

3.2 INSTALLATION/APPLICATION/ERECTION

A. **Instrumentation and accessory equipment** shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms and similar devices shown on the Drawings are approximate only. Exact locations shall be as accepted by the ENGINEER during construction. Obtain in the field all information relevant to the placing of process control work, proceed as directed by the manufacturer and furnish all labor and materials necessary to complete the work in an acceptable manner.

B. **The instrumentation installation details** on the Drawings indicate the designed installation for the instruments specified. Where specific installation details are not specified or shown on the Drawings, the manufacturer's recommended practice shall be followed.

C. **All work shall be executed in full accordance** with codes. Should any work be performed contrary to said codes and/or regulations, the CONTRACTOR shall bear full responsibility for such violations and assume all costs arising therefrom. All equipment used in areas designated as hazardous shall be designed for the Class, Division, and Group as required on the Drawings for the locations.

D. **Unless specifically shown in the Contract Documents,** direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands. All instrumentation connections shall be provided with shutoff and drain valves.

E. **All piping to and from field instrumentation** shall be provided with necessary unions, test tees, couplings, adaptors, and shut-off valves.

F. **Field instruments requiring power supplies** shall be provided with local electrical shut-offs and fuses as required.

G. **Brackets and hangers required for mounting** of equipment shall be provided. They shall be installed in a workmanlike manner and not interfere with any other equipment.

H. **The system supplier shall investigate** each space in the building through which equipment must pass to reach its final location. If necessary, the system supplier shall be required to ship his material in sections sized to permit passing through restricted areas in the building. The system supplier shall also investigate, and make any field modifications to the allocated space for each cabinet, enclosure and panel to assure proper space and access (front, rear, side).

I. **The shield on each process instrumentation** cable shall be continuous from source to destination and be grounded as directed by the manufacturer of the instrumentation equipment but in no case shall more than one ground point be employed for each shield.

J. **Lifting rings shall be removed** from cabinets/assemblies. Hole plugs shall be provided for the holes of the same color as the cabinet.

K. **The system supplier, acting through the CONTRACTOR,** shall coordinate the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to the ENGINEER'S acceptance. He shall be responsible to ensure that all field wiring for power and signal circuits are correctly done in accordance with best industry practice and provide for all necessary system grounding to ensure a satisfactory functioning installation. The CONTRACTOR hereunder shall schedule and coordinate his work under this Section with that of the electrical work specified under applicable Sections of Division 16.

3.3 FIELD QUALITY CONTROL

A. **After equipment and materials have been shipped** to the job site, the Supplier shall furnish the services of a factory-trained service technician or engineer to assist and advise the CONTRACTOR during installation and to provide programming/calibration/ adjustment at initial startup. A minimum period of 2 calendar days on the job site is required, and expenses associated with additional days necessary shall be at no cost to the OWNER.

B. **Following installation, checkout, and final adjustment** of all panels, instruments, meters, monitoring, and control devices, the CONTRACTOR shall schedule a performance test in the presence of the ENGINEER on all equipment. The CONTRACTOR shall furnish the services of the system supplier's servicemen, all special tools, calibration equipment, and labor to perform the tests.

C. **Meters shall be tested** at 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent of scale, if possible. All status and alarm switches as well as all monitoring and control functions shall also be checked, including logging at printers and change of state on graphics. Testing shall be done from the signal source to the final element or device including all field wiring. Results of all testing shall be submitted to the ENGINEER in writing.

D. **As much as possible, points shall be checked "end-to-end".** For example, valve status inputs shall be checked by stroking the valve, and a pump start output shall be checked by using it to start to start the pump. Simulated testing shall be allowed only when no practical alternative exists. Workstation displays shall be verified for correctness at the same time. An I/O checklist shall be used to record test results and a copy provided to the ENGINEER upon completion.

E. **If, during running of the tests, one or more points appear** to be out by more than the system accuracy statement, or fails to perform in accordance with agreed strategies, the system supplier's servicemen shall make such adjustment or alterations as are necessary to bring equipment/programming up to specification performance. Following such adjustment, the tests shall be repeated for all specified points to ensure compliance.

3.4 FACTORY TEST

A. **Prior to the delivery and installation** of the SCADA panels at the jobsite, but after the procurement, assembly, and configuration of all components, the

Contractor shall conduct a factory test. This test may be witnessed by representatives of the Owner and/or Engineer. The factory test is not intended to be a complete SCADA system test, since this will be performed at the jobsite prior to Project Closeout. The factory test shall demonstrate the functionality and performance of significant specified features of the SCADA system as noted below. Input and output modules shall be installed in their assigned housings and wired to field termination points in the enclosures. The Contractor shall have a complete, up-to-date set of wiring drawings, a register list, a workstation database list, and a listing of workstation displays available for review throughout the test. The test shall include verification of a random sample of 15 to 25 percent of all I/O points, which may be randomly selected by the Owner and Engineer during the test, along with their respective workstation status and/or control displays. Some points on each display shall be checked. A complete system checklist shall be submitted which provide recorded results of the test.

B. **The Contractor shall schedule** the factory test after receiving approval of the factory test procedures submittal. The Contractor shall provide the Engineer with written notice of the start and expected duration of the factory test at least 14 days prior to the start of the test.

C. **The factory test shall be conducted** in accordance with the previously submitted and approved test procedures. All testing shall be completed in one continuous factory test which may extend over several continuous days if necessary. The test procedures shall include written descriptions of how individual tests shall be performed and shall incorporate testing the following features as a minimum:

1. Verification that an alarm is generated upon loss of communication with any SCADA system component.
2. External power to enclosures and/or workstations shall be turned off and back on in order to test the operation of the UPS units.

D. **The Contractor shall record the results** of all factory testing on pre-approved test forms which the Owner's and/or Engineers' representatives shall sign. A copy of the completed test forms and a report certifying the results shall be provided to the Engineer within 10 days of completing the test.

E. **If the SCADA system does not operate as required**, the Contractor shall make whatever corrections are necessary, and the failed part of the tests shall be repeated. If in the opinion of the Engineer's representative, the changes made by the Contractor to effect such a correction are sufficient in kind or scope to effect parts of system operation already tested, then the effected parts shall be retested also. If a reliable determination of the effect of changes made by the Contractor cannot be made, then the Engineer's representative may require that all operations be retested. The Contractor shall bear all of its own costs for the factory test, including any required re-testing.

3.5 TESTING

A. **Prior to placing the equipment in service,** the Contractor shall conduct a field test. The field testing shall be a joint effort between the Process and

Instrumentation System supplier and the Engineer. The field test shall demonstrate the functionality and performance of significant specified features of the SCADA system as noted below. The test shall include verification of all I/O points, along with their respective status and/or control displays. Points on each display shall be checked. A complete system checklist shall be available during the test for recording results of points.

B. **General: Individual instrument loop diagrams per ISA Standard** S5.4 - Instrument Loop Diagrams, expanded format, shall be submitted to the Engineer for review prior to the loop tests. The Contractor shall notify the Engineer of scheduled tests a minimum of 30 days prior to the estimated completion date of installation and wiring of the system. After the Engineer's review of the submitted loop diagrams for correctness and compliance with the specifications, loop testing shall proceed. The loop check shall be witnessed by the Engineer.

C. **Interlocks: All hardware and software interlocks** between the instrumentation and the motor control circuits, control circuits of variable-speed controllers and packaged equipment controls shall be checked to the maximum extent possible.

D. **Instrument and Instrument Component Validation**: Each instrument shall be field tested, inspected, and adjusted to its indicated performance requirement in accordance with its Manufacturer's specifications and instructions. Any instrument which fails to meet any Contract requirement, or, in the absence of a Contract requirement, any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer.

E. **Loop and Point Validation: Controllers and electronic function modules** shall be field tested and exercised to demonstrate correct operation. All control I/O points and loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements and final control elements. Actual signals shall be used wherever available. Following any necessary corrections, the points shall be retested. Accuracy tolerances for each analog network are defined as the root-mean-square (RMS) summation of individual component accuracy requirements. Individual component accuracy requirements shall be as indicated by Contract requirements or by published manufacturer accuracy specifications, whenever Contract accuracy requirements are not indicated. Each analog network shall be tested by applying simulated analog or discrete inputs to the first element of an analog network. For networks which incorporate analog elements, simulated sensor inputs corresponding to 20, 40, 60, 80 and 100% of span shall be applied, and the resulting element outputs monitored to verify compliance with the calculated RMS summation accuracy tolerance requirements. Continuously variable analog inputs shall be applied to verify the proper operation and setting of discrete devices. Provisional settings shall be made on controllers and alarms during analog loop tests. All analog loop test data shall be recorded on test forms attached at the end of this section which include calculated RMS summation system accuracy tolerance requirements for each output.

F. **I/O and Loop Validation Sheets**: The Contractor shall prepare I/O and loop confirmation sheets for each PLC point and loop. Confirmation sheets shall form the basis for operational tests and documentation. Each confirmation sheet shall cite the following information and shall provide spaces for sign-off on individual items and on the complete test by the Instrumentation Contractor:

1. Project name
2. Point number
3. Tag number, description, manufacturer and model number for each element
4. Installation bulletin number
5. Specification sheet number
6. Point description number
7. Adjustment check
8. Verification of proper surge arrestor installation
9. Space for comments
10. Space for sign-off by Instrumentation Contractor and date
11. Space for Engineer witness signature and date

G. **Certifications: When installation tests have been successfully completed** for all individual instruments and all separate analog control networks, a certified copy of all test forms signed by the Engineer or the Engineer's representative as a witness, with test data entered, shall be submitted to the Engineer together with a clear and unequivocal statement that all instrumentation has been successfully calibrated, inspected, and tested.

3.6 PRE-COMMISSIONING

A. **General: Pre-commissioning shall commence** after acceptance of all wire test, calibration tests and loop tests, and all inspections have demonstrated that the instrumentation and control system complies with all Contract requirements. Pre-commissioning shall demonstrate proper operation of all systems with process equipment operating over full operating ranges under conditions as closely resembling actual operating conditions as possible.

B. **Pre-commissioning Procedures and Documentation**: Pre-commissioning and test activities shall follow detailed test procedures and check lists accepted by the Engineer. Test data shall be acquired using equipment as required and shall be recorded on test forms accepted by the Engineer, which include calculated tolerance limits for each step. Completion of system pre-commissioning and test activities shall be documented by a certified report, including all test forms with test data entered, delivered to the Engineer with a clear and unequivocal statement that all system pre-commissioning and test requirements have been satisfied.

C. **Operational Validation: Where feasible, system pre-commissioning** activities shall include the use of water to establish service conditions that simulate, to the greatest extent possible, normal final control element operating conditions in terms of applied process loads, operating ranges, and environmental conditions. Final control elements, control panels, and ancillary equipment shall be tested under start-up and steady-state operating conditions to verify that proper and

stable control is achieved using motor control center and local field mounted control circuits. Hardwired and software control circuit interlocks and alarms shall be operational. The control of final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits. The stable steady-state operation of final control elements running under the control of field mounted automatic analog controllers or software based controllers shall be assured by adjusting the controllers as required to eliminate oscillatory final control element operation. The transient stability of final control elements operating under the control of field mounted, and software based automatic analog controllers shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations (if any) and making necessary controller adjustments as required to eliminate excessive oscillatory amplitudes and decay rates.

D. **Loop Tuning: Electronic control stations** incorporating proportional, integral or differential control circuits shall be optimally tuned, experimentally, by applying control signal disturbances and adjusting the gain, reset, or rate settings as required to achieve a proper response. Measured final control element variable position/speed setpoint settings shall be compared to measured final control element position/speed values at 20, 40, 60, 80 and 100% of span and the results checked against indicated accuracy tolerances.

E. **Pre-commissioning Validation Sheets**: Pre-commissioning shall be documented on one of two types of test forms as follows:

1. For functions which can be demonstrated on a loop-by-loop basis, the form shall include:
    a. Project name
    b. Loop number
    c. Loop description
    d. Tag number, description, manufacturer, and data sheet number for each component.
    e. Space for sign-off and date by both the Instrumentation Contractor and Engineer.
2. For functions that cannot be demonstrated on a loop-by-loop basis, the test form shall be a listing of the specific tests to be conducted. With each test description the following information shall be included:
    a. Specification page and paragraph of function demonstrated
    b. Description of function
    c. Space for sign-off and date by both the Instrumentation Contractor and Engineer.

F. **Pre-commissioning Certification**: The Contractor shall submit an instrumentation and control system pre-commissioning completion report which shall state that all Contract requirements have been met and shall include a listing of all instrumentation and control system maintenance and repair activities conducted during the pre-commissioning testing. Acceptance of the instrumentation and control system pre-commissioning testing must be provided in writing by the Engineer before the performance testing may begin. Final acceptance of the control system shall be based upon plant completion as stated in the General Conditions.

3.7 PERFORMANCE TEST

A. **Subsequent to the full system implementation,** the CONTRACTOR shall conduct a successful 30 day final acceptance test for the SCADA system furnished and installed under this Contract. In this test, the entire SCADA system must operate continuously for 24 hours per day, 7 days per week during the test period, with zero downtime resulting from system failures. If a system failure occurs, the 60 day test period will be repeated, starting over at time zero, from the time that the system failure is repaired. The CONTRACTOR shall repeat the test until it is satisfactorily completed. The SCADA system will only be acceptable to the OWNER after all equipment and software has satisfied the performance test requirements.

B. **Downtime resulting from the following** shall be considered system failures:

1. If a component failure cannot be repaired/replaced within 2 hours.
2. Downtime of any component (exclusive of I/O) whose failure results in the inability of the operator to monitor and manipulate control loops from the associated workstations, using standard workstation interface procedures.
3. Downtime in excess of 2 hours resulting from any I/O component failure.
4. Downtime resulting from concurrent failure of 2 or more I/O components in a single PLC/RTU.

C. **The CONTRACTOR shall submit a final acceptance test** completion report which shall state that all Contract requirements have been met and which shall include a summary of maintenance/repair efforts that were required during the test period. Final acceptance of the system by the OWNER until this has occurred.

3.8 ADJUSTING AND CLEANING

A. **All equipment furnished under this Section of the Specifications** shall be adjusted/calibrated as defined elsewhere this Section/Division.

B. **All instruments and equipment** shall be left free from shipping stickers, paint splatter, dirt, grease, etc., and shall be clean and in like new condition at final acceptance. Touch-up paint shall be furnished as needed to repair blemishes and scratches in finish paint on panels and enclosures, which shall be corrected by the CONTRACTOR.

3.9 EXTRA STOCK/SPARE PARTS

A. **The following supplies and spare parts** shall be furnished:

1. Ten fuses for each type/size in the system.

2. One spare pressure transducer for each different range installed on the project.

3. Four Cutler-Hammer C799L2 oxidation inhibitors; Install one in each panel. Turn over spares to OWNER.

4. One (1) PLC processor for each type furnished.

5. Spare I/O cards for each PLC type. Provide a 10% spare cards (not spare points) for each type used, or a minimum of one card per type used.

6. One spare operator interface terminal as specified herein.

B. **Other spare parts are listed** in specific instrument technical specifications in the appropriate Division 13 Specification Section herein. All spare parts shall be packaged in an acceptable manner for long term storage and adequately protected against corrosion, humidity and temperature extremes. All items shall be tagged externally with what they are; both a written description and a manufacturer brand/part number.

END OF SECTION

SECTION 44 72 70

BELT FILTER PRESS DEWATERING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

B. **Related electrical and control equipment** shall be in accordance with Division 26 and Division 40.

1.2 DESCRIPTION OF WORK

A. **General.** The Contractor shall provide the labor, materials, tools, and equipment necessary to furnish, install, test, and place into operation two 1.5-meter dewatering belt filter press and appurtenant systems in accordance with the drawings and as specified herein.

Appurtenant systems include a new polymer meter pumping system and dewatered sludge conveyance system (both of which are to be supplied by others), and an existing VFD-driven progressing cavity sludge pumping system supplying the new belt filter presses with thickened sludge from existing tanks.

B. **The Contractor shall furnish** the manufacturer's services as specified in Division 1 and as specified herein.

C. **The equipment** shall be successfully tested as specified herein.

1.3 QUALITY ASSURANCE

A. **Codes**. Perform all work in compliance with all federal, state, and local codes.

B. **Standards**. Materials and workmanship shall be in accordance with the following standards:

1. AFBMA - Antifriction Bearing Manufacturer's Association.
2. AGMA - American Gear Manufacturer's Association.
3. AISC - American Institute of Steel Construction.
4. AISI - American Iron and Steel Institute.
5. ANSI - American National Standards Institute.
6. ASTM - American Society for Testing and Materials.
7. AWS - American Welding Society.
8. NEMA - National Electrical Manufacturer's Association.
9. SSPC - Steel Structures Painting Council.
10. UL - Underwriters' Laboratories, Inc.

C. **Regulatory Agencies.** Perform all work in compliance with the requirements of the following agencies.

1. OSHA - Occupational Safety and Health Administration.

D. **Manufacturer.** The 1.5-meter dewatering belt filter presses shall be furnished by a manufacturer who is fully experienced, reputable, and qualified in the manufacture of the equipment to be furnished.

All equipment and items specified herein shall be obtained from a single manufacturer who shall be responsible for the design of the entire unit. The system shall be prefabricated complete at the factory and pretested successfully prior to shipment. The dewatering belt press shall be:

1. Andritz Separation of Arlington TX; SMX-S8 Model.
2. Komline-Sanderson of Peapack NJ; Kompress GRS Model.
3. Phoenix Process Equipment of Louisville KY; WX-G8 Model.

E. **The equipment** manufacturer's shop welds, welding procedures, welders and welding operators shall be qualified and certified in accordance with the requirements of the latest edition of the applicable standards of ANSI and AWS.

F. **Qualifications.**

1. Manufacturer's Experience. The dewatering belt filter press manufacturer shall submit a list of existing successful operating USA installations of the proposed press including Owner's name, address, and telephone number. The reference list shall include at least three installations which have been in successful operation in a similar municipal sludge process for at least 2 years.

1.4 **SUBMITTALS**

A. **Product Data.** Furnish manufacturer's product data in accordance with Section 01 33 00 "Submittals."

B. **Installation List.** Provide an installation list of at least five similar facilities in the past five years.

C. **Shop Drawings**. Shop drawings shall be submitted to the Engineer/Architect for review. Shop drawings shall be in accordance with Section 01 33 00 "Submittals" and shall include:

1. Manufacturer's name and model.
2. Complete description in sufficient detail to permit item-by-item comparison with the specifications.
3. Design and performance characteristics.
4. Dimensional layout and required clearances.
5. Materials of construction.
6. Equipment specifications.
7. Repair parts.
8. Weights.
9. Anchor bolts.
10. Bill of materials.

11. Power/utility requirements and a one-line diagram indicating breaker type and size, starter type and size, device rating, and load's nameplate legend.
12. All electrical and control wiring diagrams.
13. Installation and operation instructions.
14. Warranty.
15. Detailed information shall be submitted for all buy-out items such as hardware, motors, reducers, motor controllers and instrumentation, including field devices, major panel devices and control panel layout.
16. Manufacturer's recommended spare parts, including all buy-out items.
17. Variable frequency drives (VFDs) shall include overcurrent protection with size and type indicated, input and output inductor (choke) size and type, horsepower rating of the VFD, manufacture of VFD, with factory parameter settings.
18. Arc Flash coordination study and a sample of label to be applied.

D. **Detailed Information.** The Contractor shall submit the following specific detailed information:

1. Hydraulic loading rate.
2. Solids handling capacity.
3. Minimum cake solids.
4. Solids capture.
5. Maximum polymer dosage.
6. Gravity, wedge, and dewatering areas including calculations sufficient to justify listed areas.
7. Overall dimensions.
8. Structural frame.

    a. Materials of construction.
    b. Thickness of members.
    c. Moment of inertia of frame.
    d. Structural frame safety factor.
    e. Coatings.

9. Rollers.

    a. Perforated roller size and drainage design.
    b. Number and sizes of other rollers.
    c. Materials of construction.
    d. Shaft safety factor.
    e. Roller thickness.
    f. Maximum deflections.
    g. Wrap angles of each roller.
    h. Coatings.

10. Gravity Belt Support.

    a. Design.
    b. Grid spacing.
    c. Materials of construction.

11. Sludge Furrowing.

    a. Design.
    b. Number of chicane rows.
    c. Adjustment methods.

12. Method of adjusting belt conveyance.
13. Doctor Blade.

    a. Design.
    b. Materials.

14. Washwater Requirements.

    a. Flow.
    b. Pressure.
    c. Details of water booster pumps, if needed.

15. Filter Belts.

    a. Belt life.
    b. Material.
    c. Width.
    d. Tensile strength.
    e. Tensile strength of splice.

16. Description of Belt Tensioning System.
17. Description of Belt Tracking System.
18. Bearings.

    a. Design.
    b. Material.
    c. AFBMA B-10 Life.

19. Description of Drive Unit.
20. Air Compressor.

    a. Design (Layout and Operating Pressure).
    b. Motor Size.

21. Sludge Conditioning System.

    a. Design (Layout and Capacity).
    b. Materials.

22. Control Panel.

    a. One-line diagrams.
    b. Control diagrams.
    c. Power requirements.

23. Warranty.

E. **Dimensional drawings** shall be prepared with the units in feet and inches or a dual system of feet and inches and metric dimensions.

F. **Any auxiliary equipment** required by the Bidder but not specified shall be presented in the submittal document.

G. **Operation and Maintenance Manuals.** Operation and Maintenance (O&M) manuals shall be submitted to the Engineer/Architect in accordance with Sections 01 33 00 "Submittals" and 01 79 00 "Start-up, Demonstration, and Training" of these specifications. The initial review copy of the O&M manual and six revised copies shall be submitted prior to delivery of the equipment.

H. **Operator Training Information.** Operator training data, in accordance with Section 01 79 00 "Start-up, Demonstration, and Training," and operating training lesson plans, in accordance with Section 01 33 00 "Submittals," shall be submitted with the six revised copies of the O&M manuals.

I. **Personnel Qualifications.** Qualifications statements, in accordance with Section 01 33 00 "Submittals," of all manufacturer's representative personnel that will be servicing the equipment or conducting the operator training sessions shall be submitted with the six revised copies of the O&M manuals.

J. **Manufacturer's Representative Reports.** Manufacturer's Representative reports, in accordance with Section 01 79 00 "Start-up, Demonstration, and Training," shall be submitted for each site visit. Product and material certifications and inspection data as specified in Section 01 33 00 "Submittals," shall be included with this report.

K. **Site Test Report.** A test report in accordance with Section 01 79 00 "Start-up, Demonstration, and Training."

L. **Controls**

1. Shop Drawings. Submit shop drawings showing instrumentation, control panels, control panel components, software, software licenses, accessories, panel layout drawings, panel wiring diagrams, PLC input/output card drawings, and bill of materials.

    a. Panel drawing submittals shall be complete, fully demonstrating compliance with all specification requirements and features. Panel drawings shall include, but not be limited to, panel layout and bill of materials, panel power wiring schematics, and panel input/output wiring diagrams for each panel supplied.
    b. Panel assembly and elevation drawings shall be drawn to scale and detail all equipment in or on the panel. Panel drawings shall be at least 11x17-inch print size. As a minimum, the panel drawings shall include interior and exterior panel elevation drawings to scale, nameplate schedule, conduit access locations, and panel construction details.
    c. Panel control schematics and interconnection diagrams detailing the electrical connections of all equipment in and on the panel.

Diagrams shall include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering.

d. Point to point I/O wiring diagrams depicting wiring within the panel as well as connections to external devices. The diagram shall identify all device terminal points that the system connects to, including terminal points of equipment provided by others, Wiring labeling used on the drawings shall match that shown on the Contract Documents or as developed by the manufacturer and approved by the Owner/Engineer. Field device wiring shall include the device ISA-tag and a unique numeric identifier. PLC I/O wiring shall be numbered with rack number, slot number, and point number. Two-wire and four-wire equipment shall be clearly identified, and power sources noted. Submit final wire numbering scheme for approval by the Owner/Engineer. Point-to-Point drawings shall be 11x17-inch minimum in size.

e. Submit construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.

f. Submit evidence that al control panels shall be constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application shall be accomplished at the fabrication location or by field inspection by UL inspectors. All costs associated with obtaining the UL seal and any inspections shall be borne by the Contractor and included in the contract.

g. Submit seismic calculations if applicable, and anchoring requirements, in conformance with Division 1.

2. Testing Plan.

a. Test Procedure Submittals: Submit the procedures proposed to be followed for each test. Procedures shall include test descriptions, forms, and checklists to be used to control and document the required tests. Include sign-off forms for each testing phase or loop with sign-off areas for the Supplier, Engineer, and Owner. Refer to Section 3 for specific testing requirements, and submit separate procedures for each specified test phase.

b. Test Documentation: Upon completion of each required test, document the test by submitting a copy of the signed-off test procedures. Testing shall not be considered complete until the signed-off test procedures have been submitted and favorably reviewed. Submittal of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

1) Each loop shall have a Loop Status sign-off form to organize and track its inspection, adjustment and calibration.

2) Each active analog subsystem element shall have a Component Calibration form.
3) Programming, with PLC programs for each PLC installed provided to the Owner.

c. Submit color copies of all graphic screens developed for this project for the LCP and MCP touchscreen panels. Graphics will be reviewed for approval by the Owner/Engineer.
d. Submit input/output lists for all PLCs provided for this project.

1.5 **JOB CONDITIONS**

A. **Environmental Requirements.** The equipment shall be installed in a covered, indoor location which will have a temperature range of 45 to 100 degrees F.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Delivery.** Unit shall be shipped assembled as much as practical. Components shall be labeled with all labeling intact and legible with item name, model number, size, and manufacturer's name. Delivery and storage shall be in accordance with Section 01 60 00 "Materials and Equipment" and the manufacturer's recommendations.

B. **Storage.** All equipment, accessories, and components shall be stored in the manufacturer's original package, off the ground and protected from damage. Maintain a grease coating on all bearings and shafts to prevent rusting. Store all electrical and mechanical equipment in a fully protected storage location and protect in accordance with the manufacturer's instructions.

C. **Handling.** Handle all units and components in accordance with the manufacturer's instructions. Use lifting rings and canvas harnesses for lifting to prevent scratching or abrading finished surfaces.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 - PRODUCTS

2.1 **GENERAL**

A. **The design of the 1.5-meter dewatering belt filter presses** shall be based on the principles of draining free water from the sludge by filtered gravity drainage followed by pressure drainage as applied between two moving belt filters. Sludge will be preconditioned with a polyelectrolyte polymer.

Gravity thickening shall occur by gravity drainage through a filter belt traveling horizontally or an incline. Pressure drainage shall start with a wedge zone of two belts gradually coming together, followed by the sludge being sandwiched between the belts under pressure through rollers.

The rollers shall be decreasing in size so that applied pressure increases as the sludge passes from one roller to the next. Dewatered sludge discharge shall be assisted by a doctor blade at the end of the thickener. The belts shall be subsequently washed with high pressure, low volume water from a spray header before it returns to the head of the thickener. Wash water and filtrate shall be collected in drain pans for direction to a curbed concrete drainage basin surrounding the dewatering belt press.

B. **The dewatering belt filter press system** shall be completely factory assembled, complete with sludge conditioning and distribution system.

2.2 PERFORMANCE REQUIREMENTS

A. **The dewatering belt press** shall be capable of operating satisfactorily under the following performance conditions.

1. Type of Sludge: Ferric-based thickened water treatment plant sludge.
2. Feed Sludge Solids: 1.0- to 6.0-percent dry solids.
3. Hydraulic Loading Rate: 40-120 gpm.
4. Capacity of Solids Handling: 900 lbs/hr dry solids.
5. Cake Discharge, Minimum: 24-percent dry solids.
6. Minimum Solids Capture Rate: 95-percent.
7. Maximum Polymer Usage: 10 pounds of polymer per ton of dry solids.

2.3 MATERIALS

A. **Steel.** All steel shall conform to the applicable ASTM standard. All welding shall be in accordance with the standards of the American Welding Society (AWS). Except as otherwise specified, steel plates and shapes have a minimum thickness of 1/4-inch, sheet metal shall be 14-gauge minimum, and bolts shall be minimum 1/2-inch diameter.

B. **All welding** shall be in accordance with the latest applicable codes of the AWS.

C. **All materials used** shall be of the best quality and fully suitable in every respect for the service intended.

D. **Unless otherwise specified**, all materials in direct contact with sludge, polymer, or filtrate shall be Type 316 stainless steel or polyethylene. All fasteners shall be Type 316 stainless steel.

2.4 MANUFACTURED UNITS

A. **The equipment furnished** shall be designed and constructed in accordance with the best practices and methods and for continuous service at maximum conditions. All parts shall be so designed and proportioned as to have strength, stability, and stiffness and to be fully suitable for the intended conditions of service. Provisions shall be made for easy lubrication, adjustment, or replacement of all parts. Corresponding parts of units shall be interchangeable.

2.5 **COMPONENTS**

A. **Size and Weight Limitations.** The 1.5-meter belt filter presses shall not have any dimensions larger than those shown on the drawings, and shall weigh a minimum of 18,500 pounds and a maximum of 23,000 pounds. The belt filter press's discharge shall be such that dewatered sludge will be deposited directly into a horizontal screw conveyor without spillage of any dewatered solids.

B. **Structural Frame.**

1. The structural main frame shall be fabricated of steel members conforming to AISC specifications for the Design, Fabrication, and Erection of Structural Steel and the ASTM standard specifications for structural steel, designation A36, into a rigid structure, adequately braced to withstand intended loads without excessive vibration or deflection. All mounting surfaces on the frame shall be machined to a 0.55 mm tolerance to insure plan parallelism.
2. The units shall be designed for installation on an existing concrete base and shall be designed for anchoring with Type 316 stainless steel anchor holes and foundation plates. The foundation plates and anchor bolts shall be furnished by the press manufacturer. Permanent lifting lugs shall be provided as necessary to allow installation and removal of the belt filter presses. Additional or modified concrete columns or steel beams are acceptable to support the press and shall be provided and installed by the Contractor, provided they do not impact or impede the ability of the press to drain filtrate and washwater from each belt filter press and the concrete structure below each.
3. Structural members shall be structural I or C beams with minimum flange thickness of 3/8-inch, a minimum web thickness of 1/4-inch and a minimum moment of inertia of 25.4 inches to the fourth power or MC channels with a minimum moment of inertia of 25.4 inches to the fourth power, or welded members formed from 3/8 inch thick ASTM A36 structural steel plate having a minimum moment of inertial of 44 inches to the fourth power. The framework shall be of welded and/or bolted construction. All welding shall conform with the American Welding Society Structural Welding Code. Alternatively, the frame may be a box frame of welded and bolted MC channels. Wall thickness shall be at least 1/4-inch.
4. No element of the frame shall have yield strength factor of safety less than 7.0 for the maximum load. Maximum load shall be based on the summation of all forces applied to the frame including, but not limited to, roller mass forces and tension forces (forces exerted by the tension of the belts from the belt tensioning devices). Tension forces shall include, but not be limited to, a belt tension of 50 pounds per linear inch which is equivalent to 200 pounds per inch of belt width in the shear pressure section. Maximum deflection of any frame member shall be 0.018 inches or less. Certified calculations, showing the frame in compliance with the specification, shall be part of the shop drawing submittal.
5. The construction shall allow easy access and visual contact of all internal components.
6. Each belt filter press shall be specifically designed to contain all liquid to one or more piped discharge locations. Free draining to the concrete

floor will not be permitted. Side panels shall be provided where necessary to insure containment of all liquid and mist within the boundaries of the press frame. Panels shall be fabricated of Type 316 stainless steel, 14-gauge minimum thickness, and easily removable for frequent wash-down. Cleanouts on drain piping shall be provided.

7. The frame shall be sandblasted in accordance with SSPC-SP-6 or 10. The framework shall be prepared and coated after fabrication with hot-dipped galvanizing in accordance with the latest issue of ASTM A 123 to a thickness of 4 to 7 mils, or zinc flame spray coupled with 4 to 7 mils of two-part, catalyzed epoxy coating. An alternate painting system will be considered if equal service life to the specified coating systems is proved.

C. **Sludge Conditioning System.**

1. Each belt filter press shall be provided with a sludge conditioning system, designed to efficiently mix polymer with the sludge and to adequately condition the sludge for optimum dewatering.
2. The sludge conditioning system for each press shall be mounted upstream of the press's gravity zone and shall consist of sludge pipe in-line, non-clog, static mixers with a variable orifice and four-port vortex polymer injection ring and a conditioning tank with mechanical mixer.
3. Locate each injection ring assembly as shown on the drawings. Each press shall be provided with two mixer and two injection ring assemblies. The injection systems shall be tested prior to belt filter press start-up procedures. All removing and re-installation work for the injectors shall be done by the Contractor at no cost to the Owner.
4. The polymer injection assemblies shall have the following features:

    a. Polymer and sludge must be instantly mixed (less than 1.0 second at 60 gpm).
    b. Mixing energy must be independently adjustable during operation.
    c. The in-line mixer shall have a flanged, Type 304 or Type 316 cast housing, an adjustable orifice plate, with shaft and O-ring seal, connected to an externally mounted lever and counter-weight and a removable side plate for inspection and cleaning.
    d. The inlet to the flow splitting manifold shall be fitted with a 3/4-inch male hose fitting connection. The four manifold outlets and polymer injection ring inlets, shall be fitted with 1/2- or 3/8-inch male hose fittings which provide for the interconnection of clear flexible tubing. The manufacturer shall provide sufficient length of clear flexible tubing to each injection ring and all necessary hose clamps with the sludge conditioning system. Provide an extra 20-foot length of flex tubing, and two additional clamps.
    e. The open throat area of the mixer shall be fully adjustable downward and shall open automatically to prevent clogging.
    f. The position of the counterweight on the externally mounted orifice plate. Lever shall be fully adjustable, within a 360-degree circle, to allow for adjustment of the mixing energy, regardless of the mounting angle, while the unit is in operation.

4. Locate each conditioning tank adjacent to or on each belt filter press. Tank can be free-standing or attached to the belt filter press frame. Interconnect the conditioning tank with inlet sludge piping (extension of existing piping routed and interconnected per belt filter press manufacturer's recommendations) and sludge feed section of the belt filter press. Size the conditioning tank and position the belt filter press such that operator access around the inlet end of each belt filter press is maintained between the new equipment and existing handrail. Provide each tank with a mechanical mixer.

    a. Mixer shall be a slow-speed mechanical unit, 0.75-hp minimum.
    b. Mixer impeller speed shall not exceed 400 rpm and impeller shall be positioned no less than two impeller diameters from the bottom of the tank.
    c. Mixer assembly shall include an angle riser support, right angle gear-reducer, and a TEFC motor.
    d. Mixer impeller and shaft shall be Type 316 stainless steel, 7/8-in diameter shaft, heavy-duty construction, and capable of operation at varying conditioning tank levels.

D. **Sludge Feed Section.** There shall be a device mounted on each belt filter press for receiving the sludge polymer mix, which shall uniformly distribute the sludge across the width of the dewatering belt and permit the maximum effective use of the belt width. All components of the distribution device shall be constructed of Type 316 stainless steel, minimum thickness of 10 gauge.

E. **Dewatering Zones.**

1. Gravity Section.

    a. The first dewatering section of each belt filter press shall allow gravity drainage of the free water. The gravity drainage action for each belt filter press shall provide for a minimum effective dewatering area of 69.0 square feet.
    b. The splash guard conditioned sludge shall be contained on the belt with Type 316 stainless steel barriers, 14-gauge minimum thickness, and equipped with replaceable rubber or neoprene seals to prevent leakage.
    c. The filter belt, while in the gravity drainage section, shall be firmly supported. Acceptable design includes a stainless steel grid fitted with support tubes and high density polyethylene wear bars. The wear bars may be arranged in a straight or chevron pattern, and must be spaced 6-inch or less based upon their center lines. The belt support grid shall be a minimum of 2- inch wider than the belt and so designed to reduce belt wear. Each high density polyethylene bar shall have a minimum of 3/8-inch flat surface in contact with the belt.
    d. The gravity drainage section shall be furnished with chicanes (plows) to adequately furrow the conditioned sludge to facilitate drainage. Each row of chicanes shall be provided with a single lifting handle, designed to remove the entire row of chicanes at least 6 inches from the belt, out of the sludge flow, to facilitate

cleaning. Chicanes shall be designed to be individually moved laterally or horizontally and shall pivot to allow them to pass over obstructions on the belt. There shall be a minimum of eight rows of chicanes and 45 individual chicanes. The chicanes shall be evenly spaced throughout the gravity drainage section.

e. Gravity drainage sections that require a separate belt drive motor and rotating thickening devices will not be considered equivalent to inclined or horizontal gravity sections.

2. Increasing Pressure Zone.

a. The second dewatering section of each belt filter press makes a belt/sludge sandwich, which prepares the sludge for the high pressure and shear zone. The increasing pressure shall be developed by the gradual convergence of the upper and lower belt. The minimum effective dewatering area for this section shall be 31.0 square feet. Only the lower belt shall be used in calculating this number.

b. For process flexibility, the amount of pressure exerted on the sludge and the rate at which the increasing pressure is applied in the increasing pressure zone shall be adjustable. These adjustments shall be capable of being performed without causing undue wear on the belts. The sludge inlet height at the entrance to the increasing pressure zone shall be adjustable between 1- and 3-inches.

c. Sturdy upper and lower belt support shall be provided. The lower belt in the increasing pressure zone shall be supported in the same manner as the belt is supported in the gravity drainage section.

3. High Pressure and Shear Zone.

a. After leaving the low pressure zone, the belts which have converged and contain the sludge, shall enter a combined high pressure and shear zone. A minimum of 8 rollers, arranged to provide a "S" shaped pattern of belt travel shall be provided. The belt wrap around each roll shall be a minimum of 180 degrees, except for the drive roll. The sludge, which is sandwiched between the belts, shall be subjected to an incremental increase in pressure, without an increase in belt tension, as the belt-sludge sandwich travels over decreasing diameter rollers toward the cake discharge. The high pressure and shear zone shall have a minimum effective area of 93.0 square feet.

b. Belt tension in this section shall be adjustable.

c. The first roller shall be perforated Type 316 stainless steel and shall have a minimum diameter of 16 inches. If internal drainage is provided which prevents filtrate from re-entering the sludge on the bottom of this roller, the minimum diameter shall be 24 inches. Minimum diameter of the perforations shall be 7/8-inch and open area shall be a minimum of 32-percent.

d. Subsequent rollers shall be of progressively decreasing diameter

of at least three different sizes. The first roller shall be a minimum size of 16 inches and the last two rollers shall have a maximum diameter of 11 inches (without coating).

F. **Filter Belts.**

1. The filter belts shall be of a corrosion resistant material designed for long life. Each belt shall be of a continuous design woven from polyester monofilament of a design which allows for simple, periodic belt replacement. The initial belts shall be selected by the equipment manufacturer in order to provide optimum dewatering conditions for the sludge to be processed. The belts shall be unconditionally guaranteed for a minimum of 2,000 hours of press operation.
2. Each belt and connecting seam shall be designed for a minimum tensile strength equal to five times the normal maximum dynamic tension to which the belt shall be subjected. The seam shall be designed to fail before the belt.
3. Belts shall be designed for ease of replacement with a minimum of belt filter down time. Belt replacement shall be such that any disassembly of the belt filter press is not required.

G. **Belt Tensioning.**

1. Each belt shall be provided with a belt tensioning system. Belt tension shall be infinitely variable, up to at least 50 pounds per linear inch, and shall be adjustable without shutdown of the machine. The belt tensioning systems shall accommodate a minimum of 2.5-percent increase in belt length.
2. The belt tensioning system shall be accomplished by pneumatic devices. The design of the tensioning system shall be such that dewatering pressure is directly proportional to belt tension and that adjustment in tension shall result in immediate changes in dewatering pressure. The design of the belt tensioning system shall assure reliable parallel movement of the tensioning rollers.
3. The belt tensioning system shall be furnished with individual or common tensioning stations for each or both belts. The tensioning control station shall be calibrated to provide an indication of dewatering pressure at various readings of pressure. The calibration chart shall be in the English system, scribed on laminated plastic, and mounted on the machine frame and provided as part of the O&M manual.
4. Actual dewatering pressure, as indicated by the setpoint selected on the control station, shall be maintained automatically despite process changes.
5. Sensing devices shall be furnished for each belt with sufficient electrical contacts to de-energize all drives and sound an alarm in the event of failure of the belt tensioning system.

H. **Belt Tracking.**

1. Belt tracking shall be accomplished by a pneumatic or hydraulic control system, which shall maintain the belt in its normal operating alignment and position at all times. The upper and lower belts shall have separate

or common tracking systems.

2. The alignment systems shall function as a continuous automatic belt guidance system, operate in a smooth manner, and shall be an integral part of the press. The alignment system shall operate with smooth and slow motions resulting in a minimum of belt travel from side to side. Tracking shall be accomplished by a rubber or nylon covered roll situated across the machine's width. The tracking roll shall be stationary at one end and allow horizontal movement, activated by air bellows or cylinder on hydraulic cylinder, on the opposite end. The use of electric servo tracking systems, not providing smooth operation, are not acceptable.
3. The belt sensing devices shall monitor the lateral movement of the belt at all times to maintain proper tracking. These devices shall have a spring loaded arm or other device to maintain contact with the edge of the belts. The sensing finger or plate shall be constructed of stainless steel or ceramic. The location of the sensing device shall operate controls such as a pilot valve to adjust a hydraulic actuator or pneumatic cylinder to adjust the belt tracking. The pivoting action of the belt alignment roller shall cause this roller to skew from its transverse position to guide the belts centrally along their path.
4. Electric limit switches shall be provided on the machine to shut down belt drive and all auxiliary equipment in case of tracking failure. The limit switches shall provide audio and visual alarms to alert operators and these shall be incorporated in the control panel.

I. **Belt Wash System.**

1. The belt filer press shall be equipped with individual belt wash stations for both the upper and lower belts. Each station shall consist of a spray pipe, fitted with spray nozzles, contained with a fabricated housing which encapsulates a section of each belt. The housing and nozzle assembly shall be readily removable. The housing shall be constructed so as to eliminate spray outside the press unit.
2. Nozzle spacing and spray pattern shall be such that the sprays from adjacent nozzles overlap one another at the belt surface. The spray pipe and nozzles shall be of Type 316 stainless steel construction. Individual nozzles shall be replaceable.
3. The housing shall be fabricated from Type 316 stainless steel with a minimum thickness of 16 gauge. The housing shall be sealed against the belt with rubber, neoprene, or brush-type seals. The spacing between the upper and lower housing shall be adjustable to insure continuous contact between the seals and belt. The seals shall be replaceable without disassembly of the wash station. The belt spray water and flush water shall be collected in Type 316 stainless steel pans and plumbed to the base sump to prevent dewatering of the sludge process. Provide cleanout so housing can be periodically inspected and washed.
4. Each belt wash station shall be furnished with an external handwheel which is mounted to a stainless steel cleaning brush located inside the spray pipe. One full turn of the handwheel shall cause the brush bristles to enter each spray nozzle, and dislodge any solid particles which have accumulated, open a valve and allow the solids particles to be flushed into the drainage systems.

5. Belt wash stations shall be type manufactured by Appleton Manufacturing, Menasha Corporation, Menasha, Wisconsin, Spraying Systems Company, Wheaton, Illinois; the Heinrich Stamm Company, Worms Am Rhein, Germany; or equal.
6. Each belt wash station shall be positioned such that the washing is performed after the cake has been discharged from the belt. The belt wash station shall extend over the full width of the filter belt by a minimum of 2 inches. The belt shall be cleaned by the belt wash with no blinding.
7. The belt wash system for each belt filter press shall be suitable for use with plant finished water with a maximum suspended solids concentration of 1 mg/l. Maximum water required for belt washing shall be 65 gpm per belt filter press.
8. Belt filter presses shall be provided with piping, valves, and pressure measuring and reducing devices to measure and manage water supplied at a pressure of 100 psig to that pressure required by each belt wash station. All controls and equipment necessary to provide a complete and operating system shall be provided for the belt filter presses, including controls from the machine control panel as specified herein.
9. Each belt wash system shall be furnished with a globe valve for throttling and shall be mounted on the belt filter press frame.
10. Each belt wash system shall be furnished with a pressure gauge (0-100 psi range) following each throttling globe valve.
11. Provide and install a low water pressure shut-off switch for the belt washwater for each belt filter press. The switch shall send an alarm signal to the control panel obtained from the manufacturer. The control panel shall provide both an audio and visual alarm for belt washwater low water pressure shut-off.

J. **Dewatering Drums and Rollers.**

1. All rollers shall be of double separated stub end shaft type construction, except that the perforated drum and rollers larger than 13 inches in diameter, may be of through shaft design with internal bulkhead and matched deflection of shafts and end plates. Alternatively, shaft to roller connection may be a tapered bushing design if the proposed design is approved by the Engineer/Architect. Assembly of rollers, shafts, end plates, bushings and bulkheads shall be of machined concentricity. All welds shall be continuous.
2. All rollers shall be designed to have a maximum deflection of 0.05 inches at the center of the roll under maximum loading conditions. Maximum load shall be based on the summation of all forces applied to the roller including, but not limited to, roller mass forces, friction loads, sludge loads, and the tension forces (forces exerted by the tension on the belts from the belt drive and belt tensioning devices). Tension forces shall include, but not limited to, a minimum belt tension of 50 pounds per linear inch, which is equivalent to 200 pounds per inch of belt width in the shear pressure section. Certified calculations shall be submitted as part of shop drawings showing compliance with the deflection requirements.

3. All rollers shall be of A519 or 1018 mechanical tubing, A-36, A-500, or A-53 Grade B steel with a minimum wall thickness of 0.5 inches. ASTM 572 Grade 50 steel shall be used for forged end construction. The outer surface of all rollers shall be true and concentric. If any roller is machined for this requirement and the wall thickness drops to less than 0.5 inches, the Contractor shall inform the Engineer/Architect prior to shipment. The Engineer/Architect will make a determination if any such roller is acceptable and, if not, the manufacturer shall replace the roller with an acceptable one at no cost to the Owner.
4. All shafts shall be ASTM 572 Grade 50 steel, 4140 HT, or 17-4PH solid stainless steel. Solid roller shafts shall have a minimum diameter of 4.0 inches inside the roller and machined to a minimum diameter of 2.95 inches into and through the support bearing for all bearings supporting rollers. The stub end shaft and plates shall be welded in place, or one-piece forged double-plated assemblies. Minimum stock wall thickness and end plates shall have a minimum wall thickness of 1/2 inch.
5. The perforated roller shall be of Type 316 stainless steel construction with a minimum shell or wall thickness of 0.1875 inch.
6. The minimum safety factor for the fatigue stress of the roller shafts at the maximum loading rates shall be 3.0.
7. The drive rollers shall be coated with a 1/4-inch minimum thickness of Buna N rubber coating, which shall have the following properties.

Tensile strength, ASTM D-412	2500 psi
Tear strength, die C, ASTM D-624	360 psi
Elongation at break, ASTM D-412	90 percent
Hardness, Shore A, ASTM D-676	90

8. All rollers, except the perforated drum and the drive rollers, shall be coated with a 30 mil protective coating of heat setting thermoplastic nylon (Rilsan) with the following properties:

Coefficient of friction	0.10 - 0.30
Elongation, (ASTM D638)	15 percent
Hardness, Shore D, (ASTM D2240)	77
Impact, RT. & 45 F, direct pass, (ASTM D2794)	160 in lbs.
Melting point, (ASTM D789)	370 degrees F
Rockwell Hardness, R Scale, 20 degrees C, (ASTM D785)	06
Scratch Resistance, Clemen Apparatus (0.44mm thickness)	59 N
Tensile strength, psi, (ASTM) D638	6000

9. Nip rollers shall not be used or provided on belt filter presses provided.

K. **Doctor Blades.**

1. Discharge blades shall be provided to scrape dewatered sludge from the belt at the final discharge rollers. The blades shall be of ultra-high molecular weight polyethylene construction and shall be readily removable and designed to wear before the filter belts.

2. The blades shall be affixed to a Type 316 stainless steel counterweight assembly with a Type 316 stainless steel holder. The blades and assembly shall be fabricated with sufficient stiffness so that the blades do not warp, distort, or bow under normal service condition. The blades shall apply even gentle pressure on the belts with a minimal amount of abrasiveness and shall be capable of providing passage clearance for the belt seam without injuring the seam.
3. A minimum-thickness 11-gauge, Type 316 stainless steel chute shall direct dewatered sludge to the discharge chute. The Contractor, and not necessarily the belt filter press manufacturer, shall provide and install a discharge chute for each belt filter press that extends to the side frame of the existing belt conveyor such that no significant sludge spillage is realized during the transfer operation.

L. **Belt Drive Units.**

1. The belt drive shall be variable speed, and one drive shall provide power to one drive roller shaft.
2. The range of belt speed shall be 0.6- to 6.0-meters per minute.
3. The drive motor shall be totally enclosed, fan cooled, NEMA Design B, Insulation Class F, 1.15 service factor, 1800 rpm or less, 3-phase, 208 volt AC, 60 cycles, 3 horsepower or less.
4. Variable speed control shall be provided:

    a. The motor may be controlled by a variable frequency drive unit, to be provided and installed by the manufacturer in the control panel located inside the solids handling electrical room. This device shall be reliable and user friendly.

M. **Bearings.**

1. All rollers shall be supported by greaseable type, high capacity "E" design roller bearings, equipped with a brass retainer, in sealed, splash-proof, horizontal split case pillow block housings. The bearings shall be attached to the shaft with a tapered adapter sleeve and locknut assembly.
2. All bearings shall have a minimum L10 bearing life of 500,000 hours, at a minimum belt speed of 5 meters per minute calculated by using the ANSI/AFBMA, Standard 11-1978, standard with 1.15 capacity modification factor per ISO recommendations. The L10 life shall be based on the summation of all forces applied to the bearings, including but not limited to, roller mass forces and belt tension on the rollers. The belt tension forces exerted on the pressure zone rollers shall include a minimum load of 200 pounds per lineal inch of belt width, which equates to a belt tension of 50 pounds per linear inch. Certified calculations, based on the AFBMA/ISO capacity formula, showing that all bearing life, at maximum loadings, shall be submitted to the Engineer with the shop drawing submittal.
3. The bearing housings shall be Class 30 cast iron. Design shall seal the bearing from the water of the belt filter press. Bearing housings shall be coated by a two-part epoxy base coat primer of 4 mil dry film thickness and two finish coats of two-part epoxy at four mil per coat dry film thickness. Alternatively, coating of the bearing housing shall be as

specified for the frame or the nylon coating specified for the rollers. The nylon coating, if used, shall be a thickness of 8 to 12 mils.

4. Bearings shall be specifically designed to prevent water intrusion by use of triple lip contact seals made with durable, ozone resistant rubber.
5. Bearing lubrication shall be performed through a Monel or Type 316 stainless steel button head grease fitting mounted on the bearing housing. All bearings shall be outboard (externally mounted) and shall be greaseable while the unit is in operation. Lubrication shall not be required more often than once every 6 months.

N. **Drainage Pans.**

1. Drainage pans shall be supplied as necessary to contain all filtrate and washwater within the belt filter press without splashing, total drainage to a piped discharged system, and to prevent rewetting of downstream cake. Filtrate and washwater pans shall be constructed of Type 316 stainless steel or minimum 1/4-inch thickness fiberglass reinforced plastic suitable for the intended service. Drainage pans shall be located such that the moving belts do not come into contact with the pans under any conditions. Stainless steel drainage pans shall be a minimum thickness of 14-gauge Type 316 stainless steel and be fitted with ports for inspection and wash-down.
2. All drainage piping shall be furnished, adequately sized for the intended service, and rigidly attached to the press frame. Drain piping shall be constructed of Schedule 40 solvent-welded PVC piping. Drainage piping shall terminate inside the structural frame within 6 inches of the floor of the sump as shown on the drawings. Drain connection shall be self-venting to prevent overflow. Provide cleanouts for periodic washdown.

O. **Nuts, Bolts, Fasteners.** All nuts, bolts, fasteners, and other connecting devices shall be Type 316 stainless steel.

2.6 ACCESSORIES

A. **Pneumatic Power.** The following belt filter press components shall be operated using a pneumatic system employing the following equipment.

1. All belt press pneumatic system controls, belt tensioning, tracking, and doctor blade control, shall be frame-mounted on the belt press in a NEMA 4X enclosure with Plexiglas window. Belt tensioning adjustments, tension gauges, low air alarm switch, and tensioning valves for On/Off control shall be mounted inside the enclosure. Tensioning On/Off levers and adjustment controls shall extend through the enclosure wall for easy access.
2. The enclosed controls shall be preceded by an oil coalescing filter and a 3-micron air filter regulator with gauge.
3. Air-cooled single-stage reciprocating compression with 1-1/2 HP TEFC motor, belt drive and guard mounted on a 30-gallon horizontal ASME code air receiver. The power for the motor shall be provided from the manufacturer's belt press control panel located inside the solids handling electrical room.
4. Intake filter and silencer, centrifugal unloader, safety valve, drain valve,

shut-off valve, pressure gauge and pressure switch for Start/Stop motor control. Compression shall be rated to deliver 2.5 scfm at 125 psig.

5. Pressure regulators and pressure gauges for the belt tracking and belt tensioning systems. The air pressure regulator shall be of the balanced valve high relief flow design.
6. Pressure switch shall sense low air pressure and provide signal to shut down entire system and sound alarm in the event of loss of pressure.
7. One 1/4-inch female NPT supply air connection shall only be required to the total pneumatic system. Lubrication of the pneumatic system shall not be required.
8. Pneumatic tubing shall be Type 316 stainless steel.

2.7 CONTROLS AND CONTROL PANEL

A. **A preassembled, prewired, control panel** in a free-standing NEMA 12, Type 316 stainless steel enclosure shall be furnished for each belt filter press. The control panels shall be furnished with a main disconnecting means and all motor starters, transformers, and controllers required to operate the various components of the belt filter press for safe operation including water booster pump, air compressor, two belt press feed pumps, and the interface with polymer systems. All conduit and wiring (control and power) from control panel to belt filter press terminal box shall be furnished by Contractor in compliance with Division 26.

All controls for the belt filter press shall be housed in the control panel enclosure. The control panel shall include all touchscreen control elements, relays, start-stop functions, elapsed time meters, indicator lights, audio alarm, and power disconnects as described in these specifications. The belt filter press control panel will receive one power connection rated at 208 volts, 3-phase, 60-hertz, and 30 amps and be located inside the process room. The belt filter press terminal box will be located on the belt filter press, all instruments and motor wiring will be pre-wired to this terminal box and comply with Division 26.

B. **A main disconnect circuit breaker** and operator mechanism shall be included. When the disconnect is in the open position, all power shall be removed from the control system. NEMA rated across-the-line motor starters (size 1 minimum) shall be provided for the air compressor and washwater pump. Motor control for the belt drive shall be accomplished via a variable frequency drive (VFD) mounted in the control panel.

Short circuit protection for each motor shall be accomplished utilizing thermal magnetic circuit breakers. Individual thermal overload protection shall be provided for all motors. The belt press feed pumps, polymer systems, and flush water valves shall be operable from the control panel. All devices required for control of belt press feed pumps and polymer system controls shall be supplied by Contractor.

C. **The belt filter press control panel** shall be furnished with a 208/120 volt, single phase transformer for control circuitry. The operation of the belt filter presses will be generally manual except for the specified or required automatic operation of the individual components or systems of the belt filter presses.

The control cabinet shall be equipped with an Uninterruptible Power Supply

(UPS) unit that supplies battery backup and power conditioning for the PLC, HMI and network devices within the system. UPS shall be sized for a minimum of 30 minutes of runtime at full load.

D. **Located on the front of the control panel** shall be a control power on/off switch and a touchscreen display. When in the On position, the control power On pilot light will be illuminated and control power shall be distributed to the control system. When in the Off position, the control system shall be held de-energized.

E. **An emergency stop pushbutton** shall be provided on the control panel. It shall be an illuminated mushroom head style pushbutton that when depressed shall immediately de-energize all moving equipment in the system. An alarm horn shall be included for audible alarm annunciation.

F. **The following touchscreen controls** and functions shall be provided graphically.

Item	Devices
Alarm Silence	Pushbutton
Air Compressors (2)	Start Pushbutton
	Stop Pushbutton
	Running Indicating Light
	Stop Indicating Light
	Elapsed Time Meter
BFP Drives (2)	Start Pushbutton
	Stop Pushbutton
	Running Indicating Light
	Stop Indicating Light
	Speed Potentiometer
	Speed Indicator
	Elapsed Time Meter
Sludge Conveyors (3)	On Indicating Light
	Off Indicating Light
	Remote Mode Indicating Light
	Selector Switch Manual/Auto
	E-Stop Indication Light
	Automatic Off Runtime Setpoint
	Manual Start Pushbutton
	Manual Stop Pushbutton
	Failure Alarm Indicating Light
Sludge Feed Pumps (2)	Selector Switch (Pump 1-Off-Pump 2)
	Selector Switch Manual/Automatic
	Start Pushbutton
	Stop Pushbutton
	Remote Mode Indicating Light
	Running Indicating Light
	Stop Indicating Light
	Speed Potentiometer (to adjust VFD)
	0-100% Speed Indicator
	Flow Setpoint Adjustment
	Failure Light

Sludge Feed Rate	Meter (0-150 gpm), reading based on pump selection since each pump has meter on its discharge line.
Polymer Metering Pumps (2)	Selector Switch (Pump 1-Off-Pump 2) Start Pushbutton Stop Pushbutton Running Indicating Light Stop Indicating Light Pump Speed Potentiometer 0-100 percent Speed/Flow Indicator Remote Mode Indicating Light Hand Mode Indicating Light General Alarm Indicating Light
Polymer Water Supply Motorized Ball Valve	Open Pushbutton Stop Pushbutton Open Indicating Light Shut Indicating Light
Low Washwater Pressure	Indicating Light
Low Air Pressure	Indicating Light
Belt Misaligned	Indicating Light
Belt Broken	Indicating Light
Emergency Stoppage	Indicating Light

G. **The following alarm conditions** shall be indicated on the control panel and will cause an internally-mounted horn, supplied by the manufacturer, to sound. These conditions shall automatically shut down the belt filter press, belt filter press feed pumps, polymer system, and dewatering conveyors.

Safety disconnects (grab lines) shall be provided on each side of the press. A contact closure for remote indication that each belt filter press shutdown has occurred shall be supplied and installed.

1. Emergency stop.
2. Belt misalignment.
3. Insufficient belt tension.
4. Low air pressure.
5. Loss of belt wash water pressure.
6. Belt broken.
7. Sludge collector and disposal screw conveyors fail to run.
8. Common alarm output contact closure.

H. **Each indicating light and button** shown on the touch screen panel shall have a label shown next to the device which shall show the function or use of the particular indicating light or control device. For other panel components, name plates shall be laminated plastic with contrasting colored lettering.

I. **The belt press** shall be supplied with the following NEMA 4X rated components: terminal box, mushroom head emergency stop pushbutton station (one each side), two cable-operated OSHA safety stop switches with continuous orange vinyl coated galvanized cables run on both sides, and belt tracking limit switch (one each side). All components shall be factory wired complete to the terminal box including power heads for main belt drive.

Power or control wires shall be 600-volt class, THHN/THWN insulated stranded copper and shall be of the sizes required for the current to be carried but not below 14 AWG and enclosed in plastic wiring duct. All interconnecting wires between panel mounted equipment and external equipment shall be terminated at numbered terminal blocks.

J. **Components.**

1. Circuit Breakers. Circuit breakers for the main disconnect and motor branch circuits shall be thermal magnetic molded case units. Circuit breakers shall be Square D, Class 650, Type FAL, or equal.
2. Motor Starters. Motor starters shall be VFD units, NEMA size 1 minimum.
3. Selector Switches. All selector switches shall be heavy duty, oiltight/watertight, corrosion resistant units rated for NEMA 4X service. Contact blocks shall be rated for 10 ampere continuous service. Selector switches shall be Square D, Class 9001, Type SK, or equal.
4. Pushbuttons. All pushbuttons shall be heavy duty, oiltight/watertight, corrosion resistant units rated for NEMA 4X service. Contact blocks shall be rated for 10 ampere continuous service. Pushbuttons shall be Square D, Class 9001, Type SK, or equal.
5. Pilot Lights. Pilot lights shall be heavy duty, oiltight/watertight, corrosion resistant units rated for NEMA 4X service. Units shall be 120 VAC transformer type press-to-test. Pilot lights shall be Square D, Class 9001, Type SK, or equal.
6. Terminal Blocks. Terminal blocks shall be nylon or polypropylene medium duty units rated for 300 volt for 120 volt circuits and 600 volt for 208 volt circuits. The units shall have tubular clamp type connections. Terminal blocks shall be Buchanan medium duty, or equal. Where panel space is a consideration, high density terminal blocks shall be used. Terminal blocks shall be Square D, Class 9080, Type M, or equal.
7. Programmable Logic Controller. The PLC shall be a modular type with discrete and analog capabilities. The CPU shall have 4K minimum RAM for user instructions. The unit shall have battery backed RAM and EEPROM backup. The PLC shall be by Allen Bradley and equipped with ethernet port communication.
8. Variable Frequency Drive. The VFDs shall be UL listed and shall be as manufactured by Allen Bradley.
9. See Division 26 specifications for all the items.

K. **Remote Interface**

1. Plant SCADA System

    a. The belt press control panel PLC shall be equipped with Ethernet switches and Ethernet I/P ports for remote monitoring from the plant SCADA system.
    b. A mapping table shall be submitted that includes the contiguously listed register addresses for all belt press control panel PLC monitoring and control parameters.

2. Sludge Feed Pumps

   a. The two variable-speed sludge feed pumps are directly wired to the plant SCADA PLC. The belt press control panel PLC shall control the sludge feed pumps via peer-to-peer communications pass-through interface with the plant SCADA PLC for remote pump selection (1 or 2), pump start, pump stop and pump speed controls. The belt press control panel PLC shall also monitor for pump remote mode status, pump fail alarm, pump run status, pump speed, and pump flow rate (gpm).
   b. In Automatic Flow Mode the sludge pumps shall be called to run and maintain an operator entered flow setpoint while the belt press is running. The sludge pumps will be stopped when the belt press is stopped.
   c. In Manual Flow Mode the sludge pumps shall be called to run at a set speed while the belt press is running. The sludge pumps will be stopped when the belt press is stopped.

3. Dewatering Polymer Systems

   a. The two dewatering polymer metering pumps shall be directly wired into the belt filter press control panel PLC for remote start/stop control and monitoring of remote mode status, run status, failure alarm, and e-stop activation. The belt press control panel PLC shall control remote system selection (1 or 2), system start, system stop and pump speed controls. The belt press control panel PLC shall also monitor polymer aging tank levels, polymer system remote mode status, system general alarm, system run status, pump speed, and polymer flow rate (gpm).
   b. When the polymer system is in Automatic Mode, the polymer feed system shall be called to run and maintain a setpoint determined by flow meter and solids density meter input, by adjusting the polymer pump speed (while the belt press is running). The polymer feed system shall be stopped when the belt press is stopped.
   c. When the polymer system is in Manual Mode, the polymer feed system is started, stopped and adjusted (operator-entered flow setpoint) from only the local polymer feed system control panel.

4. Dewatered Sludge Conveyors

   a. The three sludge conveyors motor starters are directly wired into the belt filter press control panel PLC for remote start/stop control and monitoring of remote mode status, run status, failure alarm, and e-stop activation.
   b. In Automatic Mode the screw conveyors shall be called to run when the belt filter press is running and continue to run for an adjustable time period after the belt filter press is stopped.
   c. In Manual Mode the screw conveyors will be manually started and stopped by the operator from the belt filter press control panel touchscreen.

2.8 **FINISHES**

A. **Painting.** The unit shall be painted in accordance with Section 09 90 00 "Painting."

1. Shop prime shall comply with Section 09 90 00 "Painting" and must be same as manufacturer of field finish coat.
2. Shop blast clean all ferrous metal surfaces in accordance with SSPC SP-10 "Near White Blast Cleaning."
3. Apply final coat in field after installation of unit.

B. **Galvanizing.** After fabrication, the frame members shall be hot dipped galvanized per ASTM A123 to a thickness of 3.9 to 7 mils to ensure complete and thorough corrosion protection. Painted or flame sprayed coatings are not acceptable since adequate surface protection at bolt holes, slots, and inaccessible areas in not ensured.

2.9 **SPARE PARTS AND MAINTENANCE EQUIPMENT**

A. **The belt filter press** manufacturer shall supply the following items:

1. Replacement seals for entire belt filter press (one set).
2. Doctor blade (one each).
3. Belt wash box seals (two sets).
4. Spray nozzles (one set).
5. Intake filter (two each).
6. Bulbs of each type used (five each).
7. Oil and grease for all components (one change).
8. Special tools as required by manufacturer (one set each).

PART 3 - EXECUTION

3.1 **FACTORY TEST**

A. **Test the belt filter press**, all its components and systems, and controls, to show that proper operation occurs. The systems tested shall include:

1. Belt tensioning.
2. Belt alignment system.
3. Pneumatic power system.
4. Belt wash water system.
5. Control panel and all controls interface and operational requirements.
6. All emergency shutdown signals operate properly.

B. **These tests** shall be successfully completed and the factory shall certify in writing that the equipment has passed these tests. A brief report describing test procedures and results shall also be provided. Before the equipment is shipped, the test results shall receive the Engineer/Architect's approval first.

3.2 EXAMINATION

A. **Site Verification of Conditions**. Verify that surfaces and site conditions are ready to receive work and the following conditions:

1. Concrete floor is appropriately sized, clean, and ready for equipment to be placed. Verify that the concrete columns for the belt filter press legs and the sump wall installation is as directed by the manufacturer, as approved by the Engineer/Architect and proper for the equipment as delivered prior to installing the belt filter press.
2. Anchor bolts are of appropriate size and properly located in accordance with approved shop drawings and manufacturer's instructions.
3. Electrical conduit is properly sized and located.
4. Install building roof in this area after the belt filter press is installed.

B. **Responsibility**. Beginning the installation means the installer accepts the existing surfaces and conditions.

3.3 PREPARATION

A. **Protection**. Protect adjacent equipment, structure and piping against damage from belt filter press installation where required.

B. **Manufacturer's Instructions.** Preparatory work in accordance with manufacturer's instructions shall be completed prior to equipment installation.

3.4 INSTALLATION

A. **Belt Filter Press.** Install belt filter press and appurtenances in accordance with the manufacturer's printed instructions, as shown on the drawings, and in accordance with approved shop drawings.

B. **Grout.** Provide non-shrink grout under frame to ensure good contact with floor.

C. **Alignment.** Ensure that mechanism is in alignment and not binding during operation.

D. **Hydraulic or Pneumatic Power Unit.** Plumb and grout hydraulic or pneumatic power unit after bolting to the floor.

E. **Installation** shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's recommendations.

F. **Interface with Other Items**

1. Complete all electrical power and control connections under Division 26.
2. Complete all piping connections under Division 40.

3.5 FIELD QUALITY CONTROL

A. **Inspection**. It is the Contractor's responsibility to notify and coordinate with the

equipment manufacturer in a timely manner in order for it to conduct their required inspection, servicing, operation, testing, and instruction a required in this specification section.

B. **Site Tests.**

1. After the belt filter press has been installed, the manufacturer's representative shall conduct a field operating test in the presence of the Engineer/Architect to verify that the equipment operates as specified. The test shall verify that all motors, drives, appurtenances, all pressure and level switches, pressure gauges, pumps, and controls operate as specified, as approved in the shop drawing, and as required. A manufacturer's representative report shall be submitted as specified in Section 01 79 00 "Start-up, Demonstration, and Training.".
2. All materials required for the testing shall be furnished by the Contractor at no additional expense to the Owner.

C. **Manufacturer's Representative.** A qualified representative of the equipment manufacturer shall inspect the completed installation, service the equipment, and operate the equipment under all design conditions, conduct the field demonstration, instruct the Owner's personnel in proper operating and maintenance procedures, and provide the Owner with a written certificate of approval in accordance with Section 01 33 00 "Submittals." The representative shall spend at least three 8-hour days over a two week period performing the required services and shall submit a manufacturer's representative report as specified in Section 01 79 00 "Start-up, Demonstration, and Training."

D. **Defective Work**. If defects are detected, it will be the responsibility of the Contractor to take corrective procedures.

3.6 FIELD DEMONSTRATION

A. **The Contractor,** in conjunction with the manufacturer, shall initially start each belt filter press to verify that the equipment and its controls operate as specified in a reliable fashion, and as required to dewater sludge. Before sludge is applied to the belt filter press, one 8-hour day onsite of successful equipment operation shall be demonstrated to Owner’s operation staff.

B. **Upon successful completion** of equipment and controls testing, the Contractor shall arrange with the Owner and Engineer to set up a mutually acceptable procedure and technique for a system acceptance test. The testing shall include enough sampling and testing to determine the solids loading rate, percent solids in the dewatered cake, solids capture rate, polymer use and cost. Ability of the equipment to meet the performance requirements, specified in Paragraph 2.2, shall be determined by the results obtained during test runs of two continuous operating days with a minimum of 6 hours operating time per day (with the other two hours per day reserved for fine-tuning during startup and a demonstration of proper cleaning at the end of each test day).

C. **The manufacturer** shall furnish operating personnel necessary to run said acceptance tests and direct and supervise the operation of said equipment during said tests. The Contractor shall furnish from the manufacturer sufficient polymer

to process 25 dry tons of sludge. Analysis of all sludge samples taken during the test periods shall be conducted by the Owner or by a reputable independent laboratory at the Owner's expense. In the event of an interruption of any acceptance test run shall be the lack of sufficient sludge to be fed into the system, the test run shall be extended by the period of actual operation. In the event of an interruption of any acceptance test run by equipment failure, the equipment shall be repaired and placed back in operating condition and the acceptance test run started again from the beginning.

D. **If equipment fails** to achieve specified performance, the Contractor shall modify and retest the equipment one time, at no cost to the Owner.

E. **Upon completion** of said acceptance tests, the Contractor shall submit a written report to the Engineer summarizing the results of the tests. The Engineer will advise the Contractor in writing confirming acceptance tests passage.

F. **Liquidated Damages.**

1. If the equipment fails to achieve the specified performance, liquidated damages will be assessed as follows:

   a. For inability to meet the solids loading capacity $100 per pound loading less than that specified.
   b. For inability to meet the minimum solids in cake discharge, $250 per each 0.10 percent solids concentration less than that specified.
   c. For minimum solids capture rate, $100 per each 0.10 percent capture less than that specified.
   d. For inability to meet maximum polymer cost, $25.00 per each $0.01 more than that specified.
   e. The above penalties will be computed to the nearest dollar at the rate shown.
   f. Total of all liquidated damages associated with performance testing shall be limited to $25,000.

3.7 ADJUSTING

A. **Test Results**. If the results of the field tests show any improper operation or design, the manufacturer shall, at its own expense, make all necessary modifications to the equipment until test can be successfully completed.

3.8 CLEANING AND DISPOSAL

A. **Cleaning**. Cleaning shall be in accordance with Section 01 74 23 "Cleaning."

B. **Disposal**. The Contractor is responsible for removal safe disposal of all excess materials and debris as a result of the work completed under this section, including testing procedures, in accordance with Section 01 74 23 "Cleaning."

3.9 PROTECTION

A. **Requirements**. The Contractor shall be responsible for provision to protect the

belt filter press and associated equipment and materials after installation, but prior to acceptance by the Owner.

3.10 INSTRUCTION OF OPERATING PERSONNEL

A. **Training**. Training shall be conducted in accordance with Section 01 79 00 "Start-up, Demonstration, and Training" and shall include all equipment specified in this section and all related electrical and instrumentation equipment. Two courses, each taking eight hours (travel time excluded) shall be provided. The second course shall follow the first by at least two weeks.

END OF SECTION

SECTION 44 72 72

POLYMER MIXING SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. **General.** Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, electrical, and all related specification sections, apply to this section.

B. **Electrical provisions** and motor starter equipment is provided within Division 26.

C. **The belt filter press system** is included in Section 44 72 70 "Belt Filter Press Dewatering System."

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide all labor, materials, tools, and equipment necessary to furnish and install a polymer mixing system in accordance with the drawings and the specifications, including:

1. Dry polymer storage, wetting, mixing, pumping and gravity transfer, and liquid storage components.
2. All interconnecting piping and tubing.
3. All interconnecting electrical conduit and conductors.
4. Controls for interfacing with main treatment plant operation and supervisory control and data acquisition (SCADA) system and dewatering control system.

B. **Process Performance Requirements**. The requirements given below represent the minimum guaranteed performance of the polymer equipment.

1. System Parameters.

   a. Number of Units. One.
   b. Maximum Polymer Usage. 10 pounds per ton of dry solids.
   c. Maximum Solids Handling Capacity. 900 lb/hr dry solids.
   d. Maximum Operating Cycle. 5 days per week, 10 hours per day.

2. The manufacturer shall provide written assurance the polymer system supplied will be capable of meeting or exceeding the minimum specified in these requirements in the shop drawing submittal.
3. Compliance with the performance requirements of the specifications will not relieve manufacturer's and ultimately the Contractor's responsibility to supply equipment having the specified structural, mechanical, corrosion resistant, and operational features. Deviations from the specified requirements will not be permitted.

1.3 QUALITY ASSURANCE

A. **Standards**. Materials and workmanship shall be in accordance with the following standards:

1. ANSI – American National Standards Institute.
1. ASTM – American Society for Testing and Materials.
2. AWS – American Welding Society.
2. NEMA – National Electrical Manufacturers Association.
3. UL – Underwriters' Laboratories, Inc.
4. IEEE – Institute of Electrical and Electronics Engineers.
5. AFBMA – Anti-Friction Bearing Manufacturers Association.
6. ASME – American Society of Mechanical Engineers.
7. AISI – American Iron and Steel Institute.

1.4 SUBMITTALS

A. **Furnish manufacturer's product data** in accordance with Section 01 33 00 "Submittals" and shall include:

1. Certified drawings showing the principal dimensions, general construction, and material used for all components of the equipment including control panels and polymer feed systems.
2. Illustrated product data.
3. Affidavit of compliance and certification of design and performance.
4. Complete electrical system drawings and description including, but not limited to, the following:

    a. Complete system interconnection diagrams between power supply, control panels, drive motor, secondary drive motor, and all ancillary equipment connected to control system, including terminal number connection points.
    b. Control panel overall dimensions and layout of external- and internal-mounted components.
    c. Complete electrical schematics with power wiring and control wiring in accordance with current standards; schematics shall include all component ratings.
    d. Description of control system in written form including functions monitored, controlled, and alarmed. Include sequence of operation and interface requirements.
    e. Control component itemized information and data.
    f. Information on field and installation requirements, including mounting and access requirements and total weight of each component and each complete assembly.
    g. List of spare parts and special tools to be furnished.
    h. Statement for machine warranties.
    i. Design Layout. If the equipment proposed to be furnished requires an arrangement differing from that shown, submit for review, detailed structural, mechanical, and electrical drawings

and equipment lists showing all necessary changes and embodying all special features of the equipment being furnished. Such changes shall be at no additional cost to the Owner.

j. For support stand, indicate profiles, sizes, spacing and locations of structural members, connections, attachments, fasteners, cambers, loads, and any special details.

k. For equipment support stand, indicate welded connections using standard AWS welding symbols.

B. **Operation and Maintenance Manuals**. Submit operation and maintenance (O&M) manuals. Submit the initial review copy of the O&M manual and six revised copies prior to delivery of the equipment. The O&M manuals shall also include storage instructions.

C. **Site Test Report**. Submit a test report within 48 hours of completion, suspension, or termination of testing the dewatering polymer system under all design conditions.

1.5 **JOB CONDITIONS**

A. **The drawings depict** a layout suitable for floor-mounted dry hopper, wetting, mixing, aging and meter pumping units. If a different layout is used, furnish and install all revisions to piping, concrete work, electrical and all else necessary for a complete system at no additional cost to the Owner. Such modification of the system for alternative equipment shall be included in the submittal package.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **In accordance with Section** 01 60 00 "Materials and Equipment" and the manufacturer's instructions.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2 – PRODUCTS

2.1 **GENERAL**

A. **The contractor shall furnish and install** according to the manufacturer’s recommendations, a dry polymer preparation and mixing system as shown on the drawings and specified hereafter.

B. **The system shall be designed** with the capability for dispensing and wetting up to 2 pounds per minute of dry polymer and shall be sized for usage of up to 10 pounds per hour at a 0.5 percent solution, aged for at least 60 minutes. Water used to wet polymer will be potable.

C. **The dry polymer feed and preparation system** shall be designed for dispensing the polymer into a wetting chamber for complete wetting of each polymer

particle. Immediately after the dry polymer has initial contact with water, it shall be pumped from the wetting chamber to a mix tank.

D. **The use of polymer preparation systems** that utilize eductors or gravity fall of polymer into water as the sole means of wetting will not be considered equal or acceptable.

2.2 MATERIAL OF CONSTRUCTION

A. **All wetted parts shall be** Type 316L stainless steel, Kynar, or PVC.

B. **Miscellaneous hardware, including bolts,** nuts, washers, and fastener clips, shall be Type 316 stainless steel.

2.3 COMPONENTS

A. Dry Polymer Feeder

1. The feeder shall employ a dissimilar speed, double-concentric auger metering mechanism mechanically geared together in a specific ratio to each other that produces uniform product density for accurate and continuous material feed without flooding, bridging or voids. The larger conditioning auger shall be 6-inch OD minimum and the smaller metering auger shall be 1-3/8 inch OD minimum.
2. The feeder shall be heavy-duty, dust-tight and designed to provide easy cleaning without the need for removing the feeder from the module, or disassembling flexible connectors and hoppers. Construction shall provide complete access to the feeder internals by simply removing the feeder's discharge spout.
3. The feeder and all parts in contact with the material shall, at minimum, be constructed of 11-gauge, Type 316 stainless steel. The seals shall be heavy-duty synthetic packing glands.
4. The feeder's discharge spout shall be provided with a hydraulically activated gate seal to prevent moisture from entering the feeder while the unit is not operating.
5. The feeder shall be driven by a 1/2 HP, totally enclosed variable speed motor, with the motor controller mounted inside the control panel. The feeder shall be controlled by an adjustable timer accessed through the touchscreen display.
6. The feeder shall have a metering accuracy of 1% to 2% based on a given number of consecutive one-minute weight readings.
7. The feeder shall be equal to the Model W-105 as manufactured by Acrison, Inc., Moonachie, New Jersey.

B. Feeder Hopper

1. The feeder hopper shall have a capacity of 2 cubic feet excluding the feeder's feed chamber.

2. The hopper shall be constructed of 11-gauge, Type 316 stainless steel and be provided with a gasketed, hinged cover, with handle and quick-clamps.

C. **Single Door Bag Loader**

1. The feeder shall be provided with a single-door, dust-tight, bag loading hopper constructed of Type 316 stainless steel to accommodate a full bag of polymer and store the bag in the hopper until empty.

D. **Hopper Low Level Switch**

1. A low level switch shall be included and installed in the feeder's hopper to energize a visual and audible alarm in the control panel when material reaches a predetermined low level.

E. **Wetting Chamber**

1. The wetting chamber shall incorporate a mixing action which utilizes swirling turbulent water and a multitude of converging water jets to completely and thoroughly wet the polymer. Wetted polymer shall drop directly into the suction of a transfer pump. Unwetted polymer is not acceptable.
2. No restrictive orifices (1-1/2 inches or less) shall be utilized in the wetting chamber.
3. All metal surfaces that come into contact with the wetted polymer shall be constructed of Type 316 stainless steel.
4. Provide pressure regulator (0 to 100 psi adjustment range) to insure optimal pressure and flow of potable water can be fully adjusted into wetting chamber for optimal polymer activation.

F. **Wetting Chamber Containment Reservoir**

1. The wetting chamber shall be mounted in a containment reservoir to prevent spillage in the event of an overflow condition.
2. A conductance type level probe shall be mounted in the containment reservoir to immediately shut down the preparation module and signal an alarm.
3. The containment reservoir shall have a clear synthetic cover to allow for visual inspection.

G. **Transfer Pump**

1. A transfer pump shall be attached directly to the outlet of the wetting chamber for transferring the wetted polymer to the mixing tank.
2. The transfer pump shall be Type 316 stainless steel in construction, shall have a mechanical shaft seal, and be directly coupled to a 3/4-horsepower, totally enclosed, constant speed motor.
3. The transfer pump shall have a minimum capacity of 30 gpm at 40 ft total dynamic head.

4. A check valve shall be mounted on the discharge side of the pump to prevent backflow of polymer solution. Connection between pump outlet and check valve shall be clear to allow for visual inspection of the process.

H. **Dilution Water Components**

1. The water supply line of the wetting system shall be sweated copper and shall include the following items:

   a. Pressure reducing valve, 1" in size, with an adjustable range of 10- to 35 psi, and brass in construction.
   b. Pressure switch with high and low pressure contacts and stainless steel wetted parts. Switching elements shall be single pole double throw snap-action.
   c. Solenoid valve, 1" in size, normally-closed and brass in construction.
   d. Pressure gauge, 2-1/2" in diameter, with black painted steel case and polycarbonate window.
   e. Visual Flow Meter with spring-retained movable piston, and constructed of polysulfone and stainless steel.

2. Minimum water supply shall be 20 gpm at 25 psig.
3. All wetting system components shall be pre-assembled, piped and wired

I. **Mixing Tank**

1. The mixing tank shall be rectangular in shape, and have a capacity of 125 gallons.
2. The tank shall be constructed of 11-gauge, Type 316L stainless steel, complete with a full cover on which the level transmitter and slow-speed mixer shall be installed.
3. Plastic or fiberglass tanks will not be acceptable. Open-top tanks are not be acceptable.

J. **Mixer**

1. The mixing tank shall be complete with a 1.0-horsepower, slow speed mechanical mixer.
2. The mixer impeller speed shall not exceed 400 RPM and the impeller shall be positioned no less than one and one half impeller diameters from the bottom of the tank.
3. The mixer assembly shall include an angle riser support, right angle gear-reducer, and a TEFC motor.
4. The impeller and shaft shall be Type 316 stainless steel. The unit shall be heavy-duty in construction and capable of operation at varying tank levels. The mixer shaft diameter shall be 7/8 inch minimum.

K. **Transfer Valve**

1. The transfer valve shall be sized for quick gravity transfer of the mixed polymer to the aging tank on a demand signal from the level transmitter in the aging tank.
2. The valve shall be motor operated with a manual over-ride and constructed of Type 316 stainless steel.
3. The valve shall be mounted on the side of the tank for easy access, and to minimize the possibility of clogging from tramp material.

L. **Mixing Tank Support**

1. A heavy-duty steel structure shall be provided to support the mixing tank assembly directly above the aging tank. Systems that have the mix tank supported directly on top of the age tank cover will not be acceptable.

M. **Aging Tank**

1. The aging tank shall have a capacity of 250 gallons to provide at least one-hour aging time when feeding 0.5 percent solution at the maximum dry polymer usage.
2. The tank shall be 11-gauge, Type 316L stainless steel, furnished with a (full) gasketed cover on which the level transmitter shall be mounted.
3. Labyrinth baffles shall be provided to promote a plug flow pattern within the tank to optimize polymer detention.
4. Plastic or fiberglass tanks will not be acceptable. Open-top tanks will not be acceptable.

N. **Ultrasonic Level Transmitters**

1. Ultrasonic level transmitters shall be mounted on both the mix tank cover and the age tank cover to provide complete control of the preparation system operation, including level-alarm indication, and to provide a continuous display of the level in each tank on the control panel touchscreen display. The control and alarm set-points shall also be settable through this display.
2. The ultrasonic level transmitters shall have a range of 0.033 to 6 feet, a resolution of 0.03 inches, 4 to 20 mA output, and simple push-button calibration. Operating frequency shall be 148 kHz.
3. Level transmitters shall not extend more than 5 inches from the top of the tank covers.
4. Level sensing devices that come into physical contact with the polymer solution will not be acceptable.

O. **Control Panel**

1. The polymer preparation module shall include a Type 316 stainless steel, NEMA 4 control panel to automatically operate the entire preparation module (system) and all components thereof.

2. The control panel shall include an Allen-Bradley CompactLogix PLC with Ethernet connectivity, as standard. The panel shall be equipped with an unmanaged four port industrial Ethernet switch.
3. Operator interface shall be a 10" Allen-Bradley PanelView Plus Compact, with 640 x 480 resolution, and a TFT 18 bit color display.
4. The panel shall also include a main disconnect switch and an emergency stop push-button.
5. The PLC program shall include an interlock to prevent feeding of dry polymer unless water is being supplied to the wetting chamber and all motors are operational. Interlocks shall trigger a visual and audible alarm.
6. The program, as standard, shall also include the capability to operate in liquid mode (a separate liquid polymer pump skid is required for such operation).
7. Should the system experience a loss-of-power, the PLC shall remember where in the sequence of operation the polymer preparation module was interrupted, and continue from that point when power is restored, and the start button pressed.
8. Magnetic starters, providing overload protection, shall be provided for each motor. Starters shall be mounted in the same control panel by the equipment supplier and wired to their respective motors to the greatest extent possible.
9. The control panel shall be mounted to the same skid as the dry polymer feeder and pre-wired to the greatest extent possible. Mixing/aging tank assembly shall be shipped separately.
10. Power supply for motors shall 208 volts, 3-phase, 60-hertz. A suitable transformer shall be included to step voltage down to 115 volts for control functions.
11. The color touchscreen operator interface shall provide the following capabilities at a minimum:

    a. "Process" screen, showing on/open status of all components during system operation.
    b. Continuous level displays for both the mixing and aging tanks.
    c. Resettable batch counter.
    d. Alarm acknowledge and reset buttons.
    e. Password protection.
    f. "Alarm" screen showing all possible alarms, noting which alarms are currently present.
    g. Alarm 'history' screen.
    h. "Timers" screen, allowing the operator to set feeder and mixer settings, in addition to various system delay timers.
    i. "Switches" screen, including Hand/Off/Auto switches for all major components.
    j. Local/Remote capability.
    k. Level Indication screen, allowing the operator to set mixing and aging tank control and alarm levels.
    l. Screen contrast adjustment.
    m. Backlight-off screen saver.

P. **Electrical Connections**

1. The polymer feed system control panel shall accept one incoming power feeder rated at 208 volts, 60-hertz, 3-phase, 15 amps.
2. Terminal Blocks.

   a. Provide dry contact input for remote start.
   b. Provide dry contact outputs for general fault, run status, hand mode status and remote mode status.

2.4 MANUFACTURER

A. **Manufacturer/Model**. The polymer mixing system equipment shall be furnished by a manufacturer who is fully experienced, reputable, and qualified in the manufacture of the equipment to be furnished. All equipment and items specified herein shall be obtained from a single manufacturer who shall be solely responsible for the design of the entire dry and wet tanks, activation chamber, mixer, transfer pump, and all component warranties. The base bid equipment shall be as manufactured by:

1. Acrison of Moonachie NJ; Model 515.

As indicated in the Bidding Documents, other manufacturers will be considered, including:

1. ProMinent Fluid Controls of Pittsburgh PA; PolyRex Model.
2. UGSI Chemical Feed Solutions of Vineland NJ; Dynajet Model.
3. Velodyne of Louisville CO; HydraMax Model.

Alternate manufacturers will be subject to the performance and space requirements but accomplishing them with components shape, size, and configuration that may vary from those specified for the base bid system.

B. **Spare Parts**

1. The polymer manufacturer shall supply the following spare parts.

   a. One set of liquid end replacement kit for polymer transfer and feed pumps.
   b. Special tools for removal of components.

PART 3 – EXECUTION

3.1 EXAMINATION

A. **Verify that surfaces** and site conditions are ready to receive work; that concrete is clean and ready for equipment to be placed; and electrical conduit cast in concrete is properly sized and located.

3.2 PREPARATION

A. **Complete preparatory work** in accordance with manufacturer's instructions prior to equipment installation.

3.3 INSTALLATION

A. **Requirements**

1. Fabrication and installation of the centrifuges shall be as shown, as specified herein, and in accordance with the approved shop drawings and the manufacturer's instructions and recommendations.
2. Dewatering area for equipment installation is available for six weeks from when the Owner last has availability to dewater until startup of new dewatering system.
3. Installation shall include furnishing the required lubrication for initial operation.
4. The grades of lubrication shall be in accordance with the manufacturer's recommendations.

B. **Interface with Other Items.** Complete all electrical power and control connection under Division 26 and Division 40. The polymer feed system shall be coordinated, tested, and demonstrated with the belt filter press supplier per Section 44 72 70 "Belt Filter Press Dewatering System."

3.4 FIELD QUALITY CONTROL

A. **Inspection**. Notify and coordinate with the equipment manufacturer in a timely manner in order for them to conduct their required inspection, servicing, operation testing, and instruction as required in this specification section.

B. **Field Tests**

1. The testing procedures shall be defined by the Contractor and agreed upon by the Engineer/Owner.
2. The polymer feed system shall be coordinated, tested, and demonstrated to be remotely monitored and controlled by the belt filter press supplier per Section 44 72 70 "Belt Filter Press Dewatering System."
3. Testing shall not be considered complete until all performance criteria described herein has been achieved for a duration set forth by the Owner.
4. The Engineer shall be notified and afforded the opportunity to witness the testing procedures.
5. Furnish all test materials, and equipment required for the testing at no additional cost to the Owner.
6. Tests shall be in accordance with Section 01 79 00 "Start-up, Demonstration, and Training" unless specified otherwise.
7. Dry Test. Test the equipment to show proper operation of the equipment and controls as specified and required.

8. Wet Test. Field test the equipment over the full operating range to demonstrate compliance with the operating conditions specified and that it will adequately dewater the sludge to the degree specified.
9. Operational test duration shall be no less than 20 continuous days prior to acceptance of equipment by Owner.

C. **Manufacturer's Representative**

1. A qualified representative of the equipment manufacturer shall inspect the completed installation, service the equipment, be present during field testing, operate the equipment under all design conditions, and provide the Owner with a written certificate of approval in accordance with Section 01 33 00 "Submittals."
2. The representative shall spend at least one 8-hour day (not including travel time) performing the required services and submit a manufacturer's representative report as specified in Section 01 79 00 "Start-up, Demonstration, and Training." The timing of this polymer system testing shall coincide with the testing of the belt filter press and polymer pump representatives, and the time of both shall overlap completely with that of the polymer system representative.
3. Representative shall bring all necessary cleaning solutions and demonstrate cleaning procedures, including wetted nozzles. Representative shall also demonstrate replacement of routinely-replaced hose segments, if applicable.

3.5 ADJUSTING

A. **If the results of the field** tests do not show successful operation, repair, adjust, modify, or replace the equipment according to the manufacturer's instructions until the equipment and systems are operating as required and the tests are successfully completed. This shall be done at no additional cost to the Owner.

3.6 INSTRUCTION OF OPERATING PERSONNEL

A. **Conduct training in accordance** with Section 01 79 00 "Start-up, Demonstration, and Training" and include all equipment specified in this section and all related electrical and instrumentation equipment. Provide one 8-hour course.

END OF SECTION

SECTION 44 72 74

POLYMER METERING PUMPS

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including Division 1 specification sections apply to this Section.

1.1 **DESCRIPTION OF WORK.** The Contractor shall provide all labor, tools, equipment, and materials necessary to furnish and install two polymer metering pumps as shown on the drawings and specified herein, including polypropylene skid support platform sized to fit available space, PVC Schedule 80 piping and manual isolation valves, pressure relief valves, and electrical disconnect switches. The metering pump skid assembly shall be located indoors, and accept, transfer, and recycle liquid polymer solution as indicated on the drawings.

1.2 **QUALITY ASSURANCE**

A. **Codes**. Perform all work to furnish and install the polymer pumping equipment in compliance with applicable requirements of governing agencies having jurisdiction.

B. **Standards**

1. NEMA - National Electrical Manufacturers Association.
2. ANSI - American National Standards Institute.
3. NSF/ANSI Standard 61, AWWA – Drinking Water System Components
4. NIOSH - National Institute for Occupational Safety and Health.

C. **Quality**. All equipment shall be installed in accordance with manufacturer's instructions and recommendations. Fabrication and installation shall be in accordance with the approved shop drawings.

1.3 **SUBMITTALS**

A. **Approval Drawings**. Shop drawings shall be submitted in accordance with Section 01 33 00 to the Engineer for approval. Shop drawings shall include:

1. Manufacturer's name and model numbers.
2. Manufacturer's standard product data.
3. Equipment specifications.
4. Materials of construction.
5. Repair parts.
6. Dimensional layouts and required clearances.
7. Weights.
8. Anchor bolts.
9. Bill of material.
10. Complete description in sufficient detail to permit an item by item

comparison with the specifications.
11. Performance characteristics.
12. Power and utility requirements.

B. **Operation and Maintenance Manuals**. Operation and maintenance (O&M) manuals shall be submitted to the Engineer/Architect in accordance with Section 01 33 00 of these specifications. The initial review copy of the O&M manual and six revised copies shall be submitted prior to delivery of the equipment.

C. **Operator Training Information**. Operator training data, in accordance with Section 01 79 02, and operator training lesson plans in accordance with Section 01 33 00, shall be submitted with six revised copies of the O&M manual.

D. **Personnel Qualifications**. Qualification statements in accordance with Section 01 33 00 of all manufacturer's representatives personnel that will be servicing the equipment or conducting the operator training sessions shall be submitted with the six revised copies of the O&M manuals.

E. **Manufacturer's Representative Reports**. Manufacturer's representative reports shall be submitted within 48 hours of each site visit. Product and material certifications and inspection data as specified in Section 01 33 00 shall be included with this report(s).

F. **Test Report**. Test reports shall be submitted to the Engineer in accordance with Section 01 75 16 within 48 hours of the completion, suspension, or termination of the test.

1.4 JOB CONDITIONS

A. **Coordination with Other Work**. The Contractor shall coordinate the scheduling of the work and the location of equipment, piping, and conduit to prevent interferences and delays.

1.5 DELIVERY, STORAGE, AND HANDLING

A. **General**. The delivery, storage, and handling of the polymer pumping equipment shall be in accordance with Section 01 60 00 and the manufacturer's instructions.

1.6 SPECIAL WARRANTY

Not used.

PART 2 - PRODUCTS

2.1 POLYMER METERING PUMPS

A. **Manufacturer**. Subject to compliance with the specifications, provide pumps by a manufacturer fully experienced, reputable, and qualified in the production of

the equipment to be furnished. The base bid equipment shall be as manufactured by

1. Watson-Marlow of Wilmington MA.

As indicated in the Bidding Documents, other manufacturers will be considered, including:

1. Vector of Minneapolis MN.
2. ProMinent of Pittsburgh PA.

B. **Description**. The polymer metering pumps shall be of the positive displacement peristaltic type using integral pressing shoe technology and reinforced hose element, and having the capacities described in the pump schedule in this specification section. Each pump shall be capable of operating in either direction without flow variation, capable of running dry without damage to pump or hose, capable of pulling 95-percent vacuum, and be of a valve- and gland-free design such that seals are never in contact with the pumped product.

C. **Hose**.

1. Hose shall be manufactured of three-layer elastomer with an extruded inner wetted layer compatible with the process fluid, with four layers of nylon reinforcement and a Natural Rubber outer layer. Hose outside diameter shall be machined to maintain a wall thickness within 0.2 mm and shall be within hardness range of 51-68 shore A durometer.
2. Hoses must have a smooth extruded internal surface and have tolerance controlled through machining. Hose shall be machined with oversized ends to ensure a secure connection between the hose and insert.
3. Minimum static burst pressure rating shall be 950 psi.
4. Hose must be replaceable without cover or pump removal.
5. Lubricant applied shall be NSF-listed food-grade, glycerin based.

D. **Pump**.

1. Pump housing shall be coated cast iron, fitted with a cover of coated cast aluminum with threaded drain plug, clear window for viewing rotation, vent cap, and lubricant registration mark for proper indication of lubricant level when pump is stationary.
2. Pump rotor shall be coated cast aluminum with two integrally mounted shoes located 180-degrees apart. Pump shall be available with a medium pressure occlusion rotor or low-pressure occlusion rotor to maximize pump performance under various conditions of operation.
3. Supply each pump with ANSI/ASA 150 lb flanged inlet and outlet connections, with wetted inserts compatible with the process fluid as indicated in the pump schedule.
4. Connector bracket shall be one-piece cast iron and secured to pump housing using two or four bolts that shall maintain a compression seal between the pump housing and hose.

5. Pump hose shall extend from the pumping chamber with connectors secured with one band clamp for leak-free connection.
6. Pump frame shall be formed, hot-dipped galvanized steel with a coating thickness of 15 microns.
7. Provide each pump with high-lubricant leak detector. A float type magnetic reed switch shall be located near the top of the pump to detect leakage of pumped product into the pump housing. Switch shall be normally-closed and field-adjustable to normally open.

E. **Drive**.

1. Drive shall be direct-coupled configuration, with rotor mounted on and independently supported by a sealed bearing hub within the pump housing. Bearing hub shall use either a single or pair of heavy duty ball bearings, sealed and greased permanently, and shall be located directly under the rotor's load.

2. Provide gearmotor with protected drive direct-coupled mounting to the pump housing. The gearmotor shall bolt directly to the pump housing which shall include a buffer zone between the gearing and pump head to prevent gearmotor contamination from pump fluid or lubricant in the event of a hose lubricant seal failure. The pump's internal bearing hub shall be vented through the rear of the pump housing to allow visual detection in the event of a hose lubricant seal failure.

3. Provide gear reduction to match output speed requirement of the pump using two or three-stage gearing and matching torque rating of pumping equipment. Gearing shall be classified for continuous heavy shock duty, 24 hr duty with a minimum of 1.4 service factor.

4. All gearing shall be helical gearing with cast aluminum housing.

5. Gearmotor shall be equipped with an integral TEFC motor, Design B, Class F insulation, 1.15 motor service factor, 4-pole, 120 volts, 60-hertz, 3-phase, inverter duty. Motor horsepower to be 2 HP or less and specifically determined by the pump manufacturer based on the process conditions noted in the pump schedule, and suitable for chemical environment and hose washdown, a maximum pump speed of 1,750 rpm, and maximum discharge pressure of 87 psi for all pumping conditions at a temperature of 55°F or higher temperature.

6. Drive shall include the following remote features.

    a. Receive start/stop command from dry contact closure from SCADA to signal pump on and off.
    b. Accept 4-20 milliampere (mA) analog signal from PLC for flow pacing.
    c. Send pump status (on/off) from dry contact closure to SCADA.
    d. Tachometer output for 4-20mA analog signal output.

e. Normally-closed float switch mounted on the pump to provide pump or hose failure detection to SCADA.
f. Send pressure relief valve status (open/close) from dry contact closure to SCADA.

7. Start/stop contact shall be functional in either manual or analog mode.

8. Drive motor shall be servo permanent magnet dc with integral gearbox. Motor brushes shall be rated for 10,000 hours to first inspection based on running continuously at full speed with largest tube size. Motor shall be rated for washdown duty.

F. **Painting**. Provide pump assembly painted with manufacturer's standard paint system, consisting of a single coat of two-component acrylate, with a dry thickness 60-80 micron, and color of brown red or Owner-approved equal.

G. **Spare Parts**. Provide spare parts that are identical to and interchangeable with parts installed. Furnish and deliver the following spare parts for the system.

1. Two replacement hose elements per pump.
2. One gallon hose lubricant.

H. **Installation**. Each metering pump shall be set on a Type 304 stainless steel or fiberglass shelf with supports as shown on the drawings. Supply support shelving and brackets, and Type 316 stainless steel connection hardware for all installation connections, from the pump manufacturer.

I. **Polymer Metering Pump Schedule**.

Liquid Pumped	No. of Pumps	Specific Gravity	Minimum Feed Rate (GPH/pump)	Design Feed Rate (GPH/pump)	Maximum Capacity (GPH/pump)	Maximum Operating Pressure (psi)
Anionic Dry Polymer	2	1.12-1.15	12	210	240	80

GPH = Gallons per Hour

PART 3 - EXECUTION

3.1 INSTALLATION

A. **Method**. Install equipment in accordance with approved shop drawings, manufacturer's installation instructions, and as shown on the drawings and specified herein.

B. **Interface with Other Items**

1. Complete all electrical power and control connections under Division 26, "Electrical."

2. Complete all control connections under Division 40, "Process Integration."
3. Complete all piping connections under Division 13, "Special Construction."
4. Inspection. The Contractor shall inspect all parts of the polymer feed systems for proper installation and conformance to the drawings and manufacturer's recommendations.

3.2 **MANUFACTURER'S SERVICES**. The polymer metering pump manufacturer shall provide a qualified representative to start up, test, calibrate, adjust and train plant personnel in the operation and maintenance of the equipment.

1. A qualified representative of the pump manufacturer shall inspect the completed installation, service the equipment, be present during field testing, operate the equipment under all design conditions, and provide the Owner with a written certificate of approval in accordance with Section 01 33 00 "Submittals."
2. The representative shall spend at least one 8-hour day (not including travel time) performing the required services and submit a manufacturer's representative report as specified in Section 01 79 00 "Start-up, Demonstration, and Training." The timing of this polymer metering pump system testing shall coincide with the testing of the belt filter press and polymer mixing system representatives, and the time of both shall overlap completely with that of the polymer metering pump representative.
3. Representative shall bring all necessary cleaning solutions and demonstrate cleaning procedures shall also demonstrate replacement of routinely-replaced hose segments, if applicable.
4. If the results of the field tests do not show successful operation, repair, adjust, modify, or replace the pump or component according to the manufacturer's instructions until the equipment and systems are operating as required and the tests are successfully completed. This shall be done at no additional cost to the Owner.

END OF SECTION

SECTION 44 72 90

DEWATERED SLUDGE SCREW CONVEYOR SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. **General**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

B. **Electrical provisions** and motor starter equipment is provided within Division 26.

C. **The belt filter press** system is included in Section 44 72 70 "Belt Filter Press Dewatering System. "

1.2 DESCRIPTION OF WORK

A. **Scope of Work**. Provide all labor, tools, equipment, supports and materials necessary to furnish and install, complete and in proper operating condition, the three-conveyor sludge conveyance system as shown on the drawings and the specifications.

1.3 QUALITY ASSURANCE

A. **Codes**. Perform all work to furnish and install the screw conveyor system in compliance with all federal, state, and local codes.

B. **Standards**. Material and workmanship shall be in accordance with the following standards:

1. AFBMA – Antifriction Bearing Manufacturers Association.
2. AGMA – American Gear Manufacturers Association.
3. AISI – American Iron and Steel Institute.
4. ANSI – American National Standards Institute.
5. ASTM – American Society for Testing and Materials.
6. AWS – American Welding Society.
7. CEMA – Conveyor Equipment Manufacturers Association.
8. NEMA – National Electrical Manufacturers Association.
9. UL – Underwriters' Laboratories, Inc.

C. **Specific Standard Requirement.** The screw conveyors shall be designed in accordance with CEMA standards, ratings, and methods of calculations as published in ANSI/CEMA Standard No. 350, *Screw Conveyors for Bulk Materials,* Fifth Edition. The screw conveyors shall meet all appropriate ANSI and Occupational Safety and Health Administration (OSHA) safety regulations.

D. **Regulatory Agencies**. Perform all work in compliance with the requirements of the OSHA.

E. **Welding**. The equipment manufacturer's shop welds, welding procedures, welders, and welding operators shall be qualified and certified in accordance with the requirements of the latest edition of the applicable standards of ANSI and AWS.

1.4 SUBMITTALS

A. **Product Data**. Submit manufacturer's product data including all major standard components included in the conveyor manufacture.

B. **Shop Drawings**. Submit shop drawings and product data for review, including:

1. Manufacturer's name and equipment model numbers.
2. Equipment specifications.
3. Materials of construction.
4. Repair parts.
5. Dimensional layouts and required clearances.
6. Weights.
7. Anchor bolts.
8. Bill of material.
9. Complete description in sufficient detail to permit an item-by-item comparison with the specifications.
10. Power/utility requirements.
11. Manufacturer's instructions on handling, installation, and operation and maintenance.

C. **Operation and Maintenance Manuals**. Submit operation and maintenance (O&M) manuals. Submit the initial review copy of the O&M manual and six revised copies prior to delivery of the equipment. The O&M manuals shall also include storage instructions.

D. **Site Test Report**. Submit a test report within 48 hours of completion, suspension, or termination of testing the dewatering screw conveyors under all design conditions.

1.5 JOB CONDITIONS

A. **Coordination - Interfacing**. Coordinate with all other trades to prevent delays, errors, or omissions.

B. **Environmental Requirements.** The screw conveyors shall be designed for operation in an indoor, covered installation.

C. **Manufacturers**. Conveyors shall be manufactured by Custom Conveyor Corporation of Rogers MN, Jim Meyers and Sons Incorporated of Charlotte NC, or JDV Equipment Corporation of Dover NJ.

1.6 DELIVERY, STORAGE, AND HANDLING

A. **Deliver, store, and handle** the screw conveyors in accordance with the manufacturer's instructions.

1.7 **SPECIAL WARRANTY**

Not used.

PART 2- PRODUCTS

2.1 **PERFORMANCE AND DESIGN REQUIREMENTS**

A. **Dewatering Building and Sludge Loadout**

1. Service. The screw conveyors shall be designed to transport dewatered water treatment ferric sludge from two belt filter presses to the dumpster loading area housing two existing roll-off dumpsters, as shown on the drawings.
2. Operation. The inclined collection conveyor shall receive dewatered sludge from both belt filter presses and discharge the sludge to both disposal conveyors. Operators will determine which disposal conveyor is in service by opening or closing Motorized Slide Gate 3. If that gate is open, sludge will be directed to Disposal Conveyor 2. If closed, sludge will be transferred to Disposal Conveyor 1.
3. Each disposal conveyor shall have three discharge outlets, with two open outlets on each end, and an outlet at its center fitted with a motorized slide gate. When that center-mounted slide gate is closed, each disposal conveyor will discharge equally at its ends and when the slide gate is open, each conveyor shall discharge at its center.

B. **Shafted Screw Conveyors**

1. Number of units: Three.
2. Designation: Inclined Collection Conveyor, Disposal Conveyors 1 and 2.
3. Operating schedule: Continuous duty.
4. Design handling capacity: 82 cu ft/hr.
5. Maximum incline: 6.5 degrees.
6. Length of Inclined Collection Conveyor trough: 55 feet.
7. Length of Disposal Conveyor 1 and 2 trough: 16 feet each.
8. Minimum screw diameter: 12 inches.
9. Material density: 60 lb/cu ft.
10. Percent solids: 24- to 30-percent solids by dry weight.
11. Maximum screw rotation speed: 25 rpm.
12. Minimum Inclined Conveyor drive horsepower: 3 hp.
13. Minimum Disposal Conveyor drive horsepower: 2 hp.
14. Intermediate hanger bearings: 12-ft maximum centers, Style 226 Type 316 stainless steel bracket with hardened iron bearing, with grease pipe extensions and 6-oz spring-loaded grease lubricators.

C. **Screw conveyors** shall have inlets and outlets as indicated on the drawings. Each Disposal Conveyor drive shall be reversing to discharge alternately into two separate dumpsters.

2.2 EQUIPMENT

A. **Type**. The conveyor system shall consist of three 12-inch diameter shaft screws housed in U-shaped troughs designed for transport of dewatered sludge at a 24- to 30-percent solids concentration from the 1.5-meter belt press to within an Owner-furnished dumpster.

B. **Drive Units.** The conveyor drives shall include a TEFC motor wired for operation on 208 volts, 3-phase, 60-hertz, gear reducer, V-belt, sheaves, and sprockets.

1. Each conveyor motor shall utilize a full-voltage, reversing NEMA Size 1 starter located within the solid handling building.
2. Drive assembly shall consist of an integral gearmotor, mounted directly to the screw shaft. Gear housing shall be cast iron, furnishing complete protection under all conditions of service. Gears shall be manufactured and rated for continuous duty in accordance with AGMA Standards, of heat-treated alloy steel. Provide splash type gear lubrication. Gear reducer shall be Class II speed reducer as manufactured by Eurodrive.
3. The gear reducer and drive shall be designed to provide an applied torque adequate to start a full loaded conveyor.
4. Drive shall have an AGMA service factor of 1.4.

C. **Screw Flights and Shafts.** Single flights with standard pitch shall be provided. Flight outside diameter shall be CEMA standardized sizes. Flights shall be of the required diameter and thickness to convey the specified material at the specified rate. Sectional flights shall have a constant cross section of 1/4-inch minimum, and shall be butt welded into a continuous helix that is continuous throughout its entire section. Conveyor flights and pipe shafts shall be manufactured from abrasion resistant Type A36 carbon steel.

1. Pipe shaft shall be minimum Schedule 80 pipe.
2. Screw augers shall be interchangeable between similar sized conveyors.
3. Coupling shafts shall be used to join screw augers. Coupling shaft shall fit inside the screw shaft with minimal play. Coupling shaft shall have matching bolt holes with screw shaft. Bolt holes shall be jig-drilled. Bolts shall secure coupling shaft and screw shaft together with a lock nut. Bolts shall be sized to adequately carry all loads generated by the conveyor.
4. Screw coupling shafts shall be of sufficient length to allow rotation within the intermediate bearings without the bearing and its housing being in contact with any part of the screw. Drive, coupling, and tail shafts shall be manufactured from Type 1045 alloy steel. Coupling shafts shall be heat treated through induction hardening.

D. **Troughs.** The conveyor flights shall be housed in a 10-gauge thick minimum Type 316L stainless steel U-trough with formed top flanges and integral end flanges.

1. The lowest point of the conveyor troughs at the tail end shall include a 2-inch minimum diameter drain connection. For conveyors not hard-piped, provide with drain cap. Contractor to pipe Inclined Collection Conveyor drain to discharge into BFP filtrate containment area, as shown on the drawings.
2. The troughs shall include a 3/8-inch minimum thickness, replaceable, UHMWP liners from roll line to roll line in the trough interior. Trough ends shall be 1/4-inch minimum thickness Type 316L stainless steel and will include top flange and support foot. A discharge port shall be provided at the end of the conveyor for discharge to the outdoor loadout container, complete with neoprene chute extension as shown on the drawings.
3. CEMA standard trough end plates shall be provided with a split gland packing ring consisting of two Teflon coated packing rings shall seal the drive shaft at its penetration through the end plate.
4. Stiffeners shall be placed across the top of the trough and fastened to both sides of the trough to maintain trough shape.
5. A neoprene or rubber gasket shall be provided at each trough flange and between trough top and covers
6. Each trough shall be equipped with filling and discharge spouts at the location shown on the drawings. Each filling and discharge spout shall be flanged so they are suitable for interconnection to other devices, including belt filter press sludge discharge hopper inlet, transfer chutes, motorized slide gates, and dumpster discharge outlets.

E. **Covers.** The troughs shall include a minimum 14-gauge Type 316L stainless steel cover with gasketing and bolted on 2 feet centers.

1. The inlet zone will incorporate a load hopper constructed of a minimum 10-gauge stainless steel which will include 1/4-inch thick polyethylene liners on all sloped sides less than 60 degrees from horizontal.
2. A removable, gasketed inspection access hatch will be provided in the cover over the discharge. Cover splices shall be flanged, gasketed and bolted.

F. **Supports.** Each conveyor is to be supported by structural shape members at locations as indicated on the drawings, spaced no more than 10 feet on center and include base plates for anchoring. Supports shall be Type 316L stainless steel, and shall be suitable for interconnection with existing concrete and structural steel components.

G. **Guards.** All exposed, accessible rotating parts as well as the drive mechanism to be covered with an OSHA type guard to prevent accidental injury. These guards to be constructed of minimum 14-gauge mild steel, epoxy coated safety yellow.

H. **Safety Stop Switches.** Each conveyor shall be provided with two cable-operated OSHA safety stop switch with continuous, orange vinyl coated, galvanized cables run on both sides and a zero speed switch mounted at the conveyor tail shaft or trough.

1. Switches shall be housed in a NEMA 4 enclosure. Support cables from conveyor frame on 10 feet maximum centers. Switches shall be single-pole, double-throw (SPDT), 120 volts alternating current (VAC). There shall be one emergency push-pull button located at each conveyor in addition to the two cable-operated safety switches.
2. Each supplied switch shall be pre-wired to a terminal box located at the conveyor and comply with Division 26.

I. **Motor Operated Slide Gates**. The three slide gates shall be designed so that in the full, open position at least one rotation of the spiral is exposed to the opening in the direction of transport. The slide gates shall have an opening at least the full width of the conveyor, with the minimum opening size 12" by 12. The slide gates shall be fabricated with Type 316L steel frame. Each gate blade and all wetted parts exposed to sludge shall be Type 316 or 316L stainless steel.

1. The conveyor manufacturer shall provide gates with electric motor actuator operators with internal limit switches to indicate open and closed status. Electric actuators provided with the gates shall be as manufactured by Auma, Limitorque, or Rotork.

J. **Hardware**. All nuts, bolts, and washers shall be Type 316 stainless steel.

K. **Spare Parts**. Provide as recommended by manufacturer.

PART 3- EXECUTION

3.1 GENERAL

A. **Site Verification of Conditions**. Verify that surfaces and site conditions are ready to receive work and the following conditions:

1. Concrete slab is ready for conveyors to be placed.
2. Conveyor locations are coordinated with the belt press and discharge chute.
3. Anchor bolts are of appropriate size and properly located in accordance with approved shop drawings and manufacturer's instructions.
4. Electrical conduit cast in concrete is properly sized and located.

B. **Responsibility**. Beginning the installation means the installer accepts the existing surfaces and conditions.

3.2 PREPARATION

A. **Protection**. Protect adjacent equipment, structure, and piping against damage from conveyor installation where required.

B. **Non-seizing Compound**. Prior to assembly, coat all stainless steel bolts and nut threads with a non-seizing compound.

C. **Manufacturer's Instructions**. Complete preparatory work in accordance with manufacturer's instructions prior to equipment installation.

3.3 INSTALLATION

A. **Requirements**. Fabrication and installation of the conveyors shall be as shown on the drawings, as specified herein, and in accordance with the approved shop drawings and the manufacturer's instructions and recommendations. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer's requirements.

B. **Interface with Other Items**. Complete all electrical power and control connections under Division 26.

C. **Protection of Supports.** Where stainless steel supports come into contact with galvanized steel or other dissimilar metals the surface shall be coated with bituminous paint.

3.4 FIELD QUALITY CONTROL

A. **Inspection**. Notify and coordinate with the equipment manufacturer in a timely manner in order for the manufacturer to conduct their required inspection, servicing, operation, testing, and instruction as required in this specification section.

B. **Site Test**

1. After the conveyor system has been installed, the manufacturer's representative shall conduct a field operating test in the presence of the Engineer/Architect, to verify that the systems operate as specified. The safety devices shall all be demonstrated to operate properly. In addition, the screw conveyors shall be tested under normal conditions of use by the Owner. Remedy all spilling, plugging, tracking, and other problems prior to acceptance.
2. Conduct a field-operating test in the presence of the Engineer/Architect, to verify that the system operates as specified under automatic control from the belt filter press panel. If any defects are found in the test, have the manufacturer's representative correct any defects on manufacturer supplied equipment at no cost to the Owner.
3. Furnish all materials required for the testing at no additional expense to the Owner.

C. **Manufacturer's Representative**. A qualified representative of the equipment manufacturer shall inspect the completed three-conveyor and three bin gate installation, service the equipment, operate the equipment under all design and sludge distribution conditions, and provide the Owner with a written certificate of approval. The representative shall spend at least 12 hours over two days onsite performing the required services.

D. **Defective Work**. If defects are detected, take corrective procedures.

3.5 ADJUSTING

A. **If the results of the field tests** do not show successful operation of the screw conveyor, repair, adjust, or modify the equipment in accordance with manufacturer's instructions, at no cost to the Owner until the tests are successfully completed.

3.6 PROTECTION

A. **Protect the screw conveyor** and associated equipment and materials after installation, but prior to acceptance by the Owner. Protection of the equipment shall include provisions during installation and testing of nearby piping, valving, or other adjacent equipment. Remove all protective means installed at completion and acceptance of the project.

3.7 INSTRUCTION OF OPERATING PERSONNEL

A. **Training of Owner's personnel** shall include all equipment specified in this section and all related electrical and instrumentation equipment. Two courses, each taking 4 hours each onsite, shall be provided.

3.8 EQUIPMENT SCHEDULE

Location	Dewatering Building
Total Number of Conveyors	3
Inclined Collection Conveyor	1
Disposal Conveyor 1	1
Disposal Conveyor 2	1
Collection Conveyor Angle of Inclination	Per drawings
Elevation Change	Per drawings
Length	Per drawings

END OF SECTION

Case No. 2020-00283
Exhibit A.6

NORTHERN KENTUCKY WATER DISTRICT

Project

Fort Thomas Treatment Plant Residuals Handling Improvements Campbell County, Kentucky

184-4008

Addendum No. 1, 2, & 3 dated 6/12/20, 6/23/20, and 6/29/20 respectively (A.6)

Northern Kentucky Water District
FTTP Residuals Handling Improvements

Addendum No. 1
June 12, 2020

A. **Scope.** Addendum No. 1 consists of Pages AD1-1 through AD1-5 and includes the following additions, clarifications, and changes to the specifications and drawings for this project. Attachments include 11 specification sections.

B. **Specifications**

1. **Section 00 01 10.10** – Table of Contents

   Replace this section in its entirety. The Table of Contents was updated to include the specification sections added by Addendum No. 1.

2. **Section 00 21 13** – Instructions to Bidders

   Replace the following sentence under item 6. INTERPRETATIONS AND ADDENDA "Questions received less than 72 hours prior to the date for opening Bids may not be answered." with the following sentence "Questions received after 2:00 PM on June 26, 2020 may not be answered." This is on page 3 of 7.

3. **Section 00 41 20** – Bid Equipment and Components

   Replace this section in its entirety. Replace specification page 00 41 20 – Page 1 of 1 dated 5/18/20 with specification page 00 41 20 – Page 1 of 1 dated 6/5/20 (attached to this Addendum). One of the listed manufacturers for dewatering polymer metering pumps (44 72 74) was changed from "a. Vector" to "a. Verder".

4. **Section 06 74 13** – Fiberglass Reinforced Products

   ADD this specification to the specifications for this project.

5. **Section 08 31 01** – Floor Doors

   ADD this specification to the specifications for this project.

6. **Section 09 90 00** – Painting

   ADD this specification to the specifications for this project.

7. **Section 40 05 13** – Process Piping, General

   ADD this specification to the specifications for this project.

8. **Section 40 05 13.53** – Process Piping, Ductile Iron

   ADD this specification to the specifications for this project.

9. **Section 40 05 14** – Process Piping, Accessories

   ADD this specification to the specifications for this project.

10. **Section 40 05 23** – Process Valves, General

    ADD this specification to the specifications for this project.

11. **Section 40 05 23.08** – Process Valves, Check

    ADD this specification to the specifications for this project.

12. **Section 40 05 23.22** – Process Valves, Plug

    ADD this specification to the specifications for this project.

13. **Section 40 70 00** – Instrumentation for Process Controls

    Add paragraph b. after 2.3.A.1.a as follows: "b. Or equivalent". This is on page 3 of 7.

    Add the following sentence to the end of paragraph 2.4.A.1. "Equivalent products will be accepted. It is the responsibility of the Contractor to confirm equality". This is on page 4 of 7.

14. **Section 44 72 70** – Belt Filter Press Dewatering System

    Add "Provide conditioning tanks fabricated from Type 316L stainless steel." before the first sentence of 2.5.C.4. that starts with "Locate each conditioning tank…". This is on page 11 of 28.

    Replace "2.5.C.4.b. Mixer impeller speed shall not exceed 400 rpm and impeller shall be positioned no less than two impeller diameters from the bottom of the tank." with "2.5.C.4.b. Mixer impeller speed shall not exceed 400 rpm, and impeller shall be positioned for optimal mixing within manufacturer's standard-size mixing tank." This is on page 11 of 28.

15. **Section 44 72 72** – Polymer Mixing System

    Delete "2.1.D. The use of polymer preparation systems that utilize eductors or gravity fall of polymer into water as the sole means of wetting will not be considered equal or acceptable." This is on page 4 of 11.

    Delete "2.3.E.2. No restrictive orifices (1-1/2 inches or less) shall be utilized in the wetting chamber." This is on page 5 of 11.

16. **Section 44 72 74** – Polymer Metering Pumps

Replace "1. Vector of Minneapolis MN." with "1. Verder of Macon GA." reference in Article 2.1.A. This is on page 3 of 6.

C. Drawings

1. **Sheet 15 & 17** – Waste Backwash Water Tank Lower Plan & Waste Backwash Water Tank Sections

Add Coded Note 15: "15. Provide hoist system mast sleeve davit base per specifications below: Stainless steel floor mount sleeve, with flush mount design for installation into an existing concrete slab, as recommended by manufacturer, DBI SALA floor mount sleeve davit base model number 8512827, or approved equal. All sleeve davit bases must be compatible with the Owner's existing DBI SALA advanced series hoist model number 8518040 mast system. All sleeve davit bases must allow for 360 degree mast rotation and be rated for a 450 pound working load. All safety devices must be able to withstand, without failure, a drop test consisting of a 500 pound weight dropping 18 inches. Core drill hole in existing concrete slab, grout in place, and secure with Type 316 stainless steel anchor bolts sized by the manufacturer. Install per manufacturer's recommendations. Install with a drain hole through the slab to permit drainage. Provide with a manufacturer provided cap or cover."

Add Coded Note 15 callout near the proposed 42" x 42" hatch near the center of the structure.

2. **Sheet E-3** – Control Circuits

Delete the analog signals to/from the VFD to the Pump Station PLC Panel in Control Circuit No. 1, Sludge Feed Pumps.

3. **Sheet E-12** – Electrical Schedules and Details

Replace "1 ¼"" referring to the feeder conduit size to DP-2 and LP-1 in Panel Schedule DP-1 with "1 ½"". In Panel Schedule DP-1 the feeder conduits to DP-2 and LP-1 are being changed from 1 ¼" o 1 ½".

4. **Sheet I-3** – Process And Instrumentation Diagram

Replace the individual discrete and analog signals between VFD-310 and Pump Station PLC Panel with Ethernet I/P connection.

D. Clarifications

1. **Grating.** All grating and associated structural supports at the polymer feed area shall be FRP. All other grating and associated structural supports on the project shall be aluminum.

2. **The address of the Ft. Thomas Treatment Plant** is 700 Alexandria Pike Ft. Thomas, KY 41075.

3. **Weight of Belt Filter Press Equipment.** The net weight of one of the proposed belt filter presses is approximately 18,000 lbs to 23,000 lbs. It is anticipated the weight of one of the existing belt filter presses is similar. Contractor shall verify weights with equipment manufacturers prior to attempting to move this equipment.

4. **Transfer Pump Ductile Iron Pipe Fittings.** Proposed 90-degree bends on the suction side of the proposed transfer pumps shall be long radius bends and proposed 90-degree bends on the suction side of the proposed transfer pumps shall be short radius bends.

5. **Temporary Dewatering.** There will be 120/208-Volt 3-Phase 100-Amp power available from the WTP facility to power temporary dewatering equipment when one of the existing belt filer presses is taken out of service for replacement. The Contractor may install a temporary 100-Amp feeder from the secondary of the transformer and set a breaker for this purpose. There is no 480-Volt power available at the site. Any temporary dewatering system shall require temporary piping to utilize the existing sludge feed pumps and to discharge filtrate either back to the backwash storage tank or to the gravity thickeners. The Owner shall provide up to 20 bags (55 lbs each) of dry polymer each month for use with the temporary dewatering system. Based on historical chemical usage, this should be an adequate polymer supply if dosed properly. Polymer required in excess of this amount shall be provided by the Contractor. Please note, this is dry polymer that is being provided, not liquid polymer There will be a minimum of 100 gpm at 80 psi of plant water available for use with the temporary dewatering system.

   Temporary dewatering equipment and dumpster storage can be placed anywhere on the site that does not interfere with ongoing construction work or Owner access for routine operation and maintenance. Generally, access to all equipment needs to be maintained throughout the project. Temporary dewatering equipment and dumpsters may be located outside of the building, provided they are covered to keep rain from rewetting the dewatered sludge. Temporary dewatering equipment may be located in the dumpster loading area provided this does not conflict with proposed construction work in the dumpster loading area.

   The access drive over to the project area can be temporarily blocked (for a few hours at a time), provided it is coordinated and approved in advance by the Owner, but in general shall remain open for the Owner and Contractor to be able to access the project area and existing facilities. The drive areas in front of the loading dock and dumpster bay areas can be blocked by temporary dewatering equipment for extended periods of time, provided the Owner can still access these areas if needed and it does not interfere with the Contractor's scheduled work and access. Coordinate temporary dewatering equipment location with the Owner and the Contractor. Contractor shall submit a plan showing proposed staging area and temporary dewatering plan for Owner approval prior to starting the work.

ACKNOWLEDGEMENT BY BIDDER. Each Bidder is required to acknowledge the receipt of this Addendum No. 1 in the space provided therefore in the Bid Form and to file same with and attached to the Bid.

NORTHERN KENTUCKY WATER DISTRICT

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SECTION 00 41 20

BID EQUIPMENT AND COMPONENTS

NORTHERN KENTUCKY WATER DISTRICT
FTTP RESIDUALS HANDLING IMPROVEMENTS

BIDDER shall indicate by placing an "X" in the "( )" space below for the equipment which shall be furnished in performance of the Work. Only one "X" shall be entered for a category of equipment or component identified by product name and specification number.

For the Dewatering Polymer System and Metering Pumps, BIDDER shall include base bid manufacturer indicated in lump sum bid indicated on the Bid Form. BIDDER may enter add / deduct to the Bid Form sum for alternative equipment, as noted in each category below. BIDDER must indicate whether the alternate is an add or deduct by circling the word which does apply and crossing out the word which does not apply. If no amount is entered, bidder agrees to perform Alternative at no change in cost. If neither add nor deduct is identified as stated herein, the bidder agrees to do the work described in the Alternative as a deduct. BIDDER shall follow these directions. Any Bid Form that is submitted not in compliance with these required identifications may be rejected by the OWNER and that Bid not considered in determining Award.

Equipment (Specification Section)	**Product Manufacturer or Supplier**
Sludge Transfer Pumps (33 32 16)	( ) a. Flygt ( ) b. KSB ( ) c. Ebara
Belt Filter Press Dewatering System (44 72 70)	( ) a. Andritz ( ) b. Komline-Sanderson ( ) c. Phoenix
Dewatering Polymer System (44 72 72)	Base Bid Manufacturer: Acrison Add / Deduct: ( ) a. ProMinent $_____ ( ) b. UGSI $_____ ( ) c. Velodyne $_____
Dewatering Polymer Metering Pumps (44 72 74)	Base Bid Manufacturer: Watson-Marlow Add / Deduct: ( ) a. Verder $_____ ( ) b. ProMinent $_____
Dewatered Sludge Screw Conveyor System (44 72 90)	( ) a. Custom Conveyor ( ) b. Jim Meyers and Sons ( ) c. JDV

End of Section

SECTION 06 74 13

FIBERGLASS REINFORCED PRODUCTS

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS.** Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK.** Provide all labor, materials, tools, and equipment necessary to furnish and install the fiberglass reinforced polymer (FRP) products in accordance with the drawings and as specified herein.

A. **Summary** – This section includes the following FRP products:

1. FRP Grating and Frames
2. FRP Structural Shapes
3. FRP Ladders

1.3 **QUALITY ASSURANCE.** Materials and workmanship shall be in conformance with the following standards as referenced herein:

A. **ASTM** - American Society for Testing and Materials.

B. The material covered by these specifications shall be furnished by a reputable and qualified manufacturer of proven ability who has regularly engaged in the manufacture and installation of FRP systems.

C. Fabricator Qualifications: Firm experienced in successfully producing FRP fabrications similar to that indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.

D. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 **DESIGN CRITERIA.**

A. The design of FRP products including connections shall be in accordance with governing building codes and standards as applicable.

B. Structural members shall be designed to support all applied loads. Deflection in any direction shall not be more than L/180 of span for structural members. Connections shall be designed to transfer the loads.

C. Resin Selection. Manufacturer shall select resin based on chemical resistance requirements of the area where the product will be installed. Lacking more detailed information on the plans, the following criteria shall be used for water and wastewater treatment, pumping, and related facilities:

1. All products shall be considered to be exposed to atmosphere UV radiation normal for the project site.
2. Chemical storage and feed areas: All products shall utilize a resin compatible with the chemical being handled. Air should be assumed to be saturated.

1.5 **SUBMITTALS.** Submit the following packages in accordance with Division 1.

A. **Submittal Package No. 1 – Product Data and Shop Drawings**.

1. Product Data. Manufacturer's data on fiberglass grating and ladders.
   a. Dimensions, spacings, and construction of grating
   b. Design tables showing limits for span length and deflection under various uniform and concentrated loads
   c. Materials of construction including glass content, glass type, resin type, resin additives for flame retarded and UV protection, gel coats.
   d. Samples of standard and custom colors available.

2. Shop Drawings. Shop drawings showing each fiberglass grating, fiberglass reinforced plastic curb angles, and fiberglass ladder.
   a. Dimensions
   b. Sectional assembly
   c. Location and identification mark
   d. Size and type of supporting frames and columns required
   e. Fasteners and anchors.

B. **Submittal Package No. 2 – Samples.** Supply samples in accordance with Section 01 33 00. Submit for review one sample of the following:

1. Samples of each type of product proposed shall be submitted for approval prior to placement of purchase orders.

1.6 **JOB CONDITIONS**

A. Coordination with Other Work. The Contractor shall coordinate all work to prevent interferences, delays, errors, and/or omissions.

B. Dimensions. The Contractor shall field verify all dimensions, locations, and elevations of anchors, bolts, plates, openings, and other miscellaneous metal items and be responsible for their proper fit.

1.7 **DELIVERY, STORAGE, AND HANDLING.** Deliver, store, and handle the FRP gratings, structural shapes, and ladders in accordance with Section 01 60 00 and the manufacturer’s instructions.

1.8 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials used in the manufacture of the FRP products shall be new stock of the best quality and shall be free from all defects and imperfections that might affect the performance of the finished product.

B. All materials shall be of the kind and quality specified, and where the quality is not specified, it shall be the best of the respective kinds and suitable for the purpose intended.

C. All FRP products with a constant cross section shall be manufactured using a pultruded process utilizing either an isophthalic polyester or a vinyl ester resin with flame retardant and ultra-violet (UV) inhibitor additives. A synthetic surface veil shall be the outermost layer covering the exterior surface. The FRP shapes shall achieve a flame spread of 25 or less in accordance with ASTM test method E-84.

D. After fabrication, all cut ends, holes and abrasions of FRP shapes shall be sealed with a compatible resin coating to prevent intrusion of moisture.

E. FRP products exposed to weather shall contain an ultraviolet inhibitor. Should additional ultraviolet protection be required, a one mil minimum U.V. coating can be applied.

F. All exposed surfaces shall be smooth and true to form.

G. Manufacturers:

1. Strongwell.
2. Or approved equal.

2.2 GRATINGS AND TREADS

A. General

1. Grating shall be shipped from the manufacturer, palletized and banded with exposed edges protected by cardboard to prevent damage in shipment.
2. Each piece shall be clearly marked showing manufacturer's applicable drawing number.
3. Grating shall be DURADEK® or DURAGRID® as manufactured by Strongwell-Chatfield Division, Chatfield, MN, or approved equal.

B. Design

1. The panels shall be 2 inches deep and sustain a deflection of no more than .25 inches under a uniform distributed load of 100 psf for the span lengths shown on the plans.
2. The bearing bars shall be joined into panels by passing continuous length fiberglass pultruded cross rods through the web of each bearing bars. The pultruded cross rod assembly shall consist of two cross rod spacers that have notches cut into them at 12 inches on center to fit the distance between the web of each bearing bar. A continuous fiberglass pultruded bar shaped section shall be wedged between the two cross rod spacers mechanically locking the notches in the cross rod spacers to the web of the bearing bars. Continuous chemical bonding shall be achieved between the cross rod spacers and the bearing web and between the bar shaped wedge and the two cross rod spacers locking the entire panel together to give a panel that resists twist and prevents internal movement of the bearing bars.
3. The top surface of all panels shall have a non-skid grit affixed to the surface by an epoxy resin followed by a top coat of epoxy resin.
4. Panels shall be fabricated to the sizes shown on the drawings.
5. Fiberglass-Reinforced Plastic Curb Angle.
   a) Fabricate fiberglass curb angles in accordance with the configuration shown.
   b) The fiberglass curb angles shall be made of the same material as the fiberglass grating.
   c) All sides of all openings to receive fiberglass grating shall receive the fiberglass curb angles, if new concrete is being placed. Where fiberglass grating is butting up to existing concrete surfaces, install FRP structural shapes below the grating to provide proper support to the fiberglass grating.
6. Hold down clamps shall be type 316L stainless steel insert hold downs as provided by Strongwell-Chatfield Division, or approved equal. A minimum of 4 each per panel.
7. Color shall be high visibility yellow.
8. Spans shown on the drawings may exceed that for which the product can meet loading and deflection criteria without intermediate supports. In this case, the necessary FRP structural members necessary to support the grating is considered part of the grating system scope of supply. Load calculations shall be included in shop drawings.

C. Products

1. The FRP grating shall be fabricated from bearing bars and cross rod manufactured by the pultrusion process. The glass fiber reinforcement for the bearing bars shall be a core of continuous glass strand rovings wrapped with continuous strand glass mat. A synthetic surface veil shall be the outermost layer covering the exterior surfaces.

2. Fiberglass Grating
   a) Fiberglass grating shall be made from a premium grade chemical resistant, fire retardant vinyl ester resin system with antimony trioxide added to meet the flame rating of 25 or less in accordance with ASTM E-84 testing and meet the self-extinguishing requirements of ASTM D-635. U. V. inhibitors are added to the resin.
3. Grating with SAFPLATE™
   a) Grating shall be the same as described above in this section.
   b) SAFPLATE™ shall be EXTREN® as manufactured by Strongwell-Bristol Division, Bristol, VA
   c) SAFPLATE™ shall be manufactured using a premium grade polyester or vinyl ester resin with fire retardant additive to meet Class I flame rating of 25 or less as tested by ASTM E-84 and meet the self extinguishing requirements of ASTM D-635. All plate shall contain a U. V. inhibitor.
   d) SAFPLATE™ shall be epoxy bonded to the grating, and a non-skid grit shall be affixed to the top surface of the assembly by epoxy resin, followed by a top coat of epoxy resin.
4. All cut and machined edges, holes and abrasions shall be sealed with a resin compatible with the resin matrix used in the bearing bars and cross rods.
5. All panels shall be fabricated to the sizes shown on the approved shop drawing.

2.3 STRUCTURAL SHAPES AND PLATE

A. Material

1. Structural shapes and plate shall be made from a premium grade polyester or vinyl ester resin with fire retardant additives to meet Class 1 flame rating of ASTM E-84 and meet the self-extinguishing requirements of ASTM D-635. All structural shapes shall contain a U.V. inhibitor.

B. Process

1. Manufactured by the pultrusion process.
2. Structural FRP members composition shall consist of a glass fiber reinforced polyester or vinyl ester resin matrix, approximately 50% resin to glass ratio. A synthetic surface veil shall be the outermost layer covering the exterior surfaces. Glass strand rovings shall be used internally for longitudinal strength. Continuous strand glass mats shall be used internally for transverse strength.

2.4 FIBERGLASS REINFORCED PLASTIC (FRP) LADDERS

A. Performance Requirements

1. Ladders shall meet the requirements set forth in OSHA 1910.27. The ladders shall also be capable of supporting a concentrated vertical load of 1200 pounds applied at the mid-span of the rung.

B. Materials

1. The side rails shall be fiberglass reinforced pultruded (isophthalic polyester) or (vinyl ester) with OSHA safety yellow pigment. An industrial grade polyurethane yellow coating shall be applied to the finished ladder.
2. The side rails shall be 2" square tube with a wall thickness of 0.156" or greater. The rungs shall be 1" diameter rod with a pigmented epoxy, non-skid grit surface.
3. Fiberglass pultruded rails and solid rod to be manufactured by Strongwell, or approved equal.

C. Fabrication Requirements

1. All joints and rungs shall be epoxied and riveted. Supports for wall or column mounting shall be attached to the rails in a manner which provides hand clearance throughout the length of the ladder.
2. Ladders shall be shop assembled or may be pre-drilled and prepared for field attachments of standoff clips.

D. Workmanship

1. All cut or machined edges, holes and abrasions shall be sealed with a resin compatible with the resin matrix used in the structural shape.

E. Approved Fabricators

1. Strongwell
   a) Chatfield Division (Chatfield, MN)
   b) Bristol Division (Bristol, VA)
2. Or approved equal.

F. Installation

1. All FRP ladder sections shall be installed as shown on the approved shop drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. **Site Verification of Conditions**. Field-measure locations before fabrication.

B. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

C. Set sleeves in concrete with tops flush with finish surface elevations; protect sleeves from water and concrete entry.

3.2 INSPECTION AND TESTING

A. The Engineer shall have the right to inspect and test all materials to be furnished under these specifications prior to their shipment from the point of manufacture.

B. All labor, power, materials, equipment and appurtenances required for testing shall be furnished by the Contractor at no cost to the Owner.

3.3 INSTALLATION, GENERAL

A. **Fastening to in-place construction:** Provide anchorage devices and fasteners where necessary for securing miscellaneous FRP fabrications to in-place construction; include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts and other connectors as required.

B. **Cutting, fitting and placement:** Perform cutting, drilling and fitting required for installation of miscellaneous FRP fabrications. Set FRP fabrication 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. **Provide temporary bracing** or anchors in form work for items that are to be built into concrete masonry or similar construction.

D. **Fiberglass Curb Angles**. Pour in place the fiberglass curb angles into the concrete so they are true, square, and level in all directions.

3.4 ALL FRP INSTALLATION

A. All field cut and drilled edges, holes and abrasions shall be sealed with a catalyzed resin compatible with the original resin as recommended by the manufacturer. The sealing of the edges shall prevent premature fraying at the field cut edges.

B. Install items specified as indicated and in accordance with manufacturer's instructions.

END OF SECTION

SECTION 08 31 01

FLOOR DOORS

PART 1 – GENERAL

1.1 **RELATED DOCUMENTS.** Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK.** Provide the labor, tools, equipment, and materials necessary to furnish and install floor doors in accordance with the plans and the specifications.

1.3 **QUALITY ASSURANCE**

A. **Single-Source Responsibility**. Obtain floor doors for entire project from a single manufacturer.

B. **Size Variations**. Obtain Engineer/Architect's acceptance of manufacturer's standard size units, which may vary slightly from sizes indicated.

C. **Coordination**. Furnish inserts and anchoring devices that must be built into other work for installation of floor doors. Coordinate delivery with other work to avoid delay.

1.4 **SUBMITTALS.** Submit the following packages in accordance with Division 1.

A. **Submittal Package No. 1 – Product Data**

1. Manufacturer’s product data, test reports, and material certifications as required.
2. Product data in form of manufacturer's technical data and installation instructions for each type of floor door assembly, including setting drawings, templates, instructions, and directions for installation of anchorage, devices.
3. Complete schedule, including types, general locations, sizes, floor construction details, finishes, latching or locking provisions, and other data pertinent to installation.

1.5 **JOB CONDITIONS.** Obtain specific locations and sizes for required floor doors from trades requiring floor to concealed equipment, and indicate on submittal schedule.

1.6 **DELIVERY, STORAGE, AND HANDLING** (Not used)

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 – PRODUCTS

2.1 **MANUFACTURERS.** Subject with compliance with these specifications, floor doors shall be manufactured by:

A. Bilco.

B. Halliday.

C. U.S.F.

D. Or equal.

2.2 **MATERIALS AND FABRICATION**

A. **All Floor Doors**.

1. Furnish each assembly manufactured as an integral unit, complete with all parts, and ready for installation.

2. Locks.

   a. Where shown or scheduled, provide one cylinder lock per door.
   b. Furnish two keys per lock.
   c. Key all locks alike unless otherwise noted.

3. Where shown or scheduled, provide secondary safety grating or netting under the floor door rated for 300 psf live loads.

4. Where shown or scheduled, provide a gastight floor door.

5. Factory finish shall be mill finish. Bituminous coating shall be applied by the manufacturer to the exterior of the frame and all aluminum in contact with concrete or mortar.

6. Leaf shall be 1/4-inch aluminum diamond plate reinforced with aluminum stiffeners as required to prevent distortion of the leaf when in any position.

7. Able to withstand a live load of 300 pounds per square foot (lbs/sf).

8. Arrangement shall be either single leaf or double leaf hinged as shown.

9. Open to 90 degrees and lock automatically in that position.

10. Frames shall be 1/4-inch extruded aluminum.

B. **Interior Floor Doors**

1. Provide frames with strap anchors bolted to the exterior.

2. Cast steel hinges shall be bolted to the underside and pivot on torsion bars that counterbalance the door for easy operation.
3. Provide a vinyl grip handle to release the hold-open arm and close the cover with one hand. Handle shall be permanently attached, and when not in use, the handle shall set flush with the surface.

C. **Exterior Doors**

1. Provide channel frames with an anchor flange around the perimeter.
2. Equip doors with heavy forged brass hinges, stainless steel pins, spring operators for easy operation.
3. Provide a vinyl grip handle to release the hold open arm and close the cover with one hand.
4. Provide a snap lock with removable handle.
5. Provide a 1-1/2-inch drainage coupling in the door frame.
6. Pipe drainage to outlet with 1-1/2-inch polyvinyl chloride (PVC) pipe to drain.
7. Hardware shall be stainless steel.

PART 3 – EXECUTION

3.1 INSTALLATION

A. **Comply with manufacturer's instructions** for installation of floor doors.

B. **Doors shall be modified** by the manufacturer as required when necessary to suit the installation shown.

C. **Coordinate installation** with work of other trades.

D. **Set frames accurately in position** and securely attach to supports with face plate flush and level in relation to adjacent finish surfaces.

E. **Install doors** to open in the direction shown.

F. **Touch up the bituminous coating** if damaged.

3.2 ATTACHMENTS

A. Floor Door Schedule. The Floor Door Schedule is for the convenience, and the omission of a floor door does not release the responsibility to furnish and install all the doors shown on the drawings.

Structure	Size	Quantity	Interior/ Exterior	Gastight	Keyed Lock	Second. Safety
Backwash Storage Tank	42” x 42”	2	Exterior	No	No	Yes

END OF SECTION

SECTION 09 90 00

PAINTING

PART 1 - GENERAL

1.1 **RELATED DOCUMENT.** Drawings and general provisions of Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**

A. **Scope of Work**. This section includes surface preparation, painting, and finishing of exposed interior and exterior surfaces. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.

B. **Definitions**. "Paint" includes coating systems materials, primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate, or finish coats.

1.3 **QUALITY ASSURANCE**

A. **Standards**. Ensure that material and workmanship are in accordance with the following standards as referenced herein:

1. SSPC – The Society for Protective Coatings.
2. Corps of Engineers.
3. NSF – NSF International.
4. ICRI – International Concrete Repair Institute.
5. ASTM – American Society for Testing and Materials.
6. NACE – National Association of Corrosion Engineering.
7. NAPF – National Association of Pipe Fabricators, Inc.

B. **Single Source Responsibility**. Provide primers, coats, and finish coats from the same manufacturer.

C. **Compatibility of Work**

1. Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates.
2. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
3. Notify the Engineer/Architect of problems anticipated using the materials specified.

1.4 **SUBMITTALS.** Submit all submittals in accordance with the Division 1 Submittal Requirements and this specification section.

A. **Submittal Package No. 1 – Product Data**

1. Package Contents.

a. Manufacturer's technical information, label analysis, and application instructions for each material proposed for use.
b. List each material and cross-reference the specific coating, finish system, and application.
c. Identify each material by the manufacturer's catalog number and general classification.

B. **Submittal Package No. 2 – Color Charts**

1. Package Contents. Manufacturer's color charts.

1.5 **JOB CONDITIONS**

A. **Environmental Conditions**

1. Climatic.

a. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 40 degrees Fahrenheit (° F.) and 90° F.

b. Apply solvent thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45° F. and 95° F.

c. Do not apply paint:

1) In precipitation or fog of any kind.
2) When the relative humidity exceeds 85 percent.
3) At surface temperatures less than 5° F. above the dew point.
4) To damp or wet surfaces.

d. When approved, continue painting during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

2. Ventilation. Be responsible for maintaining adequate ventilation, temperature, and humidity control in all areas where paint is being applied, drying, or curing. "Adequate" ventilation, temperature, and humidity levels are considered to be those required by regulatory agencies and guidelines, the paint manufacturer's product application data, the requirements of this section, and the Owner's Representative.

B. **Warning Signs.** Provide and display prominent warning signs indicating "WARNING - PAINTING AND ABRASIVE BLASTING WORK UNDERWAY" throughout the job site wherever surface preparation or painting operations are being performed. These signs shall be no less than 3' x 3' in size, and placed at clearly visible locations near all points of access by person or vehicle to the work area(s).

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **Delivery**. Deliver materials to the job site in the manufacturer's original, unopened containers bearing a label from the manufacturer that includes the following:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Federal Specification number, if applicable.
4. Manufacturer's stock number and date of manufacture.
5. Contents by volume, for pigment and vehicle constituents.
6. Thinning and application instructions.
7. Color name and number.
8. Manufacturer's name.

B. **Storage**

1. Store materials not in use in tightly covered containers in a well ventilated area at a minimum ambient temperature of 45° F.
2. Keep storage area in a clean condition, free of foreign materials and residue.
3. Store clean rags in a metal container with a tight-fitting cover.
4. Remove oily rags and waste daily.

C. **Handling**. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 **MANUFACTURERS**. Use products of the manufacturers listed in the painting schedule. No “Or Equals” will be considered for this project. Submit any potential substitutes according to Section 00 70 00, "General Conditions."

2.2 **PIPE BANDING TAPE, LABELING, AND DIRECTIONAL ARROWS**

A. **Minimum 2 inches wide**, self-sticking.

B. **Meets ASTM** B 946.

C. **5-mil minimum** thickness.

D. **Label text heights** shall be sized as follows:

Under 3/4"	Arrows only
3/4" to 1-1/4"	1/2"
1-1/2" to 2"	3/4"
2-1/2" to 6"	1-1/4"
8" to 10"	2-1/2"
10" and over	3-1/2"

E. **Subject to compliance with the specifications**, provide the pipe banding from one of the following approved manufacturers.

1. W. H. Brady Company.
2. Seton Identification Products.
3. Or equal.

2.3 **THINNERS**. Use only the recommended products of the manufacturer furnishing the paint.

2.4 **COLORS**. All colors not specified will be selected by the Owner. Where multiple coats are specified, shade-tint each coat of paint for visual inspection of the number of coats applied.

2.5 **POTABLE WATER CONTACT**. Coatings in contact with potable water shall meet NSF Standard 61 and shall be listed by NSF.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Compliance**

1. Examine substrates and conditions for compliance with paint application requirements.
2. Correct unsatisfactory conditions before painting.
3. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.
4. If any surface to be finished cannot be put in proper condition, notify the Engineer/Architect immediately in writing or assume full responsibility for failure to do so and correct any unsatisfactory work.

3.2 PREPARATION

A. **General Procedures**

1. Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in place that are not to be painted, or protect them before surface preparation and painting.
2. Remove these items if necessary for complete painting of the items and adjacent surfaces.

3. Following completion of painting operations in each space or area, reinstall items by workers skilled in the trades involved.
4. All surfaces must be clean, dry, and free of oil, grease, chalk, and other containments.
5. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet paint.

B. **Surface Preparation**. Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.

2. Cementitious Materials. Prepare concrete, concrete masonry block, cement plaster, and mineral fiber reinforced cement panel surfaces to be painted.

a. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents.

b. Roughen as required to remove glaze.

c. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

d. Use abrasive blast cleaning methods according to SSPC-SP13/NACE 6, ICRI CSP 2-3 to prepare concrete unless an alternate method is approved.

e. Prepare all concrete surfaces per ICRI CSP 3-5 minimum with all bugholes opened and filled with an epoxy surfacer (Paint Code F in the Schedule).

f. Determine alkalinity and moisture content of surfaces by performing appropriate tests.

1) If surfaces are sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application.
2) Do not paint surfaces where moisture content exceeds the manufacturer's recommendations.

3. Wood.

a. Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required.
b. Sand surfaces smooth which are exposed to view and remove dust when finished.

c. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer before application of primer.
d. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.

4. Ferrous Metals. Clean nongalvanized ferrous metal surfaces; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC-SP1/SP2/SP3.

a. Blast steel surfaces that will be submerged in accordance with requirements of SSPC Specification SSPC-SP 10, near white blast cleaning. Maintain a minimum 2-mil profile.
b. Abrasive-blast-clean nonsubmerged steel per SSPC-SP 6, Commercial Blast Cleaning creating a minimum 1.5-mil profile.
c. Brush off blast cleaned (SSPC-SP 7, Brush-Off Blast Cleaning) epoxy shop-primed surfaces that will be submerged and have not been painted for 60 days or longer before application of the intermediate and finish coats.
d. Blast ductile iron surfaces in accordance with requirements of NAPF 500 Abrasive Blast Cleaning.
e. Touch up bare areas and prime coats that have been damaged. Surface preparation shall be the same as the original surface preparation. Touch up with the same primer as the shop coat.
f. Prime all surfaces blast-cleaned on the same day or before rusting or soiling occurs.

5. Plastic. Clean surface and sand uniformly to resemble 80-100 grit sandpaper.

6. Existing Epoxy Finishes. Thoroughly and uniformly sand or otherwise abrade prior to recoating.

C. **Materials Preparation**. Carefully mix and prepare paint materials in accordance with manufacturer's directions.

1. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density; stir as required during application.
3. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
4. Use only thinners approved by the paint manufacturer, and only within recommended limits.

3.3 APPLICATION

A. Requirements

1. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

    a. Paint colors, surface treatments, and finishes are indicated in Part 4 of this section.
    b. Provide finish coats that are compatible with primers used.
    c. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
    d. Grind all 90-degree angles of carbon steel and apply a stripe coat of the specified primer.

B. Special Techniques/Requirements

1. Do not permit spraying unless approved in writing.
2. Ensure that the application, drying time between coats, and mixing are in accordance with the recommendations of the manufacturer.
3. Protect all areas from damage by equipment, materials, spatterings, drippings, and overspray. Take particular care to prevent staining of concrete. Immediately remove all spattering, dripping, and overspray. Paint or repaint any area discolored or stained as directed.
4. Prior to installation, finish-paint all surfaces inaccessible after installation.

3.4 MARKING

A. **Color Coding**. Paint and mark according to function all exposed piping as specified in Part 4 of this section.

B. **Banding**. Band all exposed piping as specified in Part 4 of this section. Space banding as directed, but not greater than 10 feet apart with a minimum of one group of bands between fittings.

C. **Flow Arrows**. Provide arrows indicating flow direction on all exposed piping.

D. **Labeling**. Label all exposed piping with the function of the pipe. Apply labeling on any single run of pipe before any tees or elbows, but not greater than 20 feet on center.

3.5 **FIELD QUALITY CONTROL**

A. **The Owner reserves the right** to invoke the following test procedure at any time and as often as desired during the period when paint is being applied.

1. The Owner will engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the project will be taken, identified, sealed, and certified in the presence of the Contractor.

2. If test results show material being used does not comply with the published manufacturer's specifications for that paint system:

a. Stop painting.
b. Remove noncomplying paint.
c. Pay for testing.
d. Repaint surfaces coated with rejected paint.
e. Remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are incompatible.

B. **The Owner reserves the right** to check the minimum dry mil thickness per coat (MDMTPC) at any time following application. Repaint areas not meeting minimum requirements.

C. **Provide a 10' x 10' mock-up** of each specified system, including surface preparation and finish color. The mock-up may remain as part of the completed project. Proceed with the rest of the paint application when authorized to proceed in writing.

3.6 **PROTECTION**

A. **Cover**. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage in an acceptable manner by cleaning, repairing or replacing, and repainting.

B. **Signs**

1. Provide "wet paint" signs to protect newly painted finishes.
2. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.
3. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
4. Remove all "Wet Paint" signs and other warning signs utilized during installation and curing.

3.7 **DEMONSTRATION.** The Contractor, Owner, and Engineer/Architect will visually review the painting for completion, colors, finish, and uniformity before acceptance by Owner.

PART 4 - SCHEDULE

4.1 GENERAL

A. **Dry Film Thickness Per Coat**. DFT is the acronym for this term in the following schedules. Do not exceed the manufacturer's recommended maximum dry film thickness per coat.

B. **New Work**. Paint all new surfaces according to paragraph 4.2.

C. **Existing Areas**

1. Compatibility Test. Before painting, patch test all areas for compatibility of new paint with existing and notify the Engineer/Architect of any incompatibility.

2. Adhesion Test. Before painting, perform the tests per ASTM D 3359, Methods A and/or B, followed by a report detailing the system tested, their results, and any recommended changes to the specified system.

3. Disturbed Areas.

   a. Paint all surfaces of existing areas disturbed due to tie-ins, closing of openings, cutting new openings, rerouting of pipe, relocating or removal of equipment, and other related work as specified herein.
   b. Color match existing surface and paint to lap existing by not less than 3 inches.

4. Undisturbed Areas. Paint the following undisturbed surfaces in their entirety.

   a. Paint undisturbed areas per the requirements of the plan sheets.

D. **Coding and Banding**. When exposed, color code and band the following piping, fittings, and valves with the specified colors:

Material	Tnemec	PPG	Carboline	Sherwin Williams	International
Water					
Raw	Spring Water	Fiberoptics	Blue Ice	Current	Seafoam Breeze
Settled	Aqua Sky	Water Garden	Skyward	Alloy Aqua	Cascading Water
Filtered	Delft Blue	Cavern Ice	Open Sky	Spillway	Car Blue
Softened	Clear Sky	Cooling Tower	Atomic Blue	Robotic Blue	Light Blue
Finished or Potable	Safety Blue	Safety Blue	Safety Blue	Safety Blue	Safety Blue
Backwash Supply	Purple Haze	Cyprus Blue	National Blue	Blueprint	National Blue
Nonpotable	Safety Purple	Safety Purple	Safety Purple	Plumb	Safety Purple
Wastewater					
Raw	Deep Space	Dark Gray	Machine Gray	Anchor Gray	Machine Gray
Primary	Gray	Light Gray	Gull Gray	Slate Gray	Haze Gray
Secondary	Light Gray	ASA No. 70	Light Gray	ANSI 70 Gray	Light Gray
Filtered	Slate Gray	Mountain Mist	Sterling Gray	Zephyr	Mist Gray
Effluent	White	Porcelain White	Safety White	Ultra White	White on White
Backwash Waste/ Supernatant	Aluminum	Conveyor Gray	Granite Gray	Nickel	Swordplay
Filter to Waste/Drain	Black	Black Gold	Black	Black	Black
Sludge					
Primary	Clay	Weathered Marble	Basket Weave	Lodestone	Water Chestnut
WAS	Muley	Desert Brown	Blush	Firedust	Clay Pot
RAS	Amber Canyon	Beechnut	Alpaca	Pallet Tan	Tuscan Tan
Digested	Tiki Wood	Tantone	Dunes Tan	Cantilever	Sand Motif
Thickened	Weathered Bark	Telegraph	Falcon Brown	Walnut Brown Tan	Warm Brown
Flammable/Explosive					
Natural and Propane Gas	Safety Red	Safety Red	Safety Red	Safety Red	Safety Red
Liquid Fuel Oil/Diesel	Chilean Red	Caution Red	Tile Red	Deck Red	Oxide Red
Methane/Digester Gas	Safety Orange	Safety Orange	Safety Orange	Safety Orange	Safety Orange
Odor Control Foul Air	International Orange	Caution Orange	Copper Smith	International Orange	Kessy's Bark
Air					
Low Pressure (≤ 90 psi)	Hunter Green	Caution Green	Vernal Green	Rain Forest	Medium Green
High Pressure (> 90 psi)	Safety Green	Safety Green	Safety Green	Safety Green	Safety Green

Material	All Manufacturers
Storm	Match ceilings and walls.
Electrical Conduit	Match ceilings and walls.
Chemicals	
Chlorine/Sodium Hypochlorite	Safety Yellow with no bands
Oxidants (Ozone, Permanganates, Ammonia)	Safety Yellow with purple bands
Phosphates	Safety Yellow with brown bands
Coagulants (Alum, Ferric Chloride, Polymers)	Safety Yellow with orange bands
Carbon Slurry	Safety Yellow with black bands
Bases (Lime Slurry, Caustic, Soda Ash)	Safety Yellow with green bands
Fluoride	Safety Yellow with blue bands.
Acids (Sulfuric, etc.)	Safety Yellow with red bands
Sodium Bisulfite	Safety Yellow with white bands
Brine	Safety Yellow with gray bands

4.2 **PAINT SCHEDULE**

Surface Substrate	Surface Location	Immersed or Below Grade	Exterior Only	Interior Only	Exterior / Interior	Required Coats	DFT	Paint Codes
Concrete Block or Masonry • Paint Interior of all new Exposed Concrete Block • Paint all other Masonry Where Noted in the Plans or Specifications	Walls			X		1 Primer/Block Filler 1 Intermediate 1 Finish	12 4 4	A B B
	Walls		X			1 Primer/Block Filler 1 Intermediate 1 Finish	12 6 6	A M M
Precast Concrete and Cast-in-Place Concrete • Paint the interior of all exposed precast concrete ceilings. • Paint all other Concrete Where Noted in the Plans or Specifications.	Walls and Ceilings			X		1 Primer/ Surfacer 1 Finish	12 4	F B
	Walls and Ceilings		X			1 Primer/ Surfacer 1 Intermediate 1 Finish	12 6 6	F M M
	Walls, Ceilings, and Floors, In Contact with Potable Water	X			X	1 Primer/Surfacer 1 Intermediate 1 Finish	12 4 4	F C C
	Walls, Ceilings, and Floors, In Contact with Nonpotable Water or Sewage	X			X	1 Primer/Surfacer 1 Intermediate 1 Finish	12 10 10	F D D
	Walls and Floors, Chemical Resistant				X	1 Primer/ Surfacer 1 Intermediate 1 Finish	12 9 9	F H H
	Floors			X		1 Primer/ Surfacer 1 Intermediate 1 Finish	12 9 9	F E E

For paint codes see paragraph 4.3 at the end of this Section.

Surface Substrate	Surface Location	Immersed or Below Grade	Exterior Only	Interior Only	Exterior / Interior	Required Coats	DFT	Paint Codes
Ferrous Metal Products • Paint all Ferrous Metal Products including Piping, Valves, Fittings, Equipment, and Miscellaneous Metals Installed during Project. • Paint existing Ferrous Metal Products Where Noted in the Plans or Specifications. • Metal Siding, Fascia, and Coping shall be prefinished by the manufacturer. • Paint all exposed galvanized conduit and pipe in painted finished areas. • Paint all damaged and disturbed areas of any galvanized products such as threading or field–welds. • Do not paint stainless steel, aluminum, galvanized steel or similar corrosion resistant materials unless noted otherwise in the drawings or the specifications.	Submerged, In Contact with Potable Water	X			X	1 Shop/Primer 1 Touch Up 1 Intermediate 1 Finish	4 4 4 4	C C C C
	Submerged, In Contact with Nonpotable Water or Sewage	X			X	1 Shop/Primer 1 Finish	10 10	D D
	High Temperature(<450 °F)				X	1 Shop/Primer 1 Intermediate 1 Finish	1.6 1 1	J K K
	Galvanized Product Touch-ups				X	1 Primer 1 Finish	2 2	P P
	Exterior		X			1 Shop/Primer 1 Touch Up 1 Intermediate 1 Finish	4 4 4 4	B B B G
	Interior			X		1 Shop/Primer 1 Touch Up 1 Intermediate 1 Finish	4 4 4 4	B B B B

For paint code details, see paragraph 4.3 at the end of this Section.

Surface Substrate	Surface Location	Immersed or Below Grade	Exterior Only	Interior Only	Exterior / Interior	Required Coats	DFT	Paint Codes
Plastic Products • Paint all exposed interior Plastic Pipe, Fittings, and Valves installed in this project or where noted in the plans or specifications.			X			1 Primer 1 Intermediate 1 Finish	4 4 4	B B G
				X		1 Primer 1 Finish	2 3	B B
Wood Products • Paint all exposed Wood installed in this project or where noted in the plans and specifications except for Prefinished, Redwood, or Pressure-Treated Products.					X	1 Primer 1 Intermediate 1 Finish	2 2 2	N O O
Foam Piping Insulation • Paint all Foam Piping Insulation Where Noted in the Plans or Specifications.					X	1 Primer 1 Finish	2 4	N O
Drywall and Plaster • Paint all exposed Drywall and Plaster installed in this project or where noted in the plans or specifications.				X		1 Primer 1 Intermediate 1 Finish	2 4 4	N O O
Pipe Coverings and Pipe Drains	Match walls and ceilings							

For paint code details, see paragraph 4.3 at the end of this Section.

4.3 **MANUFACTURERS AND PAINT CODES**

Generic Name	Code	Tnemec	PPG	Carboline	International	Sherwin Williams
Cementitious Acrylic or Polyamide Epoxy Block Filler	A	Series 130-6602 Envirofill	Aquapon 97-685 Series	Sanitile 600	Tru-Glaze WB 4015	Cement Plex 875
Polyamide Epoxy	B	Series N69-H.B. Epoxoline II	Aquapon HB 97-130	Carboguard 893 SG	Devran 224V	Macropoxy 646
Polyamide Epoxy NSF 61 Approved	C	Series N140 Pota-Pox Plus	Aquapon 95-132	Carboguard 61	Bar-Rust 233H	Macropoxy 646 PW
Coal Tar Epoxy/Ultra High Build Epoxy	D	Series 46H-413 Black HB Tneme-Tar	Coal Cat 97-650	Bitumastic 300M	Devtar 5A	Hi-Mil Sher Tar
Self-Leveling/ Polyamide Epoxy, Polyamine	E	Series 281 Tneme-Glaze	Megaseal SL 99-6680	Sanitile 945	Ceilcote 683 Flooring	Cor-Cote HP
Filler and Surfacer	F	Series 218 MortarClad	Megaseal CF 99-6672 or -6675	Sanitile 600 TG	Devfil 145 or Devran 133 w/ Cabosil or Devmat 142 HB or Ceilcote 680M	Steel Seam FT 910
Polyurethane	G	Series 1074 H.B. Endura-Shield II	Pitthane Ultra 95-812	Carbothane 134 HG	Devthane 379 H	Acrolon 218HS
Novolac Epoxy	H	Series 282 Tneme-Glaze	Megaseal SC/HSN	Semstone 145	Devran 124	Cor-Cote HCR
High Temperature Primer	J	Series 90E-92 Tneme-Zinc	Silicone-Acrylic Red	Carbozinc 11	Interzinc 22/HS	Zinc Clad II
High Temperature Silicone (Resists at least 450 °F)	K		Speedhide 6-230	Thermaline 4900 R	Intertherm 50 Aluminum	Kem Hi-Temp Heat-Flex 450
Elastomeric Acrylic	M	Series 156/157 Envirocrete	Permacrete 4-110	Flexxide Elastomer		Loxon XP
Acrylic Primer	N	Series 10-99W	Seal Grip 17-921	Carbocrylic 120	Intercryl 520	Multi-Purpose Latex Primer
Acrylic	O	Series 6 Tneme-Cryl	Pitt Tech 90-474	Carbocrylic 3359	Intercryl 520 or 530	DTM Acrylic
Cold Galvanizing Compound	P	Minimum 95% Zinc. Approved Manufacturers: Rust-Oleum, ZRC, Chesterton 752, or Sherwin Williams Cold Galvanizing Aerosol.				

END OF SECTION

SECTION 40 05 13

PROCESS PIPING, GENERAL

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**

A. **Scope of Work**

1. Provide the labor, tools, equipment, and materials necessary to furnish and install the process piping in accordance with the drawings and specifications.
2. This section, in conjunction with the corresponding process piping material sections, is intended to cover the supply and installation of all exposed (nonburied) process piping.
3. This work shall also include all pipe supports and restraints, fittings, joints, testing, cleaning, and work on existing exposed process piping.
4. See Division 33 for buried piping.

1.3 **QUALITY ASSURANCE**

A. **Standards**. All materials, testing, and workmanship shall be in conformance with the following standards and as referenced herein.

1. ANSI – American National Standards Institute.
2. ASME – American Society of Mechanical Engineers.
3. ASTM – American Society for Testing and Materials.
4. AWWA – American Water Works Association.
5. NSF – National Sanitary Foundation.

1.4 **SUBMITTALS**. Submit the specified submittal packages in accordance with Section 01 33 00, "Submittals," and the pipe material's specific specification section included later in this contract document.

1.5 **JOB CONDITIONS**

A. **Verify job conditions** which may impact piping layouts and locations prior to ordering.

B. **Coordination**

1. Coordinate schedule of the work and the location of equipment and conduit to prevent interferences and delays.
2. Coordinate type and materials (gaskets, glands, and bolts) of joints connecting to valves and equipment with the suppliers of each item.

C. **Field Dimensions**. Install all piping to field dimensions unless specifically shown otherwise.

1.6 **DELIVERY, STORAGE, AND HANDLING**

A. **General**. The delivery, storage, and handling of the process piping and accessories shall be in accordance with Section 01 60 00, "Materials and Equipment," and the manufacturer's instructions.

B. **Handling**. Handle all pipe, fittings, and accessories carefully using proper handling devices. Do not insert lifting devices into barrels of pipe.

C. **Storage**

1. Store pipe and fittings on wood blocking or platforms to avoid contact with ground.
2. Keep pipe free from dirt and foreign matter.
3. Plastic and fiberglass-reinforced plastic (FRP) piping shall be shaded but not covered directly to allow air circulation and reduce heat build-up due to direct sunlight.

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 **GENERAL**

A. **Pipe and Fittings**. All process piping, fittings, and joints shall conform to the drawings and requirements specified in the corresponding section for each type of pipe installed.

B. **Manufacturer**. All new process piping of one material shall be by a single manufacturer. All process fittings and couplings of one material shall be by a single manufacturer. All pipe and fittings manufactured outside the United States shall be certified to ISO 9001:2000 standards for quality assurance.

C. **Identification**

1. All pipe and fittings 4 inches in diameter and larger shall have the pipe size, material, and class or schedule painted or cast on the exterior pipe surface.
2. All piping less than 4 inches in diameter shall have the pipe size, material, and class or schedule factory marked on the exterior pipe surface.

2.2 **JOINTS**

A. **Flanged**

1. Standard. Conform to ANSI/AWWA C115/A21.15 or ANSI/ASME B16.1, Class 125, unless otherwise shown.

2. Gaskets.

a. All joints for 12 inches and smaller shall include 1/8-inch-thick full-face SBR red rubber gaskets unless noted otherwise.
b. All joints for pipe 14 inches and larger shall include 1/8-inch-thick full-face synthetic rubber gaskets with one or more annular rings.
c. Gaskets shall conform to ANSI/AWWA C111/A21.11 and be rated for a minimum of 170 degrees Fahrenheit (° F.) unless noted otherwise.
d. All gasket types shall be suitable for the process material being conveyed.
e. Air and gas piping shall have high temperature type gaskets, rated to 300° F. Material shall be fluoroelastomer (FKM).

3. Bolts.

a. Nonsubmerged Service.

1) Bolts shall have American Standard heavy unfinished hexagonal head and nut dimensions conforming to ANSI B18.2.1 and ANSI/ASME B18.2.2.
2) For bolts of 1-3/4-inch diameter and larger, bolt studs with a nut on each end are recommended.
3) Material for nuts and bolts shall conform to ASTM A 307, Grade B.

b. Submerged Service.

1) Bolts shall have American Standard heavy unfinished hexagonal head and nut dimensions, all as specified in ANSI B18.2.2, "Square and Hex Nuts Inch Series."
2) For bolts 1-2/4 inches in diameter and larger, bolt studs with a nut on each end are recommended.
3) Material for bolts and nuts shall be Type 316 stainless steel.
4) Utilize antiseize compound on all nuts.

B. **Threaded**

1. Standard. Pipe threads shall conform to American Standard Taper Pipe thread ANSI B2.1.

2. Preparation. Threaded joints shall include a Teflon tape for sealant purposes.

C. **Grooved and Shouldered**

1. Conform to AWWA C606 unless otherwise shown.
2. Coupling housings shall be ductile iron ASTM A 536 or stainless steel ASTM A 351, with synthetic rubber gasket of central cavity pressure-responsive design. Grooved mechanical couplings shall meet the requirements of ASTM F 1476.
3. Gaskets shall conform to the same material requirements as the flanged joints.
4. Bolts and nuts shall conform to the same material requirements as the flanged joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. **Inspection**

1. Inspect all pipe for damage resulting from shipping and handling. Reject and replace all damaged pipe and fittings.
2. If any defective pipe or fitting is discovered after installation, remove and replace defective piece.
3. Keep all pipe and fittings clean until they are accepted in the completed work.

3.2 INSTALLATION

A. **General**. Installation of all process piping shall be in accordance with manufacturer's instructions, approved shop drawings, drawings, and as specified herein.

1. Use of flange adapters and flanges, or flexible couplings, shall be acceptable only where shown on the approved dimensional layouts or drawings.
2. Bring conflicts between the specifications or drawings and the manufacturer's instructions to the Engineer/Architect's attention for a resolution.

B. **Cutting**

1. Pipe cutting shall be neat, smooth, at right angles to the axis of the pipe, and without damage to the pipe, coating, or lining.
2. Flame cutting will not be permitted.
3. Ream all pipes and tubing to full inside diameter after cutting. Remove sharp edges on cut ends.
4. Remove all cuttings from inside the pipe before installation.

C. **Alignment**

1. Install straight runs true to line and elevation and vertical pipe plumb in all directions.
2. Install parallel or perpendicular to building walls unless shown otherwise.
3. Piping without specific locations or elevations indicated shall be located to avoid obstructions and shall not obstruct corridors, walkways, equipment areas, or work areas.
4. Provide a minimum headroom clearance of 7 feet 6 inches under all piping unless otherwise noted.

D. **Temporary Caps**. Provide temporary caps or plugs at all pipe openings at the end of each day's work and where directed.

E. **Pipe Supports, Hangers, and Blocking**. Furnish and install, whether shown or not, all required supports, hangers, and blocking.

1. Provide thrust blocking at all bends and tees, where changes in pipe diameter occur at reducers or in fittings, at all dead ends, and at pipes which are tapped or plugged.
2. Provide pipe hangers at all bends and tees, and on either side of all valves.
3. Pipe supports, hangers, and thrust blocks shall be of the size, shape, and quantities as shown or as required.
4. All proposed hangers, supports, and blocking must be approved before placement.
5. Spacing of supports and hangers shall be as shown, and in no instance exceed the pipe manufacturer's recommendations.

F. **Pipe Fittings**

1. Unions. Provide unions where shown, and at the following locations:

   a. Downstream of each screwed end valve.
   b. Screwed or flanged union at each piece of equipment.
   c. Dielectric unions where dissimilar metals are connected except at bronze or brass valves installed in ferrous piping.
   d. Where necessary to install or dismantle piping.

2. Reducers. Install eccentric reducers where reducers are shown and where air or water pockets would occur in mains because of reduction in pipe size.

3. Transitions. Provide all necessary adapters, specials, and connector pieces when connecting different type and sizes of pipe, connecting pipe by different manufacturers, or connecting to equipment, valves, or meters.

G. **Joints**

1. Flanged.

   a. Clean. Flange faces shall be clean. Hexagonal bolts and nuts shall be clean and lubricated.
   b. Alignment. Fit joints so that contact faces bear uniformly on the gasket and are made up with uniform bolt stress.
   c. Assembly. Assemble joints without forcing.

2. Grooved.

   a. Install grooved joints in accordance with the manufacturer's latest published installation instructions.
   b. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing.

3.3 FIELD QUALITY CONTROL

A. **Testing**

1. Test all process piping for leaks in accordance with Section 01 89 19, "Leakage Test and Disinfection."
2. Visible leakage will not be accepted in exposed piping.
3. If the test fails, repair or replace the piping and retest.

B. **Cleaning**

1. Thoroughly clean and flush all process piping prior to placing in service in an acceptable manner.
2. Inspect piping and remove all debris, dirt, and foreign matter. Disinfection shall be done in accordance with Section 01 89 19, "Leakage Test and Disinfection."

3.4 PIPING SCHEDULE

INTERIOR PIPING SCHEDULE					
PIPE IDENTIFICATION	MATERIAL	TYPE OF JOINT	CLASS/DESIGN	RESTRAINT SYSTEM DESIGN PRESSURE[1]	TEST PRESSURE
Air	COPPER	SOLDER	ASTM B 88, TYPE L	100 PSI	50 PSI
Drain	< 4" PVC	SOCKET	SCH 80	N/A	N/A
	>= 4" DIP	FLANGED	CLASS 53		
Gas	CARBON STEEL	THREADED	ASTM A 53 SCH 40	50 PSI	25 PSI
Plant Water / Domestic Water	< 4" COPPER	SOLDERED	ASTM B 88, Type L	125 PSI	100 PSI
	>= 4" DIP	FLANGED	CLASS 53		
Transfer Pump Piping	DIP	FLANGED	CLASS 53	100 PSI	75 PSI
Return Piping	DIP	FLANGED	CLASS 53	100 PSI	25 PSI
Backwash Drain Piping	DIP	FLANGED	CLASS 53	100 PSI	25 PSI
Belt Filter Press Process Piping	DIP	FLANGED	CLASS 53	100 PSI	75 PSI
Chemical Feed Piping	PVC	WELDED	SCH . 80	150 PSI	100 PSI

NOTES:

1. DESIGN PRESSURE SHALL BE USED TO DETERMINE THE SIZE, NUMBER, MATERIAL, AND DIMENSIONS OF TABS AND THREADED RODS FOR PIPING SPECIFIED OR SHOWN TO HAVE THREADED RODS FOR THRUST RESTRAINT.
2. If the pipe material is not shown on the Piping System Schedule or otherwise specified, the following materials shall be used:

Pipe Size	Material	Type of Joint	Class/Design	Test Pressure
4-in and larger	DIP	Flanged(Exposed) Restrained (Buried)	53 52	(1)
Less than 4-in	PVC	Socket	Sch 80	(1)

(1) Test at 150 percent of normal operating pressure or 25 psi, whichever is greater.

END OF SECTION

SECTION 40 05 13.53

PROCESS PIPING, DUCTILE IRON

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions; Division 1; Section 40 05 13, "Process Piping, General"; and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. Provide the labor, tools, equipment, and materials necessary to furnish and install the ductile iron process piping in accordance with the drawings and specifications.

1.3 **QUALITY ASSURANCE**. In accordance with Section 40 05 13, "Process Piping, General."

1.4 **SUBMITTALS**. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

A. **Submittal Package No. 1 – Shop Drawings and Product Data**

1. Do not deliver or install piping or fittings before this submittal package has been reviewed and approved. Shop drawings and product data shall include:

   a. Illustrated Product Data. Submit the product data of the pipe, fittings, manufacturer's name, pipe material, size, class, and gaskets specified on the drawings.
   b. The manufacturer's recommended maximum unsupported length of the size piping specified.
   c. Affidavit of compliance and certification of design and performance.
   d. Information on field and installation requirements, including mounting and access requirements and total weight of each component and each complete assembly.
   e. Description of proposed test methods, procedures, and apparatus.
   f. Coatings and linings.

B. **Submittal Package No. 2 – Layout Drawings**

1. Do not deliver or install piping or fittings before this submittal package has been reviewed and approved. Layout drawings shall include:

   a. Detailed plan and profile drawings showing details of piping, fittings, end connections, valve locations, and locations of all flanged joints.
   b. Piping supports, hangers, and thrust block type and locations.

1.5 **JOB CONDITIONS**. In accordance with Section 40 05 13, "Process Piping, General."

1.6 **DELIVERY, STORAGE, AND HANDLING**. In accordance with Section 40 05 13, "Process Piping, General."

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE AND FITTINGS

A. **Pipe**

1. Standard. Conform to American National Standards Institute/American Water Works Association (ANSI/AWWA) C151/A21.51 and the chemical constituents shall meet the physical property recommendations of American Society for Testing and Materials (ASTM) A 536 to ensure suitability for drilling and cutting.
2. Thickness. Pipe barrel thickness shall be a minimum of Class 53 unless otherwise shown.

B. **Fittings**

1. Standard. Fittings shall be ductile iron conforming to ANSI/AWWA C110/A21.10.

2. Pressure Rating for Fittings.

   a. Flanged ductile iron fittings shall be suitable for 250 pound- per-square-inch (psi) working pressure.
   b. Nonflanged ductile iron fittings less than 12 inches in diameter shall be suitable for 350 psi working pressure.
   c. All ductile iron fittings 14 inches in diameter and larger shall be suitable for 250 psi working pressure.

C. **Joints**. Flange or groove all joints in accordance with Section 40 05 13, "Process Piping, General," unless otherwise shown.

D. **Coatings and Linings**

1. Seal-coat interior wall of pipe and fittings except air mains, plastic-, cement-, or glass-lined pipe, and their associated fittings. Minimum 1-mil-thick asphaltic seal coat in accordance with ANSI/AWWA C104/A21.4 and ANSI/AWWA C151/AA21.5 with no cement lining unless noted otherwise.

2. Coat exterior wall of exposed pipe and fittings with shop primer specified in Section 09 90 00 for ferrous metals.

PART 3 – EXECUTION. In accordance with Section 40 05 13, "Process Piping, General."

END OF SECTION

SECTION 40 05 14

PROCESS PIPING, ACCESSORIES

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions; Division 1; Section 40 05 13, "Process Piping, General"; and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. Provide the labor, tools, equipment, and materials necessary to furnish and install the process piping accessories in accordance with the drawings and specifications.

1.3 **QUALITY ASSURANCE**

A. **Standards**. All materials, testing, and work performed shall be in conformance with the following standards as referenced herein:

1. ANSI – American National Standards Institute.
2. ASTM – American Society for Testing and Materials.
3. AWWA – American Water Works Association.
4. MSS – Manufacturers Standardization Society of the Valve and Fittings Industry.

1.4 **SUBMITTALS**. Submit all submittals in accordance with the Division 1 Submittal Requirements and the requirements within this specification section.

A. **Submittal Package No. 1 – Shop Drawings and Product Data**

1. No piping accessories shall be delivered or installed before this submittal package has been reviewed and approved. Shop drawings and product data shall include:

a. Illustrated product data.
b. Affidavit of compliance and certification of design and performance.
c. Information on field and installation requirements, including mounting and access requirements and total weight of each component and each complete assembly.
d. Description of proposed test methods, procedures, and apparatus.
e. Coatings and linings.

1.5 **JOB CONDITIONS**. Coordinate work with that of other sections to provide proper combination of pipe size, core or sleeve size, and link size.

1.6 **DELIVERY, STORAGE, AND HANDLING**. In accordance with Section 40 05 13, "Process Piping, General."

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 MECHANICAL PIPE SEALS

A. **General.** Mechanical pipe seals shall be expandable link type rubber seals to fill the annular space between pipe or conduit and the cored hole or sleeve through which it passes. The seals shall provide airtightness and watertightness as well as electrical insulation between the pipe or conduit and wall or floor opening.

B. **Application**

1. Seal pipes or conduits passing through sleeves or cored openings in exterior walls or walls subject to hydrostatic pressure at each face of the wall.
2. Seal all pipes or conduits passing through floor, roof or interior wall sleeves or cored openings at one face only, unless specifically shown otherwise.
3. Included in this section are pipes and conduits including round electrical ducts. These are all referred to as pipes in the balance of this section.

C. **Products**

1. General Use. Seals shall incorporate an ethylene-propylene dienemonomer (EPDM) rubber sealing element with 316 stainless steel bolts and nuts and glass reinforced nylon plastic plates.
2. Certified as NSF 61 complaint when used in contact with potable water.
3. Size seals in accordance with manufacturer's recommendations.
4. Cored opening size shall be as recommended by the mechanical seal manufacturer.
5. Manufacturer. Seals shall be Link-Seal, Service Designation S/S61 (corrosive service), by Thunderline Corporation or approved equal.

2.2 WALL AND FLOOR PIPES AND PIPE SLEEVES

A. **Wall and Floor Pipes**

1. Type. Wall and floor pipes shall be of the same material and wall thickness specified for the connected piping.
2. Collar. Include an integral collar at the midpoint of the wall or floor pipe for anchorage and watertightness. Collar shall be integral with the body or continuously welded on both sides to the body.
3. End Connections. End connections shall be as shown. Drill and tap mechanical joint bells and flanged ends for studs.
4. Provide studs of the same material as connected piping. Submerged or buried studs shall be Type 304 stainless steel.

B. **Pipe Sleeves**

1. Type. Pipe sleeves shall be ductile iron with a minimum working pressure rating of 350 pounds per square inch (psi).
2. End Connections. Pipe sleeve end connections shall be as shown.
3. Size. Pipe sleeve dimensions shall be as required for pipes to pass through the sleeve. Length shall be as required or as shown.

2.3 PIPE SUPPORT

A. **General**

1. Furnish and install all necessary restraints, blocks, bracing, supports, or hangers, including all necessary miscellaneous steel, inserts, anchors, nuts, bolts, and concrete to support and anchor the piping as shown and required to prevent displacement, vibration, sagging, warping, or failure of the piping expansion and contraction.
2. Locate all supports in accordance with the piping manufacturer's recommendations.

B. **Standard**. Pipe hangers shall be in accordance with MSS Standard Practice SP-58 unless noted otherwise.

C. **Types**. The following types of pipe supports are acceptable.

1. Hanger Type.

   a. Adjustable Clevis. Clevis shall be carbon steel unless noted otherwise. Clevis shall be in compliance with MSS SP-69, Type 1.

   b. Trapeze. Universal trapeze assembly shall be carbon steel unless noted otherwise. Trapeze assembly shall be Anvil Figure 46, or equal.

   c. Structural Attachments.

      1) Welded Steel Bracket. MSS SP-69, Types 31, 32, and 33.
      2) Malleable Concrete Insert. MSS SP-69, Type 18.

2. Support Type.

   a. Pipe Saddle Support. MSS SP-69, Types 35, 36, and 38.
   b. Pipe Stanchion Saddle. MSS SP-69, Type 37.

3. Submit any additional pipe support required not listed above for review.

D. **Coatings**. Conform to Section 09 90 00, "Painting."

1. Hot-dip-galvanize steel items at the factory unless otherwise noted.
2. Copper-plate steel or malleable iron materials used for support of copper piping.

2.4 **CONCRETE PIPE SUPPORT**. Install concrete pipe support and thrust blocking as shown and where directed.

2.5 **CORPORATION STOPS**. Install corporation stops where shown. Corporation stops shall be bronze body and ground key plug with AWWA C800 taper threaded inlet and outlet to match the connecting piping material.

2.6 **EXPANSION COUPLINGS**

A. **General**. Expansion couplings shall be arch type, constructed of a single piece of synthetic or natural rubber with wire reinforcing and integral full faced flanges. The wall thickness, dimensions, exterior coating, control rod requirements, and number of arches shall be in accordance with manufacturer's recommendations.

B. **Service**. Pressure rating shall be the same as the connected piping. See appropriate process piping specification sections for pipe pressure ratings.

C. **Joints**. Joints shall be flanged in accordance with ANSI B12.1. Flanges shall be constructed of resilient rubber, full face, with galvanized metal or baked enamel ductile iron retaining rings providing a metal backup ring behind the rubber flange.

D. **Manufacturer**. Subject to compliance with the specifications, provide expansion couplings from one of the following approved manufacturers.

1. General Rubber Corporation.
2. Mercer Rubber Company.
3. MetraFlex.
4. Flexicraft.
5. Proco Products, Inc.

2.7 **SLEEVE COUPLINGS**

A. **General**. Provide sleeve couplings where shown to tightly seal piping without leakage and allow for deflection and vibration within the pipe line and meet the requirements of AWWA C219.

B. **Construction**

1. Followers shall be cast iron or ductile iron.
2. Sleeves shall be carbon steel or ductile iron.
3. Bolts. Bolts shall be of a corrosion-resistant material.

4. Gaskets. Provide resilient gaskets to cushion vibration and safely accommodate for pipe deflection or longitudinal pipe movement without leakage. Gaskets shall be suitable for the service of the pipe.
5. Coating. Coatings shall be according to manufacturer's instructions and be suitable for the service of the pipe. Shop-prime and field-coat the couplings in accordance with Section 09 90 00, "Painting."

C. **Service**. Couplings shall be rated for the same pressure as the connected piping. See appropriate process piping specification sections for pipe pressure ratings.

D. **Manufacturer**. Subject to compliance with the specifications, provide sleeve couplings from one of the following approved manufacturers.

1. Dresser. Style 38/138.
2. Smith Blair. Style 411.
3. Romac. Style 400.
4. JCM. Style 201.
5. Ford Meter Box. Style FC3/FC4.

2.8 FLANGED COUPLING ADAPTERS

A. **General**. Flanged coupling adapters shall include a flanged end and a sleeve-type flexible coupling and meet the requirements of AWWA C219.

B. **Adapter Restraints**. Harness adapters as required to restrain pressure piping.

1. For 12 inches in diameter or less, harnessing shall be with 1/2-inch stainless steel anchor studs.
2. For larger than 12 inches in diameter, harnessing shall be with a minimum of four corrosion resistant alloy steel bolts tied to adjacent flange or lugs on the pipe.
3. Number of bolts or studs shall be according to manufacturer's recommendation.

C. **Construction**

1. The adaptors shall be cast iron or ductile iron.
2. Bolts shall be of a corrosion resistant material.
3. Gaskets. Provide resilient gaskets to cushion vibration and safely accommodate for pipe deflection or longitudinal pipe movement without leakage. Gaskets shall be suitable for the service of the pipe.
4. Coating. Coatings shall be according to manufacturer's instructions and be suitable for the service of the pipe. Shop-prime and field-paint the joints in accordance with Section 09 90 00, "Painting."

D. **Service**. Flanged coupling adapters shall be rated for the same pressure as the connected piping. See appropriate process piping specification sections for pipe pressure ratings.

E. **Manufacturer**. Subject to compliance with the specifications, provide flanged coupling adapters from one of the following approved manufacturers.

1. Smith Blair. Style 912.
2. Dresser. Style 227.
3. JCM. 301.
4. ROMAC. 501.
5. Ford Meter Box. Style FFCA.

2.9 DISMANTLING JOINTS

A. **General**. Provide dismantling joints where shown to tightly seal piping without leakage and allow for deflection and vibration within the pipe line. This fitting shall also be fully restrained.

B. **Service**. Dismantling joints shall be rated for the same pressure as the connected piping. See appropriate process piping specification sections for pipe pressure ratings.

C. **Construction**

1. The joints shall be cast iron or ductile iron.
2. Bolts shall be of a corrosion resistant material.
3. Gaskets. Provide resilient gaskets to cushion vibration and safely accommodate for pipe deflection or longitudinal pipe movement without leakage. Gaskets shall be suitable for the service of the pipe.
4. Coating. Coatings shall be according to manufacturer's instructions and be suitable for the service of the pipe. Shop-prime and field-paint the joints in accordance with Section 09 90 00, "Painting."

D. **Manufacturer**. Subject to compliance with the specifications, provide dismantling joints from one of the following approved manufacturers.

1. Dresser. Style 131.
2. Smith Blair. Model 975.
3. JCM. Restrained Style 309.
4. ROMAC. Style DJ400.
5. Ford Meter Box. Style FDJ.

PART 3 – EXECUTION. Install all piping accessories according to manufacturer's instructions, and as shown.

END OF SECTION

SECTION 40 05 23

PROCESS VALVES, GENERAL

PART 1 – GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 1, and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**

A. **Provide the labor, tools, equipment, and materials** necessary to furnish and install the valves and accessories in accordance with the drawings and the specifications.

B. **Provide all valves required** for complete functional systems.

C. **All references to valves shall also imply** gates where applicable.

1.3 **QUALITY ASSURANCE**

A. Materials and workmanship shall be in accordance with the following standards as referenced herein:

1. ANSI – American National Standards Institute.
2. ASTM – American Society for Testing and Materials.
3. AWWA – American Water Works Association.
4. NEMA – National Electrical Manufacturers Association.
5. NSF – NSF, Inc.
6. OEPA – Ohio Environmental Protection Agency.
7. MSS – Manufacturers' Standardization Society.

1.4 **SUBMITTALS**

A. **General**

1. Submit all required documents and materials in accordance with Section 01 33 00, this section, and the individual valve specifications.
2. Submit all submittals only under individual valve section designations and not Section 40 05 23, Process Valves, General."

B. **The following submittal content and schedule requirements** are required to be submitted when indicated by the individual valve specifications.

1. Shop Drawings and Product Data.

a. Schedule. No other submittal packages related to this equipment can be approved before this one.

b. Submittal Package Contents.

1) Manufacturer's name.
2) Body, seating, and trim materials.
3) Dimensions.
4) Connection details.
5) Required clearances.
6) Parts list with materials and part numbers for the valves and accessories.
7) Maximum operating pressure and temperature ratings.
8) Manufacturer's instructions.
9) Electrical data when applicable.
10) Certificate of compliance and proof of design with AWWA standards.

2. Operation and Maintenance (O&M) Manuals.

a. Schedule. Submit the initial review copy of the O&M manual and the revised copies prior to delivery of the equipment.

1.5 **JOB CONDITIONS**. All valves shall be suitable for the service they are installed in.

1.6 **DELIVERY, STORAGE, AND HANDLING.** In accordance with Section 01 60 00 and the manufacturer's instructions.

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 – PRODUCTS

2.1 **GENERAL VALVE REQUIREMENTS**

A. **Manufacturer**. Each type of valve shall be supplied by only one manufacturer.

B. **Materials**. No bronze or brass components shall contain more than 16 percent zinc.

C. **Fabrication and Assembly**

1. Valve Ends.

a. Coordinate furnishing of joint materials with pipe supplier.

b. Required valve ends on exposed piping are shown, usually with a symbol. Connections shown include:

1) Flanged. (FF or F) ANSI B16.1, Class 125 unless noted otherwise.
2) Screwed. National (tapered) pipe thread (NPT).
3) Socket. Conform to specifications for adjacent piping.

4) True Union. Conform to specifications for adjacent piping. Use true union ends for all polyvinyl chloride (PVC) valves.

c. Buried. Mechanical joint (MJ), unless noted otherwise.

1) MJ. AWWA C111, rubber gasket joints for ductile iron pressure pipe and fittings.
2) Screwed. NPT.
3) Socket. Conform to specifications for adjacent piping.

2. Seals. Buried and submerged valves shall have enclosed, nonlubricated, watertight stem seals.

2.2 OPERATORS

A. General

1. Open counterclockwise unless noted otherwise.
2. Provide a permanent open direction indicator.
3. Furnish operators according to the valve schedule in each valve specification section.
4. Supplied and fully warranted by the valve manufacturer.
5. Enclose all gearbox components in a cast aluminum or stainless steel weatherproof housing with positive mechanical seals to exclude moisture and dirt and prevent lubricant leakage.
6. Furnish lubrication fittings for all gears and bearings.

B. Manual

1. Enclosed gear or traveling nut type with no external moving parts.
2. Operating force shall not exceed 40 pounds.
3. Provide chainwheel and chain for valves over 6 feet above floor.
4. All buried valves shall have operating nuts and valve boxes.
5. Furnish floor boxes with all valves where operating nut is at concrete slab.
6. Provide at least one fixed-bar and one sliding-bar valve wrench for close quarters for each building.

2.3 FINISHES

A. **Buried valve accessories**. Coat all buried valve accessories with a bituminous material in conformance with ANSI A21.10 (AWWA C110).

B. **Painted surfaces**. Unless noted otherwise, prime and finish-paint all interior and exterior ferrous surfaces of all valves, operators, and accessories in the factory.

1. Clean Water Service. Interior surfaces according to AWWA C550. Exterior surfaces according to Section 09 90 00, "Painting."

2. Wastewater Service. Interior and exterior surfaces to be coated with a fusion-bonded epoxy according to Section 09 90 00.

C. **All valve operator and accessory coatings** in contact with potable water shall meet NSF Standard 61 and be listed by NSF and/or the OEPA.

D. **Do not paint stainless steel** surfaces unless noted otherwise.

2.4 VALVE ACCESSORY PRODUCTS

A. Valve Boxes

1. Standard, adjustable, heavy pattern, cast iron extension type, three piece, screw type, and with 5 1/4 inch inside diameter.
2. Sufficient length to extend from valve to finished grade.
3. Set tops at established grades.
4. Mark cover with pipe function.

Valve Size	Base
4" and smaller	round, 8" in height, 10-7/8" diameter at bottom
6" and 8"	round, 11" in height, 14-3/8" diameter at bottom
10" through 16"	oval, 9-1/2" in height, 21" by 12-1/2" diameter at bottom
18" and 20"	oval, 10" in height, 25-1/2" by 16" diameter at bottom
24"	dome, 5" in height, 15" diameter and 17" square flange bottom

B. Floor Boxes

1. Cast or ductile iron construction with cover.
2. Bronze bushing type.
3. Suitable for installation in floors and slabs as shown.

C. Floor Stands

1. Weatherproof, right-angle type, crank operated, straight or offset as required, and rigidly anchored, and include position indicator.
2. 304 stainless steel or cast aluminum.
3. Nonrising type unless noted otherwise.
4. Provide single or double gear reduction as required.
5. Antifriction bearings shall properly support both opening and closing thrust to floor stand.
6. Floor stand pedestal shall position the input shaft approximately 30 to 36 inches above the base.
7. Furnish a permanently attached or cast arrow with the word "OPEN" on the floor stand indicating the direction of rotation to open the valve.

D. **Extension Stems**

1. Schedule 80 steel rod for buried valves and Type 304 stainless steel rod for the stems inside structures and buildings or submerged.
2. Length shall be as required for proper operation of the valve or as specified in the valve schedule.
3. Securely fasten extension stems to the valve stem.
4. Extend extension stems for buried or submerged valves to within 12 inches of finished grade unless noted otherwise.
5. Diameter as recommended by the gate or valve manufacturer.

E. **Stem Guides**

1. Cast iron or stainless steel with bronze bushing.
2. Adjustable design for plumb alignment.
3. Adjusting bolt and washer shall be stainless steel.
4. Installed with stainless steel anchor bolts.
5. Spacing as required to support stem but shall not exceed 7 feet.

F. **Handwheels, Operating Nuts, Top-of-Wall Brackets, and Cranks**

1. Cast iron construction.
2. Cranks shall be removable and a maximum of 15 inches long.
3. All operating nuts shall be 2 inches square.

G. **Chainwheels**

1. Cast or ductile iron unless noted otherwise.
2. Chain shall be galvanized steel unless noted otherwise.
3. Extend chain from the chain wheel to three feet off the operating floor.
4. Mount all chainwheels directly to the valve shaft. Chainwheels mounted to handwheels shall not be accepted.

H. **Valve Wrenches.** T-bar design with socket. Length shall be sufficient to comfortably operate valves.

PART 3 – EXECUTION

3.1 **EXAMINATION.** Verify job conditions and intended valve service before ordering each valve. Inspect for damage to valve resulting from shipping and handling prior to installation.

3.2 **INSTALLATION**

A. **Procedures**

1. Remove debris from inside piping system before installation.
2. Install in accordance with manufacturer's instructions.
3. Install plumb and level.
4. Install free from distortion.
5. Install with proper support and restraint.

6. Coordinate valve mounting position with respect to operating convenience, maintenance access, and safety.
7. Locate all valve operator access only after coordinating with the Owner's operation personnel and the Engineer/Architect.
8. Remove and reinstall valves which are installed with improper orientation at no additional cost to the Owner.

3.3 **REPAIRS/RESTORATION**. Repair or replace any damage to the valve or operator or chips, dents, scratches, stains, or other disfiguring of surrounding floors, walls, and/or accessories to the satisfaction of the Owner and/or Engineer at no additional cost to the Owner.

3.4 **FIELD QUALITY CONTROL**

A. **Visual**

1. Verify conformance with manufacturer's shop drawings and instructions.
2. Report defects in workmanship, materials, and performance.
3. The Contractor, Owner, and/or Engineer shall inspect the equipment for deficiencies.

B. **Field Service and Start-Up**

1. Follow manufacturer's instructions.
2. Adjust stops and friction clamps for proper operation.
3. Demonstrate proper operation under actual service conditions.
4. Demonstrate valves that have moving internal mechanisms that operate without manual operation shall have functions demonstrated for a minimum of three repeat cycles. This includes, pressure reducing valves, back pressure valves, check valves, pressure relief valves, surge anticipator, and surge relief valves.
5. Demonstrate that all valves are watertight under maximum design operating pressures when operated for a minimum of three repeat cycles of open and close during the operational demonstration period.

3.5 **ATTACHMENTS**

A. **Valve Schedules**

1. The valve schedules at the end of each individual valve specification are for convenience, and the omission of any valve does not release responsibility to furnish and install all the valves required by the drawings and specifications.
2. Only valves 3 inches and larger are included in the valve schedule.
3. Valves integral to or specified with other equipment, valves bid as part of unit price items, and valves to be furnished under plumbing, heating, or other sections of the specification items are not included.

END OF SECTION

SECTION 40 05 23.08

PROCESS VALVES, CHECK

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions; Division 1; Section 40 05 23, "Process Valves, General"; and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. In accordance with Section 40 05 23, "Process Valves, General."

1.3 **QUALITY ASSURANCE**. In accordance with Section 40 05 23, "Process Valves, General."

1.4 **SUBMITTALS**. Submit each of the following submittal packages in accordance with Section 40 05 23, "Process Valves, General," and this section.

A. **Submittal Package No. 1 – Shop Drawings and Product Data**

B. **Submittal Package No. 2 – Operation and Maintenance Manuals**

1.5 **JOB CONDITIONS**. In accordance with Section 40 05 23, "Process Valves, General."

1.6 **DELIVERY, STORAGE, AND HANDLING**. In accordance with Section 40 05 23, "Process Valves, General."

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 **CHECK VALVES**. In accordance with Section 40 05 23, "Process Valves, General."

A. **Swing Check**

1. Manufacturer. Subject to compliance with the specifications, provide the swing check valves from one of the following approved manufacturers.

   a. Apco (2 inches – 66 inches).
   b. Clow/M&H (2 inches – 30 inches).
   c. Golden Anderson (2-1/2 inches – 60 inches).
   d. Milliken (3 inches – 24 inches).
   e. Mueller (2-1/2 inches – 24 inches).

2. Performance.

   a. Seat and seat ring shall be easily replaced without removing the valve from the line.

b. Convertable from weight assisted to spring assisted in the field without sending the valve back to the factory or replacing the valve.
c. All working parts removable through top of valve.
d. Valves 4 inches through 12 inches shall be rated for 175-pound-per-square-inch (psi) working pressure, and valves 14 inches and larger shall be rated for 150 psi working pressure, unless noted otherwise.

3. Materials.

Part	Material
Body	Cast iron
Seat	Bronze
Disc	Cast iron
Hinge Pin	Type 300 Series Stainless steel
Disc Seat Ring	Bronze

4. Fabrication and Assembly.

a. Full compliance with American Water Works Association (AWWA) C508.
b. Furnish outside lever and weight (or spring) that can be mounted on either side of valve, nonslamming and externally balanced as noted on the check valve schedule.

PART 3 – EXECUTION. In accordance with Section 40 05 23, "Process Valves, General."

3.1 **ATTACHMENTS**

A. **Valve Schedule**

Location	Pipe/Use	Type	Size (Inches)	Ends	Service	Quantity	Mounting	Position Indicator Required	Assist Type	Install.	Remarks
PUMP	Pump Check Valve	SC	6	FLG	WW	2	H	Y	W	AG	None

Schedule Notes:
Location: PUMP – In the Pump Room
Type: RF – rubber flapper; SC – swing check; BC – ball check; GS – globe style silent check.
Ends: FLG – flanged; GR – grooved; MJ – mechanical joint; TR – threaded; TU – true union; SK – socket.
Service: WW – wastewater; CW – clean water; NPW – Nonpotable.
Mounting: V – vertical; H – horizontal.
Assist Type: for swing check valves only; W – weight and lever; S – spring and lever; N – none.
Install.: BU – buried; AG – aboveground; SM – submerged.
Remarks: FIBA – factory install a backflow actuator

END OF SECTION

SECTION 40 05 23.22

PROCESS VALVES, PLUG

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS**. Drawings and general provisions of the Contract, including General and Supplementary Conditions; Division 1; Section 40 05 23, "Process Valves, General"; and all related specification sections, apply to this section.

1.2 **DESCRIPTION OF WORK**. In accordance with Section 40 05 23, "Process Valves, General."

1.3 **QUALITY ASSURANCE**. In accordance with Section 40 05 23, "Process Valves, General."

1.4 **SUBMITTALS**. Submit each of the following submittal packages in accordance with Section 40 05 23, "Process Valves, General," and this section.

A. **Submittal Package No. 1 – Shop Drawings and Product Data**

B. **Submittal Package No. 2 – Operation and Maintenance Manuals**

1.5 **JOB CONDITIONS**. In accordance with Section 40 05 23, "Process Valves, General."

1.6 **DELIVERY, STORAGE, AND HANDLING**. In accordance with Section 40 05 23, "Process Valves, General."

1.7 **SPECIAL WARRANTY** (Not used)

PART 2 - PRODUCTS

2.1 **PLUG VALVES**. In accordance with Section 40 05 23, "Process Valves, General."

A. **Manufacturers**

1. Reduced Port Plug Valves. Subject to compliance with the specifications, provide the reduced port plug valves from one of the following approved manufacturers.

   a. Clow/M&H (3 inches – 24 inches).
   b. Crispin Series 900 (14 inch – 48 inches)
   c. DeZurik (1/2 inch – 72 inches).
   d. Milliken/Pratt (14 inches – 54 inches).
   e. Val-Matic (1/2 inch – 36 inches).

2. Full Port Plug Valves. Subject to compliance with the specifications, provide the full port plug valves from one of the following manufacturers.

a. Clow/M&H (3 inches – 12 inches).
b. DeZurik (3 inches – 36 inches).
c. Milliken/Pratt (2 1/2 inches – 12 inches).
d. Crispin KFlo (2 ½ inch – 12 inches)
e. Val-Matic (1/2 inch – 36 inches).

B. **Description**. Nonlubricated, eccentric-type plug valves.

C. **Performance**

1. All plug valves, for whatever service, shall be capable of passing "pigging" cleaning equipment in either direction and without the use of special equipment.

2. Valve Design Pressure.

a. 12 Inches and Under. 175 pounds per square inch (psi).
b. 14 Inches Through 36 Inches. 150 psi.
c. 42 Inches and Larger. 125 psi.

3. Valve Capacity.

a. Reduced Port Plug Valves. Port clear areas shall be a minimum of 80 percent port.
b. Full Port Plug Valves. Port clear areas shall be a minimum of 100 percent port.

D. **Materials**

Part	Material
Body	ASTM* A 126, Class B cast iron or ASTM A 536 ductile iron
Seat Overlay	Not less than 90% nickel or Type 316 stainless steel
Plugs	One-piece ductile or cast iron
Sealing Surface	BUNA-N or chloroprene
Grit Seals	PTFE

*ASTM – American Society for Testing and Materials

E. **Fabrication and Assembly**

1. In conformance with AWWA C517 except where noted below.

2. Furnish valves 3 inches and larger with a welded-in overlay seat. Overlay thickness shall be not less than 0.125 inch. Sprayed, plated, or screwed-in seats are not acceptable.

3. Equip valve plug with grit seals on the upper and lower bearing journals to reduce torque and prevent dirt from entering bearing and seal area.

4. Valve Shaft Seals.

   a. Dual "U" cup type in accordance with AWWA C517-05, Section 4.4.7 or a multiple V-ring and installed on the upper and lower plug shafts.
   b. Seals shall be self-adjusting and repackable without removing the bonnet from the valve.
   c. Furnish valves with a spacer bonnet to allow for visual inspection for shaft leakage.

5. Valve Shaft Packing.

   a. Packing adjustment shall not result in an increase in plug friction or resulting torque.
   b. Packing replacement shall be achieved without need to cut packing during reinstallation and not require cap removal.

6. Valve Bearings. Furnish valves with replaceable sleeve-type bearings.

   a. 20-Inch-Diameter Valves and Under. The bearings shall be of sintered, oil-impregnated Type 316 stainless steel ASTM A 743, Grade CF8M.
   b. Over 20-Inch-Diameter Valves. The bearings shall be bronze or stainless steel Type 316.

2.2 **OPERATORS**. In accordance with Section 40 05 23, "Process Valves, General."

A. **Manual**

1. Valves 6-inch and smaller shall be wrench-operated and valves 8-inches and larger shall have worm gear operators.

2. All buried service plug valves shall have worm gear operators.

3. Wrench-operated valves shall be capable of being converted to worm gear or automated operation without removal of the bonnet or plug from the valve.

4. Equip all wrench-operated valves with a 2-inch square nut for use with removable levers or extended "T" handles.

5. Worm Gear Operators.

   a. Heavy-duty ductile iron construction with ductile iron quadrant supported on top and bottom by oil-impregnated bronze bearings.
   b. Manufacture the worm gear and shaft of hardened steel and run on high-efficiency roller bearings.
   c. Gear shall have both open and closed stops, shall be flush-mounted to the valve, exposing no portion of the plug stem and shall be rated for the valve design pressure rating for bidirectional shutoff.
   d. Buried service gears shall be designed and certified to withstand input loads of up to 300 foot-pounds minimum without damage.

2.3 **VALVE ACCESSORY PRODUCTS**. In accordance with Section 40 05 23, "Process Valves, General."

PART 3 – EXECUTION. In accordance with Section 40 05 23, "Process Valves, General."

3.1 **ATTACHMENTS**

A. **Valve Schedule**

Location	Pipe/Use	Type	Size (Inches)	Ends	Quantity	Operator	Controls	Accessories	Installation	NSF 61 Compliant?	Operation	Service
PUMP	Transfer Pump Isolation - Discharge	FP	6	FLG	2	MH	NA	N	AG	N	OC	WW
PUMP	Transfer Pump Isolation - Suction	FP	4	FLG	2	MH	NA	N	AG	N	OC	WW
BFP	Isolation for Temporary Dewatering Equipment Sludge Feed Connection	FP	4	FLG	1	MH	NA	N	AG	N	OC	WW

Schedule Notes:
Location: PUMP – in the Pump Room, BFP – in the Belt Filter Press Room
Type: FP – full port; RP – reduced port.
Ends: FLG – flanged; GR – grooved; MJ – mechanical joint.
Operator: MH – manual handwheel; MC – manual chainwheel; MN – manual nut; PAE – power-actuated electric.
Controls: DG – digital; AG – analog; CC – contact closure; NA – not applicable.
Accessories: FS – floor stands; ES – extension stems; EB – extended bonnets; FB – floor boxes; VB – valve boxes; N – none
Installation: BU – buried; AG – above ground; SM – submerged.
Operation: OC – open/closed; MOD – modulating.
Service: WW – wastewater; CW – clean water.

END OF SECTION

Northern Kentucky Water District
FTTP Residuals Handling Improvements

Addendum No. 2
June 23, 2020

A. Scope. Addendum No. 2 consists of Pages AD2-1 through AD2-3 and includes the following additions, clarifications, and changes to the specifications and drawings for this project. Attachments include 1 specification section (00 41 20).

B. Specifications

1. **Section 00 41 20** – Bid Equipment and Components

   Replace this section in its entirety. This includes the section in the original bid documents and the section that was provided as part of Addendum No. 1. Replace specification page 00 41 20 – Page 1 of 1 dated 6/5/20 with specification page 00 41 20 – Page 1 of 1 dated 6/22/20 (attached to this Addendum). Fairbanks-Morse was added to the listed manufacturers for sludge transfer pumps (33 32 16).

2. **Section 26 24 16** – Panelboards

   Delete paragraph 2.3.A.2. that reads "Minimum short circuit rating as indicated or as required to meet the short circuit study criteria specified elsewhere."

3. **Section 44 72 74** – Polymer Metering Pumps

   Replace the last sentence of paragraph 2.1.A. "The base bid equipment shall be as manufactured by" with "The base bid equipment shall be Series 600 as manufactured by". This is on page 3 of 6.

   Replace "Integral pressing shoe technology" in the first sentence of paragraph 2.1.B. with "integral roller head technology". This is on page 3 of 6.

   Replace "Integrally mounted shoes" in the first sentence of paragraph 2.1.D.2. with "integrally mounted roller heads". This is on page 3 of 6.

C. Drawings

1. **Sheet 22** – Polymer System Enlarged Plan and Section

   Add Coded Note 8 to sheet 22 and add a Coded Note 8 callout to "eyewash & shower" as follows:

   8. Provide eyewash and shower, Guardian, Model G1902, with floor mount, stainless steel eyewash bowl, sign, and shower hood and piping orange in color.

2. **Sheet 23** – Dewatering Building Loading Area Drain Plan

Add the to the Polymer System Schematic the following general note:

Water Supply and Polymer Piping Notes: Hot Water Tank on Sheet 23 is the same as Domestic Water Heater on Sheet 25. From the existing potable water supply line, tie the cold water into the water heater with a new supply line. Route a new supply line to the new polymer system, connected to both a hot water supply and cold water supply so it can be charged with either hot or cold water. In a separate new line, route a line to the pressure washer, connected to both a hot water supply and cold water supply so it can be charged with either hot or cold water. Also in a separate new line, supply tempered water to the new eyewash. Provide a cold water bypass around the heater and interconnect with the existing water line downstream of the new water heater. Supply and bypass piping, along with corresponding isolation ball valves, shall be 1" Schedule 80 PVC and all other piping and isolation ball valves ¾" Schedule 80 PVC. Tie two new dilution water lines (1/2" Schedule 80 PVC) into existing water supply line. In addition to routing polymer solution to four injection rings, route to two belt filter mix tanks. Polymer piping can be a combination of new and existing piping and valves. Paint new piping to match existing piping.

3. **Sheet E-8** – Pump Room Power Plan

Replace the note that reads "Replace existing transfer pump starter with 2-20A/3P circuit breakers" with "Replace existing MCC bucket with transfer starter with new MCC bucket with 2-20A/3P circuit breakers".

4. **Sheet E-12** – Electrical Schedules and Details

Add to Panel Schedule DP-1, the following note: "An external surge protection device will be acceptable if mounted directly adjacent to panel and provided with internal disconnect switch."

Replace in Panel Schedule DP-1 the AIC Rating of "22K" with "65K".

D. Clarifications

1. **Temporary Power.** The power available from the existing FTTP facilities may be utilized by the Contractor for temporary power needs during construction for the duration of the project. The Contractor may also obtain a temporary service from the utility, if preferred.

2. **Domestic Water Piping and Polymer Piping in the Dewatering Room** may be schedule 80 PVC. All other water piping on this project that is in areas other than the Dewatering Room shall be copper piping per the piping schedule.

3. **Temporary Dewatering.** Additional details on typical solids production and temporary dewatering requirements are as follows:
   a. Solids content from the thickeners varies between 4- to 6-percent solids at the start of mid-week NKWD dewatering operations and during two pilots of

this dewatering equipment, this range was maintained most of the time during the several-weeks testing.

b. Volume of sludge varies based on river turbidity, which is generally highest in the spring months. Historical quantity of sludge produced to be dewatered ranges between 25,000 dry lb/week on an average basis and 42,000 dry lb/week on a maximum month basis.
c. Additional settled solids that can be applied to the dewatering system during sedimentation basin cleaning are estimated to increase the maximum month sludge to 59,300 dry lb/week. Please note this is dry lb/week and the dewatered sludge is approximately 20% solids so the amount of solids to be hauled off is significantly more. NKWD staff estimates the peak week sludge disposal can be as high as 10 to 13 dumpsters per week (at a limit of 12 tons per dumpster) for short periods during this sedimentation basin cleaning.
d. Polymer supply is based on NKWD annual usage. Historical application of 25-percent active polymer is approximately 6 lb per dry ton of sludge dewatered. Polymer necessary to produce acceptable dewatered sludge quality is to be supplied by NKWD throughout the temporary dewatering period, up to the amount defined in Addendum No. 1. Provided the Contractor is diligent in operation of the temporary dewatering equipment and is not overfeeding polymer, the amount of polymer provided by NKWD each month, will be an adequate supply, based on historical usage.
e. Each existing progressive capacity BFP feed pump's capacity varies between 30- and 150 gallons per minute (range adjustable with a variable frequency drive).
f. The holding capacity of the dewatering system (with holding capacity defined as point where solids are overflowing the weirs of either thickener) is approximately two to three days during average annual solids production.

ACKNOWLEDGEMENT BY BIDDER. Each Bidder is required to acknowledge the receipt of this Addendum No. 2 in the space provided therefore in the Bid Form and to file same with and attached to the Bid.

NORTHERN KENTUCKY WATER DISTRICT

SECTION 00 41 20

BID EQUIPMENT AND COMPONENTS

NORTHERN KENTUCKY WATER DISTRICT
FTTP RESIDUALS HANDLING IMPROVEMENTS

BIDDER shall indicate by placing an "X" in the "( )" space below for the equipment which shall be furnished in performance of the Work. Only one "X" shall be entered for a category of equipment or component identified by product name and specification number.

For the Dewatering Polymer System and Metering Pumps, BIDDER shall include base bid manufacturer indicated in lump sum bid indicated on the Bid Form. BIDDER may enter add / deduct to the Bid Form sum for alternative equipment, as noted in each category below. BIDDER must indicate whether the alternate is an add or deduct by circling the word which does apply and crossing out the word which does not apply. If no amount is entered, bidder agrees to perform Alternative at no change in cost. If neither add nor deduct is identified as stated herein, the bidder agrees to do the work described in the Alternative as a deduct. BIDDER shall follow these directions. Any Bid Form that is submitted not in compliance with these required identifications may be rejected by the OWNER and that Bid not considered in determining Award.

Equipment (Specification Section)	**Product Manufacturer or Supplier**
Sludge Transfer Pumps (33 32 16)	( ) a. Flygt ( ) b. KSB ( ) c. Ebara ( ) d. Fairbanks-Morse
Belt Filter Press Dewatering System (44 72 70)	( ) a. Andritz ( ) b. Komline-Sanderson ( ) c. Phoenix
Dewatering Polymer System (44 72 72)	Base Bid Manufacturer: Acrison Add / Deduct: ( ) a. ProMinent $_____ ( ) b. UGSI $_____ ( ) c. Velodyne $_____
Dewatering Polymer Metering Pumps (44 72 74)	Base Bid Manufacturer: Watson-Marlow Add / Deduct: ( ) a. Verder $_____ ( ) b. ProMinent $_____
Dewatered Sludge Screw Conveyor System (44 72 90)	( ) a. Custom Conveyor ( ) b. Jim Meyers and Sons ( ) c. JDV

End of Section

Northern Kentucky Water District
FTTP Residuals Handling Improvements

Addendum No. 3
June 29, 2020

A. **Scope.** Addendum No. 3 consists of Pages AD3-1 through AD3-4 and includes the following additions, clarifications, and changes to the specifications and drawings for this project. Attachments include 8 specification sections.

B. **Specifications**

1. **Section 00 01 10.10** – Table of Contents

   Replace this section in its entirety (this includes the original Table of Contents and the Table of Contents issued via Addendum No. 1). The Table of Contents was updated to include the specification sections added by Addendum No. 3.

2. **Section 00 41 20** – Bid Equipment and Components

   Replace this section in its entirety. This includes the section in the original bid documents and the section that was provided as part of Addendum No. 1 and Addendum 2. Replace specification page 00 41 20 – Page 1 of 1 dated 6/22/20 with specification page 00 41 20 – Page 1 of 1 dated 6/26/20 (attached to this Addendum).

   A section was added for Variable Frequency Motor Controllers (26 29 23) with Allen Bradley as the base bid equipment and ABB, Eaton, and Square D as allowable alternates.

   For Dewatering Polymer Metering Pumps (44 72 74), Watson-Marlow was removed as base bid equipment and the three listed manufacturers are listed for the Bidder to indicate upon which equipment the bid is based.

3. **Section 00 41 25** – Bid Bond

   ADD this specification to the specifications for this project.

4. **Section 00 52 13** – Agreement

   Delete "Article 8. Contract Correction Period" in its entirety. This is on page 4 of 7.

5. **Section 00 61 00** – Performance Bond

   ADD this specification to the specifications for this project.

6. **Section 00 62 00** – Payment Bond

ADD this specification to the specifications for this project.

7. **Section 00 65 00** – Certificate of Insurance

ADD this specification to the specifications for this project.

8. **Section 00 65 20** – Certificate of Property Insurance

ADD this specification to the specifications for this project.

9. **Section 00 73 01** – Supplementary Conditions

Delete paragraph 2 that begins with "All machinery, piping, materials…" in its entirety from "SC-13.07. Correction Period". This is on page 14 of 16.

10. **Section 01 11 00** – Summary of Work

Add to the end of paragraph 3.1.C "To perform gravity thickener scope of work, one thickener can be removed from service at a time. One thickener must be in service at all times. It shall be the Contractor's responsibility to manage the solids and dewatering systems to ensure solids do not overflow the active thickener (overtop the weirs where solids are then returned to the reservoirs). The Owner will clean and dewater the gravity thickeners for the Contractor's initial access. If additional access within the tank is required, the Contractor shall be responsible for dewatering and cleaning." This is on page 2 of 3.

11. **Section 26 29 23** – Variable Frequency Motor Controllers

Delete "and Section 26 01 26 – Testing of Electrical Systems." from paragraph 1.5.A.3.a.

Delete item 2.1.D.1. This is on page 7 of 17.

Add items to 2.1.D. as follows:

"1. The base bid equipment shall be PowerFlex 755 as manufactured by Allen-Bradley.

2. As indicated in the Bidding Documents, other manufacturers will be considered, including:
   a. ABB.
   b. Eaton.
   c. Square D.

12. **Section 28 23 13** – Video Surveillance System

Replace this section in its entirety. Replace specification 28 23 13 dated 3/24/20 with specification 28 23 13 dated 6/26/20 (attached to this Addendum).

13. **Section 44 72 70** – Belt Filter Press Dewatering System

Replace "NEMA 12" with NEMA 4X" in the first sentence of item 2.7.A. This is on page 19 of 28.

14. **Section 44 72 74** – Polymer Metering Pumps

Delete paragraph 2.1.A.

Add paragraph 2.1.A. as follows:

A. Manufacturer. Subject to compliance with the specifications, provide pumps by a manufacturer fully experienced, reputable, and qualified in the production of the equipment to be furnished. The equipment shall be as manufactured by one of the following:

1. Watson-Marlow.
2. Verder.
3. Prominent.

Delete paragraph 2.1.E.8. This is on page 5 of 6.

C. Drawings

1. **Sheet 9** – Pump Room Demolition Plans

Add the following note to the end of coded note 3: "The vault measures approximately 5' wide x 8' long x 6' deep. There is approximately 1' of mud in the bottom of the vault."

2. **Sheet 23** – Dewatering Building Loading Area Drain Plan

Add the following note to the end of coded note 1: "For all trench drains (new and existing) in the dumpster loading area, provide new aluminum grating and new angles cast in new concrete."

3. **Sheet 24** – Standard Details

Replace on the Adjustable Pipe Saddle Detail the note that reads "Anvil Fig. 264, Elcen Fig. 50 or equal for pipes 2 ½" to 36" diameter" with the following note "Type 304 stainless steel adjustable pipe support (Elcen Fig. 48, or equal) for pipes 2 ½" to 36" diameter". The entire assembly shall be stainless steel.

4. **Sheet E-11** – Dewatering Building Power Plan

Add a disconnect switch and control station tagged with keynote 24 and 38 respectively in the dumpster area.

Add three phase power connection and control connection with keynote 39 between disconnect switch and control station with motor operated slide gate no. 3.

Add feeder from disconnect switch, DP2-25, 27, 29.

This is to provide power and control to slide gate no. 3 on the screw conveyor.

5. **Sheet E-12** – Electrical Schedules and Details

   Add to Panel Schedule DP-2 for No. 25, 27, 29 "Slide Gate No. 3" with 20A/3P circuit breaker and 4#12, 1#12 GND., ¾" C feeder. This is changing No. 25, 27, 29 from unused space to power slide gate no. 3.

6. **Sheet I-3** – Process and Instrumentation Diagram

   Add a motor operated slide gate above the horizontal slide gate, with controls HS-451 (LOR), HMS-451 (OSC), ZSL-451, ZSH-451, and HMS-452 (OSC).

   Add inputs and outputs in BFP #1 Control Panel and BFP #2 Control Panel for VB-451, VD-451, ZIL-451 and ZIH-451.

   Add 480V and discrete connections matching those for the other two motor operated slide gates.

D. Clarifications

1. **Temporary Power.** The FTTP facility does not have 480-Volt power. If the Contractor requires 480-Volt power to power temporary dewatering equipment, it could be obtained by either providing a 12,470-Volt x 480-Volt transformer and connecting the primary side of the transformer to the plant primary power distribution system or by providing a 208-Volt x 480-Volt step up transformer. Either of these approaches would be capable of providing at least 80-Amps of 480-Volt power for powering temporary dewatering equipment. The Contractor shall be responsible for setting up and maintaining any and all temporary power feeds.

2. **Warranty Period.** The warranty period is intended to be 12 months for this project. This is true for equipment as well, unless otherwise noted.

3. **Sheet 3 – Site Piping Plan.** All site piping shown on this sheet is existing. The piping shown as "GT 6" New Piping" is existing site piping.

4. **Transfer Pump Ductile Iron Pipe Fittings.** Addendum No. 1 incorrectly clarified the 90-degree bend fittings for the transfer pump. Proposed 90-degree bends on the SUCTION side of the proposed transfer pumps shall be long radius bends and proposed 90-degree bends on the DISCHARGE side of the proposed transfer pumps shall be short radius bends.

ACKNOWLEDGEMENT BY BIDDER. Each Bidder is required to acknowledge the receipt of this Addendum No. 3 in the space provided therefore in the Bid Form and to file same with and attached to the Bid.

NORTHERN KENTUCKY WATER DISTRICT

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SECTION 00 41 20

BID EQUIPMENT AND COMPONENTS

NORTHERN KENTUCKY WATER DISTRICT
FTTP RESIDUALS HANDLING IMPROVEMENTS

BIDDER shall indicate by placing an "X" in the "( )" space below for the equipment which shall be furnished in performance of the Work. Only one "X" shall be entered for a category of equipment or component identified by product name and specification number.

For the Dewatering Polymer System and Metering Pumps, BIDDER shall include base bid manufacturer indicated in lump sum bid indicated on the Bid Form. BIDDER may enter add / deduct to the Bid Form sum for alternative equipment, as noted in each category below. BIDDER must indicate whether the alternate is an add or deduct by circling the word which does apply and crossing out the word which does not apply. If no amount is entered, bidder agrees to perform Alternative at no change in cost. If neither add nor deduct is identified as stated herein, the bidder agrees to do the work described in the Alternative as a deduct. BIDDER shall follow these directions. Any Bid Form that is submitted not in compliance with these required identifications may be rejected by the OWNER and that Bid not considered in determining Award.

Equipment (Specification Section)	**Product Manufacturer or Supplier**
Variable Frequency Motor Controllers (26 29 23)	Base Bid Manufacturer: Allen Bradley Add / Deduct: ( ) a. ABB $_____ ( ) b. Eaton $_____ ( ) c. Square D $_____
Sludge Transfer Pumps (33 32 16)	( ) a. Flygt ( ) b. KSB ( ) c. Ebara ( ) d. Fairbanks-Morse
Belt Filter Press Dewatering System (44 72 70)	( ) a. Andritz ( ) b. Komline-Sanderson ( ) c. Phoenix
Dewatering Polymer System (44 72 72)	Base Bid Manufacturer: Acrison Add / Deduct: ( ) a. ProMinent $_____ ( ) b. UGSI $_____ ( ) c. Velodyne $_____

Equipment (Specification Section)	Product Manufacturer or Supplier
Dewatering Polymer Metering Pumps (44 72 74)	( ) a. Watson-Marlow ( ) b. Verder ( ) c. ProMinent
Dewatered Sludge Screw Conveyor System (44 72 90)	( ) a. Custom Conveyor ( ) b. Jim Meyers and Sons ( ) c. JDV

End of Section

BID BOND

BIDDER (Name and Address)

_____
_____
_____

SURETY (Name and Address of Principal Place of Business)

_____
_____
_____

OWNER (Name and Address)

_____
_____
_____

BID

BID DUE DATE _____

PROJECT (Brief Description Including Location)

_____
_____
_____

BOND

BOND NUMBER _____

DATE (Not later than Bid due date) _____

PENAL SUM _____ _____
(Words) (Figures)

IN WITNESS WHEREOF Surety and Bidder intending to be legally bound hereby subject to the terms printed on the reverse side hereof do each cause this Bid Bond to be duly executed on its behalf by its authorized officer agent or representative

BIDDER	SURETY
_____(Seal)	_____(Seal)
Bidder's Name and Corporate Seal	Surety s Name and Corporate Seal
By _____	By _____
Signature and Title	Signature and Title (Attach Power of Attorney)
Attest _____	Attest _____
Signature and Title	Signature and Title

Note (1) Above addresses are to be used for giving required notice
(2) Any singular reference to Bidder Surety OWNER or other party shall be considered plural where applicable

1 Bidder and Surety jointly and severally bind themselves their heirs executors administrators successors and assigns to pay to OWNER upon default of Bidder the penal sum set forth on the face of this Bond

2 Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by OWNER) the executed Agreement required by the Bidding Documents and any performance and payment Bonds required by the Bidding Documents

3 This obligation shall be null and void if

3 1 OWNER accepts Bidder s Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by OWNER) the executed Agreement required by the Bidding Documents and any performance and payment Bonds required by the Bidding Documents or

3 2 All Bids are rejected by OWNER or

3 3 OWNER fails to issue a Noti e of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and if applicable consented to by Surety when required by paragraph 5 hereof)

4 Payment under this Bond will be due and payable upon default by Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from OWNER which notice will be given with reasonable promptness identifying this Bond and the Project and including a statement of the amount due

5 Surety waives notice of and any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by OWNER and Bidder provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from Bid due date without Surety s written consent

6 No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in paragraph 4 above is received by Bidder and Surety and in no case later than one year after Bid due date

7 Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located

8 Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond Such notices may be sent by personal delivery commercial courier or by United States Registered or Certified Mail return receipt requested postage pre paid and shall be deemed to be effective upon receipt by the party concerned

9 Surety shall cause to be attached to this Bond a current and effective Power or Attorney evidencing the authority of the officer agent or representative who executed this Bond on behalf of Surety to execute seal and deliver such Bond and bind the Surety thereby

10 This Bond is intended to conform to all applicable statutory requirements Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length If any provision of this Bond conflicts with any applicable statute then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect

11 The term Bid as used herein includes a Bid offer or proposal as applicable

Performance Bond

Any singular reference to Contractor Surety Owner or other party shall be considered plural where applicable

---

CONTRACTOR (Name and Address)

SURETY (Name and Address of Principal Place of Business)

OWNER (Name and Address)

CONTRACT
Date
Amount
Description (Name and Location)

BOND
Date (Not earlier than Contract Date)
Amount
Modifications to this Bond Form

Surety and Contractor intending to be legally bound hereby subject to the terms printed on the reverse side hereof do each cause this Performance Bond to be duly executed on its behalf by its authorized officer agent or representative

CONTRACTOR AS PRINCIPAL
Company (Corp Seal)

Signature _____
Name and Title

SURETY
Company (Corp Seal)

Signature _____
Name and Title
(Attach Power of Attorney)

(Space is provided below for signatures of additional parties if required)

CONTRACTOR AS PRINCIPAL
Company (Corp Seal)

Signature _____
Name and Title

SURETY
Company (Corp Seal)

Signature _____
Name and Title

EJCDC No 1910 28 A (1996 Edition)
Originally prepared through the joint efforts of the Surety Association of America Engineers Joint Contract Documents Committee the Associated General Contractors of America and the American Institute of Architects

1 The CONTRACTOR and the Surety jointly and severally bind themselves their heirs executors administrators successors and assigns to the Owner for the performance of the Contract which is incorporated herein by reference

2 If the CONTRACTOR performs the Contract, the Surety and the CONTRACTOR have no obligation under this Bond except to participate in conferences as provided in paragraph 3 1

3 If there is no OWNER Default, the Surety s obligation under this Bond shall arise after

3 1 The OWNER has notified the CONTRACTOR and the Surety at the addresses described in paragraph 10 below that the OWNER is considering declaring a CONTRACTOR Default and has requested and attempted to arrange a conference with the CONTRACTOR and the Surety to be held not later than fifteen days after receipt of such notice to discuss methods of performing the Contract If the OWNER the CONTRACTOR and the Surety agree the CONTRACTOR shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive the OWNER s right if any subsequently to declare a CONTRACTOR Default and

3 2 The OWNER has declared a CONTRACTOR Default and formally terminated the CONTRACTOR s right to complete the Contract Such CONTRACTOR Default shall not be declared earlier than twenty days after the CONTRACTOR and the Surety have received notice as provided in paragraph 3 1 and

3 3 The OWNER has agreed to pay the Balance of the Contract Price to

3 3 1 The Surety in accordance with the terms of the Contract,

3 3 2 Another contractor selected pursuant to paragraph 4 3 to perform the Contract

4 When the OWNER has satisfied the conditions of paragraph 3 the Surety shall promptly and at the Surety s expense take one of the following actions

4 1 Arrange for the CONTRACTOR, with consent of the OWNER to perform and complete the Contract, or

4 2 Undertake to perform and complete the Contract itself through its agents or through independent contractors or

4 3 Obtain bids or negotiated proposals from qualified contractors acceptable to the OWNER for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by the OWNER and the contractor selected with the OWNER s concurrence to be secured with performance and payment bonds executed by a qualified surety equivalent to the Bonds issued on the Contract, and pay to the OWNER the amount of damages as described in paragraph 6 in excess of the Balance of the Contract Price incurred by the OWNER resulting from the CONTRACTOR Default or

4 4 Waive its right to perform and complete arrange for completion or obtain a new contractor and with reasonable promptness under the circumstances

4 4 1 After investigation, determine the amount for which it may be liable to the OWNER and as soon as practicable after the amount is determined tender payment therefor to the OWNER, or

4 4 2 Deny liability in whole or in part and notify the OWNER citing reasons therefor

5 If the Surety does not proceed as provided in paragraph 4 with reasonable promptness the Surety shall be deemed to be in default on this Bond fifteen days after receipt of an additional written notice from the OWNER to the Surety demanding that the Surety perform its obligations under this Bond and the OWNER shall be entitled to enforce any remedy available to the OWNER If the Surety proceeds as provided in paragraph 4 4 and the OWNER refuses the payment tendered or the Surety has denied liability in whole or in part without further notice the OWNER shall be entitled to enforce any remedy available to the OWNER

6 After the OWNER has terminated the CONTRACTOR s right to complete the Contract, and if the Surety elects to act under paragraph 4 1 4 2 or 4 3 above then the responsibilities of the Surety to the OWNER shall not be greater than those of the CONTRACTOR under the Contract, and the responsibilities of the OWNER to the Surety shall not be greater than those of the OWNER under the Contract To a limit of the amount of this Bond but subject to commitment by the OWNER of the Balance of the Contract Price to mitigation of costs and damages on the Contract the Surety is obligated without duplication for

6 1 The responsibilities of the CONTRACTOR for correction of defective Work and completion of the Contract

6 2 Additional legal design professional and delay costs resulting from the CONTRACTOR s Default and resulting from the actions or failure to act of the Surety under paragraph 4 and

6 3 Liquidated damages or if no liquidated damages are specified in the Contract, actual damages caused by delayed performance or non performance of the CONTRACTOR

7 The Surety shall not be liable to the OWNER or others for obligations of the CONTRACTOR that are unrelated to the Contract and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations No right of action shall accrue on this Bond to any person or entity other than the OWNER or its heirs executors administrators or successors

8 The Surety hereby waives notice of any change including changes of time to the Contract or to related subcontracts purchase orders and other obligations

9 Any proceeding legal or equitable under this Bond may be instituted in any court of competent jurisdiction in the location in which the Work or part of the Work is located and shall be instituted within two years after CONTRACTOR Default or within two years after the CONTRACTOR ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond whichever occurs first If the provisions of this paragraph are void or prohibited by law the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable

10 Notice to the Surety the OWNER or the CONTRACTOR shall be mailed or delivered to the address shown on the signature page

11 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the Contract was be performed any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted here from and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein The intent is that this Bond shall be construed as a statutory bond and not as a common law bond

12 Definitions

12 1 Balance of the Contract Price The total amount payable by the OWNER to the CONTRACTOR under the Contract after all proper adjustments have been made including allowance to the CONTRACTOR of any amounts received or to be received by the OWNER in settlement of insurance or other Claims for damages to which the CONTRACTOR is entitled reduced by all valid and proper payments made to or on behalf of the CONTRACTOR under the Contract

12 2 Contract The agreement between the OWNER and the CONTRACTOR identified on the signature page including all Contract Documents and changes thereto

12 3 CONTRACTOR Default. Failure of the CONTRACTOR, which has neither been remedied nor waived to perform or otherwise to comply with the terms of the Contract

12 4 OWNER Default. Failure of the OWNER, which has neither been remedied nor waived to pay the CONTRACTOR as required by the Contract or to perform and complete or comply with the other terms thereof

(FOR INFORMATION ONLY Name Address and Telephone)
AGENT or BROKER OWNER S REPRESENTATIVE (Engineer or other party)

Payment Bond

Any singular reference to Contractor Surety Owner or other party shall be considered plural where applicable

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CONTRACTOR (Name and Address)

SURETY (Name and Address of Principal Place of Business)

OWNER (Name and Address)

CONTRACT
Date
Amount
Description (Name and Location)

BOND
Date (Not earlier than Contract Date)
Amount
Modifications to this Bond Form

Surety and Contractor intending to be legally bound hereby subject to the terms printed on the reverse side hereof do each cause this Payment Bond to be duly executed on its behalf by its authorized officer agent or representative

CONTRACTOR AS PRINCIPAL		SURETY	
Company	(Corp Seal)	Company	(Corp Seal)
Signature _____		Signature _____	
Name and Title		Name and Title (Attach Power of Attorney)	

(Space is provided below for signatures of additional parties if required)

CONTRACTOR AS PRINCIPAL		SURETY	
Company	(Corp Seal)	Company	(Corp Seal)
Signature _____		Signature _____	
Name and Title		Name and Title	

EJCDC No 1910 28 B (1996 Edition)
Originally prepared through the joint efforts of the Surety Association of America Engineers Joint Contract Documents Committee the Associated General Contractors of America the American Institute of Architects the American Subcontractors Association, and the Associated Specialty Contractors

1 The CONTRACTOR and the Surety jointly and severally bind themselves their heirs executors administrators successors and assigns to the OWNER to pay for labor materials and equipment furnished for use in the performance of the Contract, which is incorporated herein by reference

2 With respect to the OWNER this obligation shall be null and void if the CONTRACTOR

2 1 Promptly makes payment directly or indirectly for all sums due Claimants and

2 2 Defends indemnifies and holds harmless the OWNER from all claims demands liens or suits by any person or entity who furnished labor materials or equipment for use in the performance of the Contract provided the OWNER has promptly notified the CONTRACTOR and the Surety (at the addresses described in paragraph 12) of any claims demands liens or suits and tendered defense of such claims demands liens or suits to the CONTRACTOR and the Surety and provided there is no OWNER Default

3 With respect to Claimants this obligation shall be null and void if the CONTRACTOR promptly makes payment directly or indirectly for all sums due

4 The Surety shall have no obligation to Claimants under this Bond until

4 1 Claimants who are employed by or have a direct contract with the CONTRACTOR have given notice to the Surety (at the addresses described in paragraph 12) and sent a copy or notice thereof to the OWNER stating that a claim is being made under this Bond and with substantial accuracy the amount of the claim

4 2 Claimants who do not have a direct contract with the CONTRACTOR.

1 Have furnished written notice to the CONTRACTOR and sent a copy or notice thereof to the OWNER, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating with substantial accuracy the amount of the claim and the name of the party to whom the materials were furnished or supplied or for whom the labor was done or performed and

2 Have either received a rejection in whole or in part from the CONTRACTOR or not received within 30 days of furnishing the above notice any communication from the CONTRACTOR by which the CONTRACTOR had indicated the claim will be paid directly or indirectly and

3 Not having been paid within the above 30 days have sent a written notice to the Surety and sent a copy or notice thereof to the OWNER stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to the CONTRACTOR

5 If a notice required by paragraph 4 is given by the OWNER to the CONTRACTOR or to the Surety that is sufficient compliance

6 When the Claimant has satisfied the conditions of paragraph 4 the Surety shall promptly and at the Surety s expense take the following actions

6 1 Send an answer to the Claimant with a copy to the OWNER within 45 days after receipt of the claim stating the amounts that are undisputed and the basis for challenging any amounts that are disputed

6 2 Pay or arrange for payment of any undisputed amounts

7 The Surety s total obligation shall not exceed the amount of this Bond and the amount of this Bond shall be credited for any payments made in good faith by the Surety

8 Amounts owed by the OWNER to the CONTRACTOR under the Contract shall be used for the performance of the Contract and to satisfy claims if any under any Performance Bond By the CONTRACTOR furnishing and the OWNER accepting this Bond they agree that all funds earned by the CONTRACTOR in the performance of the Contract are dedicated to satisfy obligations of the CONTRACTOR and the Surety under this Bond subject to the OWNER s priority to use the funds for the completion of the Work

9 The Surety shall not be liable to the OWNER Claimants or others for obligations of the CONTRACTOR that are unrelated to the Contract The OWNER shall not be liable for payment of any costs or expenses of any Claimant under this Bond and shall have under this Bond no obligations to make payments to give notices on behalf of or otherwise have obligations to Claimants under this Bond

10 The Surety hereby waives notice of any change including changes of time to the Contract or to related Subcontracts purchase orders and other obligations

11 No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the Work or part of the Work is located or after the expiration of one year from the date (1) on which the Claimant gave the notice required by paragraph 4 1 or paragraph 4 2 3 or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs If the provisions of this paragraph are void or prohibited by law the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable

12 Notice to the Surety the OWNER or the CONTRACTOR shall be mailed or delivered to the addresses shown on the signature page Actual receipt of notice by Surety the OWNER or the CONTRACTOR however accomplished shall be sufficient compliance as of the date received at the address shown on the signature page

13 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the Contract was to be performed any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein The intent is that this Bond shall be construed as a statutory Bond and not as a common law bond

14 Upon request of any person or entity appearing to be a potential beneficiary of this Bond the CONTRACTOR shall promptly furnish a copy of this Bond or shall permit a copy to be made

15 DEFINITIONS

15 1 Claimant An individual or entity having a direct contract with the CONTRACTOR or with a Subcontractor of the CONTRACTOR to furnish labor materials or equipment for use in the performance of the Contract The intent of this Bond shall be to include without limitation in the terms labor materials or equipment that part of water gas power light, heat, oil gasoline telephone service or rental equipment used in the Contract architectural and engineering services required for performance of the Work of the CONTRACTOR and the CONTRACTOR s Subcontractors and all other items for which a mechanic s lien may be asserted in the jurisdiction where the labor materials or equipment were furnished

15 2 Contract. The agreement between the OWNER and the CONTRACTOR identified on the signature page including all Contract Documents and changes thereto

15 3 OWNER Default. Failure of the OWNER which has neither been remedied nor waived to pay the CONTRACTOR as required by the Contract or to perform and complete or comply with the other terms thereof

(FOR INFORMATION ONLY--Name Address and Telephone)
AGENCY or BROKER OWNER S REPRESENTATIVE (Engineer or other party)

CERTIFICATE OF INSURANCE

Issue Date:

PRODUCER:

Code Sub-Code

INSURED:

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW.

COMPANIES AFFORDING COVERAGE

COMPANY LETTER A	
COMPANY LETTER B	
COMPANY LETTER C	
COMPANY LETTER D	
COMPANY LETTER E	

COVERAGES

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES.

CO LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE	POLICY EXPIRATION DATE	ALL LIMITS IN THOUSANDS	
	GENERAL LIABILITY				GENERAL AGGREGATE	$1,000,
	[X] COMMERCIAL GENERAL LIABILITY				PRODUCTS-COMP/OPS AGGREGATE	$1,000,
	[X] OCCURRENCE	(Completed Operations & Products Liability remains			PERSONAL & ADVERTISING INJURY	$1,000,
	[X] BLANKET CONTRACTUAL	in force for 2 years after final payment)			EACH OCCURRENCE	$1,000,
	[ ] _____					
	AUTOMOBILE LIABILITY					
	[X] ANY AUTO				COMBINED SINGLE LIMIT EACH OCCURRENCE Bodily Injury & Property Damage	$1,000,
	[X] HIRED AUTOS					
	[X] NON-OWNED AUTOS					
	EXCESS LIABILITY				EACH OCCURRENCE	$4,000,
	[X] UMBRELLA FORM	(Follows Form of the Primary)			AGGREGATE	$4,000,
	WORKERS' COMPENSATION AND EMPLOYERS' LIABILITY				STATUTORY	
					EACH ACCIDENT	$1,000,
		(Includes US Longshoremen and Harbor Workers Act and Maritime Coverage Where Applicable and All States Endorsement)			DISEASE-POLICY LIMIT	$1,000,
					DISEASE-EACH EMPLOYEE	$1,000,
	OTHER				EACH OCCURRENCE	
	[ ] _____				AGGREGATE	

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS:

1. Certificate Holder(s) & their Officers, Directors, Partners, Employees, & Agents Named as Additional Insured (all policies except WC). The coverage afforded the Additional Insured under these policies shall be primary insurance. If the Additional Insured has other insurance which is applicable to the loss, such other insurance shall be on an excess or contingent basis. (Copy of Additional Insured Endorsement attached.)
2. Blanket Coverage for XCU Hazards (General Liability & Excess Liability).
3. Waiver of Subrogation Against Certificate Holder(s), Their Officers, Directors, Partners, Employees, & Agents (all policies).
4. Contractual Coverage covers liability assumed in the Indemnification Clause of the Contract between Certificate Holder and Insured (General Liability & Excess Liability).
5. General and Products/Completed Operations aggregates apply for each Certificate Holder contract(s) or amendments (General Liability & Excess Liability).
6. Contractual Liability Limitation Endorsement CG2139 or its equivalent is not included in either General or Excess Liability policies.
7. Severability of Interest or Cross Liability clause or endorsement included (General Liability & Excess Liability).

CERTIFICATE HOLDERS	CANCELLATION
1.	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELED, TERMINATED, OR MATERIALLY CHANGED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING COMPANY WILL MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDERS NAMED TO THE LEFT. ANY IMPAIRMENT OR EXHAUSTION OF AGGREGATES WILL BE THE SUBJECT OF IMMEDIATE NOTICE TO THE CERTIFICATE HOLDERS.
2.	AUTHORIZED REPRESENTATIVE

CERTIFICATE OF PROPERTY INSURANCE

ISSUE DATE _____ (mm/dd/yy)

THIS IS EVIDENCE THAT INSURANCE AS IDENTIFIED BELOW HAS BEEN ISSUED IS IN FORCE AND CONVEYS ALL THE RIGHTS AND PRIVILEGES AFFORDED UNDER THE POLICY

PRODUCER	COMPANY
Code Sub-Code	
INSURED	POLICY NUMBER
	EFFECTIVE DATE (mm/dd/yy) / EXPIRATION DATE (mm/dd/yy)

PROPERTY INFORMATION

LOCATION/DESCRIPTION

COVERAGE INFORMATION

COVERAGES/PERILS/FORMS	AMOUNT OF INSURANCE	DEDUCTIBLE
BUILDERS RISK/INSTALLATION FLOATER All Risk of Physical Damage or Loss to Equipment and Materials at or Incidental to the Jobsite on Completed Value Form	Insurable value of completed work.	

REMARKS (Including Special Conditions)

1 Certificate Holder and others identified in the property insurance paragraph of the Contract Documents are Named Insureds
2 Waiver of Subrogation against Named Insureds
3 Any similar insurance carried by Named Insureds is excess of coverage described hereon
4 Losses are payable to Owner as fiduciary for the Named Insureds

CANCELLATION

THIS POLICY IS SUBJECT TO THE PREMIUMS FORMS AND RULES IN EFFECT FOR EACH POLICY PERIOD SHOULD THE POLICY BE TERMINATED OR MATERIALLY CHANGED THE COMPANY WILL GIVE THE CERTIFICATE HOLDERS IDENTIFIED BELOW 30 DAYS' WRITTEN NOTICE, AND WILL SEND NOTIFICATION OF ANY CHANGES TO THE POLICY THAT WOULD AFFECT THAT INTEREST IN ACCORDANCE WITH THE POLICY PROVISIONS OR AS REQUIRED BY LAW

CERTIFICATE HOLDERS

Name and Address	Nature of Interest
1	X Additional Named Insured
2	SIGNATURE OF AUTHORIZED AGENT OF THE COMPANY

SECTION 28 23 13

VIDEO SURVEILLANCE SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

A. Work Included: This section includes a complete and operational Video Surveillance System (VSS).

B. Related Sections and Divisions: Applicable provisions of Division 01 shall govern work in this section.

1.2 SYSTEM DESCRIPTION

A. Provide a complete Operating Video Surveillance System (VSS). The system shall include fixed cameras, protective housings, Workstation, monitor, keyboard and mouse, wiring, and all other equipment necessary for a complete and operational Video Surveillance System.

B. CONTRACTOR shall be responsible for providing final working drawings to be approved by ENGINEER and OWNER, based on the information described herein and shown on the drawings as well as by field observations. System design provided is not intended and does not show all details required for a complete system.

C. CONTRACTOR shall inspect all work. The Bid shall include everything necessary to obtain a complete installation operating in accordance with these specifications. All responsibility for these systems ultimately lies with CONTRACTOR.

D. CONTRACTOR shall be responsible for the placing of circuits and making of electrical connections in accordance with the manufacturer-furnished drawings, instructions, and field supervision to provide proper connection. The Contract shall include the services of the manufacturer's factory engineer to supervise making of connections to power supplies, communication circuits, and any other connections external to the new Video Surveillance equipment; to adjust the equipment; initiate and check operation; instruction of OWNER's staff on operation and maintenance of the equipment, and place the equipment in operation in a manner fully satisfactory to OWNER.

1.3 QUALITY ASSURANCE

A. Installer: A qualified security system contractor shall be one which has a minimum of 5 years experience with security systems of size and complexity as specified herein.

B. The System Supplier shall provide the final checkout and testing.

C. The complete installation is to conform to the applicable sections of the National Electric Code.

D. All items of the Video Surveillance System be listed under the appropriate category by Underwriters Laboratories, Inc. (UL), and shall bear the UL label.

1.4 SUBMITTALS

A. Submit shop drawings and product data in accordance with provisions of Section 01 33 00–Submittals.

B. Provide wiring diagrams, equipment ratings, dimensions and finishes for all proposed devices and equipment.

C. Provide a complete Surveillance System riser diagram including: Point of origin of each camera circuit, circuit type and labeling, area covered by each camera, wire/cable type and size, and locations of POE network switch.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 01 33 00–Submittals.

B. Include source and current prices of replacement parts and supplies and recommended maintenance procedures and intervals.

C. Submit a record copy of site-specific computer software of software-based Video Surveillance System.

1.6 DELIVERY, STORAGE, AND HOLDING

A. Store in a clean, dry space. Maintain factory wrapping or provide additional plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer’s written instructions.

1.7 VIDEO SURVEILLANCE SYSTEM SUPPLIER AND GENERAL REQUIREMENTS

A. This specification, along with the Contract drawings, defines the requirements of a computer-based Video Surveillance System. Video Surveillance System supplier shall construct a surveillance system specifically for the demanding requirements of a closed-circuit television system.

B. It is the intent of this specification to define a fully integrated surveillance system, tested, delivered to the site, ready to function upon connection of power source and field wiring. Components, peripherals, interconnections, cabling, power supplies, software, and services necessary to form a complete, integrated system shall be identified and provided by CONTRACTOR. CONTRACTOR shall be responsible for reviewing the wiring diagrams and control sequences for equipment provided under other sections of this specification and coordinating all

interface requirements. CONTRACTOR shall submit to ENGINEER in writing any deficiencies noted during this review. Any changes required by CONTRACTOR due to failure to complete this review shall be the responsibility of CONTRACTOR at no increase in cost to OWNER.

C. To provide a complete and totally integrated system, a single manufacturer who has experience in furnishing similar video surveillance systems of the same complexity and size shall provide specified equipment and services. The system proposed to meet this specification shall be of field-proven design, incorporating manufacturer's standard equipment and software. Service of all peripheral devices shall be provided by the manufacturer of the Video Surveillance System.

D. Design and specification of devices and completed system shall conform to applicable portions of latest edition of National Electrical Code (NEC).

E. Training Program:

1. Submit training plan including course syllabus, personnel who will be conducting the training, and schedule.

2. Provide materials, instructors, and workbooks to complete the training.

3. Training courses shall include: Operator training: Course length minimum 1 day. Training shall utilize equipment specified herein following installation and field testing. (Two half-day sessions with four personnel each shall be provided. Training sessions shall occur at a minimum of 1-month intervals.)

4. Manufacturer's training shall be directed to system and equipment operation, maintenance, troubleshooting, and equipment and system-related areas.

5. Training shall conform to the requirements in Sections 01 43 23 and 01 91 13.

F. Post start-up support shall include replacements of defective equipment, as well as additional training, software modifications, and control configurations as requested by OWNER. This shall include an allowance of 16 hours for work on-site other than warranty repair or replacement of defective equipment. This time shall be used for software enhancements and modifications to improve the operation of the system. It shall be assumed that this 16 hours includes two trips to the site.

G. Video surveillance supplier shall meet the following minimum requirements:

1. Video surveillance supplier shall have a full-time staff of qualified technicians who are knowledgeable in the configuration of networked systems and the equipment being provided.

2. Video surveillance supplier shall have a minimum of one Microsoft Certified Engineer.

3. Video surveillance supplier shall have training capabilities and shall have conducted training courses in setup and operation.

4. Video surveillance supplier shall have an adequate inventory of spare parts.

5. Video surveillance supplier shall have a full-time staff of qualified service technicians.

6. Video surveillance supplier shall be responsible for start-up and documentation of the system.

7. Video surveillance supplier shall be responsible for all details that may be necessary to properly install, wire, adjust, and place in operation a complete and working system.

8. Video surveillance supplier shall be responsible for all coordination between the system and the field devices furnished with other divisions of this specification.

H. All components are to be standard make acceptable to OWNER, with one manufacturer to provide all similar components.

1.8 **WARRANTY**

A. Standard One-Year Warranty: Unless otherwise stated below, manufacturer shall warrant the equipment to be free from defects in material and workmanship for a period of one year from the earlier of either the date established or the date specific equipment or process is considered substantially complete and placed into beneficial service.

PART 2 – PRODUCTS

2.1 FIXED CAMERAS

A. All cameras shall be of the same manufacturer unless noted otherwise.

B. The network camera system shall offer two simultaneous video streams with up to 2 MPx,1920 by 1080 resolution, auto iris, and varifocal lens capabilities.

C. The network camera system shall possess the following primary characteristics:

1. H.264 High or Main profiles; and MJPEG compression.

2. 2 megapixels.

3. Dual streaming (two independent IP video streams).

4. Day/night operation with IR cut filter.

5. Wide Dynamic Range (WDR): 75 dB minimum.

6. PoE+ Class 4, 24 VAC and PoE+.

7. Pelco Smart Compression Technology.

8. Multicast or unicast capable with unlimited H.264 viewers.

9. Unicast capable with up to 20 simultaneous viewers.

10. Local storage via SD card.

11. Audio input and output.

12. Alarm input and output.

13. IP66 rated housing.

D. Imaging Device:

Model	Sensor	Maximum Resolution
2 MPx	1/2.8-inch	1920 x 1080 (2.1 MPx)

E. Imager Type: CMOS

F. Electronic Shutter Range:

Model	Range
2 MPx	1/5 – 1/25,000 sec

G. Minimum illumination:

1. Color mode:

Model	Sensitivity
2 MPx	0.25 lux (33 ms, F1.2), 0.03 lux (200 ms, F1.2)

2. Black & white mode:

Model	Sensitivity
2 MPx	0.10 lux (33 ms, F1.2), 0.02 lux (200 ms, F1.2)

H. Scanning: Progressive

I. Image Control Settings

1. White balance range: 2,000º to 10,000ºK

2. Adaptive IR Illumination

3. Day and night settings

4. Privacy zone definition: up to 8 zones of window blanking

5. 3D noise reduction

J. Lens:

1. Built-in, varifocal

2. Focal Length: F1.4, 3 ~ 10.5 mm

3. Zoom: Remote

4. Auto Iris: DC drive lens

5. Auto Focus: Automatically focuses during runtime operation

6. Field of view:

	2 MPx
Diagonal	116º ~ 35º
Horizontal	100º ~ 31º
Vertical	54º ~ 17º

K. Video:

1. The network camera system shall support up to 2 simultaneous streams; the secondary stream is variable based on the setup of the primary stream.

2. Compression type: H.264 High or Main profiles; and MJPEG

3. Corridor Mode: Electronic image flip and mirror: 180°, 90° 270° (H.264 only)

4. Service Stream: 640 x 480 or 640 x 352; 2 ips, JPEG

5. Available resolutions:

Model	Width x Height	Aspect Ratio
2.1	1920 x 1080	16:9

6. Constant bit rate (CBR), constrained variable bit rate (CVBR) with configurable maximum value.

7. Frame rate:

MPx	Images per Second (ips)
2	30, 25, 20, 16.67, 15, 12.5, 10, 7.5, 5, 3, 2, 1

8. Video streams shall support ONVIF profile S.

9. Pelco's Smart Compression Technology lowers bandwidth and storage requirements by up to 70%. Our technology allows the user to make intelligent decisions regarding storage savings and image quality.

10. Low resolution JPEG stream for configuration of camera settings.

L. Storage and Recording

1. The network camera system control shall have onboard SD card storage.

   a. Card type: Micro SD
   b. Capacity: up to 64 GB

2. The local SD storage shall have the ability to be backed up to alternate media without removal of the SD card from the camera.

3. Local recording on the SD card shall commence upon loss of network connectivity, based on a pre-programmed schedule.

4. The network camera system shall record video continuously in the case of network outage.

5. Alarm recording: The network camera system shall capture selectable 1, 5, or 10 second video clips on camera sabotage, motion detection, or alarm input.

6. Video recording and storage shall support ONVIF profile G.

M. Manual Pan Tilt

1. Pan Range: 370º

2. Tilt Range: +1º –90º

3. Rotate Range: 355

N. Simple motion and sabotage analytics.

O. Connectivity: 100 BASE-TX Ethernet with RJ-45 connector

P. Protocols supported

1. Transmission Control Protocol (TCP), Internet Protocol (IP) v4 and v6, User Datagram Protocol (UDP)

2. Configuration: Dynamic Host Configuration Protocol (DHCP)

3. Web services: Hypertext Transfer Protocol (HTTP), Secure HTTP (HTTPS)

4. Network services: Domain Name System (DNS), Network Time Protocol (NTP), Internet Control Message Protocol (ICMP), Simple Network Management Protocol (SNMP) v2c/v3, Universal Plug and Play (UPnP)

5. Media: Real-Time Transport Protocol (RTP), Real-Time Streaming Protocol (RTSP)

6. Multicast: Internet Group Management Protocol (IGMP)

7. Notifications: File Transfer Protocol (FTP), Simple Mail Transfer Protocol (SMTP)

8. Remote Access: Secure Shell (SSH)

9. Security: Secure Sockets Layer (SSL), IEEE 802.1x (EAP-MD5, EAP-TLS, EAP-TTLS, EAP-PEAP and EAP-FAST)

10. Quality of Service: IEEE 802.1p Layer 3 Differentiated Services Code Point (DSCP)

11. DDNS–The network camera system shall support DDNS services offered by the Manufacturer and other publicly available service offerings.

Q. Q. Security

1. The network camera system shall support IP address filtering whereby users can enter a list of allowed or blocked IP addresses for viewing video and configuring camera settings

2. The network camera system shall provide three levels of user access with password protection.

3. User authentication shall be available through a Lightweight Directory Access Protocol (LDAP) server.

R. The network camera system shall have a built in web server which supports browser-based configuration.

S. The camera’s web server shall allow access to camera information and all primary software functions.

T. The Manufacturer shall offer video viewer and configuration to implement the following actions:

1. Camera discovery

2. Live Video

    a. Video stream selection
    b. Video stream configuration
        1) Use preset video setting configurations
        2) Configure custom video setting configurations
        3) Multicast
        4) Unicast
        5) JPEG frame rate
    c. Maximize view area of video to full size of browser
        1) Revert to normal view
    d. Open stream in new window
    e. Capture and save image as .jpg file
    f. Resize viewing area

3. Image Settings

    a. image quality
    b. exposure
    c. focus
    d. white balance
    e. window blanking
    f. digital zoom
    g. lighting mode
    h. video noise reduction
    i. digital processing (color and detail adjustment)
        1) image enhancement
        2) quick setup preset modes
        3) sharpness
        4) saturation
        5) contrast
        6) brightness
    j. exposure modes

4. Recording

    a. Initiate instant record and playback
    b. Manage SD card storage

5. Events

    a. configure event sources:
        1) external alarm events
        2) analytic events
    b. e-mail setup
    c. define web addresses for notifications

6. Camera network settings

7. System

    a. firmware upgrade
    b. reset to factory default
    c. set date, time, and NTP server synchronization
    d. user access control
    e. view and export camera settings
    f. view system logs

U. Acceptable Web Browsers:

1. Microsoft® Internet Explorer® 9.0

2. Apple® Safari® 7.0.6

3. Mozilla® Firefox® 31.0

4. Google® Chrome™ 37.0.2032.124 m and later

V. The Manufacturer shall offer a mobile application with the capability to access live video from up to 500 cameras.

W. The Manufacturer shall support integrations as follows:

1. Video Management: VideoXpert™; Endura® 2.0 (or later); Digital Sentry® 7.3 (or later); Third-party system through Pelco API/SDK, ONVIF Profile S, Profile G, and Profile Q

2. Mobile Application

3. Camera Discovery and Firmware: Discover cameras upgrade firmware upgrade

X. Power

1. Source Options

    a. 24 VAC and PoE+
    b. PoE+ Class 4
    c. 18 to 32 VAC range, 12 VDC

2. Power Consumption: <16 W (with heater ring)

Y. Connectors:

1. Ethernet: RJ-45 connector

2. External power: 2-conductor power to terminal block

Z. Construction Material: Aluminum body and trim ring, polycarbonate bubble

AA. Finish: RAL 7047

BB. Impact Resistance: IK10 (20J)

CC. Temperature:

1. Operating: -40°C to 55°C (-40°F to 131°F)

2. Storage: -40°C to 60ºC (-40°F to 140ºF)

DD. Ingress Protection: IP66

EE. NEMA Type 4X

FF. Exterior Environmental Mini Dome fixed camera with Day/Night standard resolution type model IMP321-1RS as manufactured by Pelco, or equal. System supplier shall provide camera lenses as required per camera location. Camera lens shall be Varifocal, 1/3-inch format, Auto Iris, and IR corrected. Coordinate exact lens type with camera coverage area shown on drawings.

2.2 COMPUTER MONITOR

A. Minimum 17-inch (viewable) SVGA, color, 1920 by 1440 pixel, noninterlaced, dot pitch 0.31 inch maximum. Monitor shall be flat LCD type. Monitor shall have BNC and VGA inputs. Monitor shall be capable of having two independent input sources. Monitor shall be capable of toggling between sources. Monitor shall be connected to the video surveillance VMS.

2.3 ENHANCED KEYBOARD

A. The keyboard must be compatible with all distributed, network video management systems.

B. The keyboard must support USB 2.0 protocol, and the USB must operate at full-speed.

C. System Requirements

1. Windows Vista, Windows 7, or Windows 8/8.1

2. Two (2) USB ports

3. 70 MB of available hard disk space

2.4 MOUSE CONTROLLERS

A. The 3D Mouse must be compatible with all distributed, network video management components.

B. Patented six-degrees-of-freedom (6DoF) sensor–Intuitively and precisely navigate digital models or camera positions in 3D space.

C. Advanced ergonomic design–The full-size, soft-coated hand rest positions the hand comfortably, and 15 large, soft-touch, function keys allow quick access to frequently used commands.

D. QuickView Keys–Fingertip access to 12 views makes it easier to switch cameras.

E. Intelligent Function Keys–Easy access to 4 application commands for an optimized workflow.

F. On-Screen Display–Provides a visual reminder of function key assignments on your computer screen.

G. 3D Space Mouse Modifiers–Fingertip access to Ctrl, Shift, Alt and Esc keys saves time by reducing the need to move your hand between mouse and 3D Mouse.

H. Virtual NumPad–Allows direct numerical input into your application using your standard mouse rather than the 3D Mouse.

I. The 3D Mouse must be part of an integrated system and shall be configured so any number can be added to the system. When combined with user interfaces (UIs), network storage managers (NSMs), encoders, IP cameras, and video consoles, the 3D Mouse forms an integral part of a complete network-based video control system.

J. Hardware

1. Power Supply

    a. Input Connector Type Universal, interchangeable

2. Connectivity

    a. 3D Space Mouse Interface USB 2.0
    b. Cable USB

3. Module Specifications

    a. 3D Space Mouse Keypad
    b. Joystick Fully proportional PTZ, variable speed; with zoom, iris, and focus controls

4. Physical

    a. Dimensions 204 x 142 x 58 cm (8.0" D x 5.6" W x 2.3" H)
    b. Unit Weight 665 g (1.47 lbs)

5. Environmental

a. Ambient Temperature 21° to 23°C (70° to 74°F)

K. Operating Temperature 0° to 40°C (32° to 104°F) air intake of unit

2.5 WORKSTATION

A. Specifications / Minimum Hardware Requirements

1. Processor: Intel Core™ i7-8700

2. Operating System: Microsoft Windows 10 IoT Enterprise 64-bit (LTSC)

3. OS Drive: m.2 256 GB

4. RAM: 16 GB DDR4

5. Video

a. Outputs:

1) 4x Mini DisplayPort

b. System NVIDIA Quadro P620 (2 GM memory)

c. Maximum Video Resolution Per Output Type

d. mDP 1.4 direct connect HDR 5120 x 2880 at 60 Hz (30-bit color)

6. Optical Drive DVD±RW

7. Audio

a. Inputs Universal Audio Jack (front)

b. Outputs Universal Audio Jack (front), Line Out (rear), Internal Speaker, 4x Mini DisplayPort

c. Connector Types 3.5 mm 4 pole (In/Out), 3.5 mm 3 pole (Out), mDP cable (Out)

8. USB Ports

a. USB 2.0 2x front, 2x rear

b. USB 3.0 1x front, 4x rear

c. USB 3.3 Type-C 1x front

9. Networking

a. Gigabit Ethernet (1000Base-T) ports 1x

b. IP Version IPv4 and IPv6

10. Browser Current version of Google Chrome, Mozilla Firefox, or Microsoft Edge

11. Power

a. Input 90 to 264 VAC, 47 to 63 Hz, 3 A/1.5 A

b. Supply Internal 180 W

2.6 IP VIDEO MANAGEMENT SYSTEM DESCRIPTION

A. The Video Management System (VMS) shall be a Microsoft Windows-based video management and surveillance system consisting in a single server performing the following functions:

1. Allow users to define users and assign sets of permissions (known as roles) to each user.

2. Record and store video per user-defined retention settings for up to 96 cameras per server

3. Serve live and recorded video to clients on demand

B. The IP video management system shall record video and audio streams from IP cameras and video encoders on the network.

1. Video: MPEG4, MJPEG, H.264, or H.265 in High, Main, or Base Profile streams from both standard resolution and megapixel cameras

2. Audio: Bidirectional, full or half duplex compressed via G.711 PCM 8 bit, 8khz mono at 64 Kbps.

C. The system shall support recording schedules, including the ability to record based on motion, analytic, and alarm events.

D. The IP video management system shall be capable of continuous scheduled alarm/event and motion recording. Pre- and post- alarm recording shall also be available and shall be fully programmable on a per channel basis.

E. The IP video management system shall have the ability to record and playback audio streams along with associated video.

F. The IP Video Management System shall support recording of primary or secondary streams, individually or simultaneously. The server application can be configured to record a stream in unicast or multicast.

G. The IP Video Management System shall support video bookmarking, such that users can identify and recall important moments in recorded video based on the bookmark name or notes that are associated with it.

H. The IP video management system shall allow the administrator to set minimum and maximum retention periods for recorded video.

I. The IP video management system shall support network health and monitoring utilizing
third-party SNMP monitoring tools.

J. The IP video management system shall indicate system performance and operation status utilizing a variety of reports.

K. The system shall be configurable remotely or over a network.

L. The system shall discover third-party cameras on the network.

M. The system shall allow users to manually add cameras and devices by IP address or DNS hostname.

N. The system shall allow users with sufficient rights to control cameras (pan, tilt, and/or zoom).

O. The system shall support aggregation by a higher-level system, tying multiple servers together in a single, unified environment.

P. The system shall support third-party cameras using ONVIF profile S or native drivers.

Q. The IP VMS shall support Lightweight Directory Access Protocol (LDAP) to authenticate users.

R. The IP video management system shall allow archival of video data to external network locations or NAS devices over a network connection. The archival schedule shall be either automatic at user-defined intervals or manually executed.

S. The video management system shall be available as a hardware server with capacity to record up to 96 cameras at up to 450 Mbps recording throughput (per recorder).

T. The video management system shall be available as a software product that can be installed on COTS hardware.

U. The server shall support semantic grouping and organization of cameras/devices into groups using “tags”.

V. The system shall allow users to export video on request; exported video shall be stored locally on the server or on another network location selected by the administrator.

W. The system shall support aggregation by a higher-level environment, allowing the IP video management system to belong to a confederation of servers.

X. The VMS shall be accessible via a web browser with no software installed for live and playback functionality.

Y. Basic Analytic capabilities

1. Motion – Receive motion detection events from cameras

2. Alarm – Receive detection of physical alarms from cameras within the system, triggering an event

3. Analytic – Detection of analytic events and edge analytic events from cameras, including those that are free of charge

Z. Advanced Analytics Suite powered by Deep Learning

1. Detection of Objects (People and Vehicles) from an enabled camera

2. Configure notifications when objects are detected in zones

3. Configure notifications when objects move the wrong way though zones

4. Configure confidence thresholds for object classification within a scene

2.07 CLIENT DESKTOP APPLICATION

A. The Client application shall be Windows-based, providing an environment from which authorized users can watch live and recorded video on a computer in which the application has been installed.

1. The Client application shall import users and roles from existing LDAP servers, and enable single sign-on (SSO).

B. The Client shall be comprised of a main Mission Control panel, which may be hidden, working in unison with a series of windows (workspaces), each providing a tab-based experience.

C. The Client application shall be capable of connecting to either unicast or multicast.

D. The Client application shall be able to connect with multiple systems simultaneously.

E. Workspaces and Tabs

1. The Client interface shall be based upon workspaces and tabs.

a. A tab shall be a configurable layout populated with sources of content and plugins contained in cells.

b. A collection of one or more tab windows shall constitute a workspace.

c. The Client shall allow configuration and recall of complete workspaces.

1) An operator with appropriate permissions shall be able to send a saved workspace to other clients, causing their system to launch the saved workspace.

d. Any layout of video can be saved as tab to be later recalled by an operator.

1) Remote tab push: An operator with appropriate permissions shall be able to send a saved tab to other clients, causing their system to launch the saved tab.

e. Video in cells shall have the capability for live view, playback search options, and export.

f. Collaborative Tabs: an operator with appropriate permissions can view a designated collaborative tab so that multiple operators at different stations can see the exact same content and can make changes to live and playback video on this tab that other operators can see in real time.

g. Shared Display Decoder: Client shall be capable of being designated as an independent Shared Display mode. In this mode:

1) The client will restart automatically if the machine reboots.

2) The client will log in with the Shared display account automatically.

3) The client will restore the last tab and content that was displayed prior to shut down.

4) The client will accept stream and tab pushes from any connected client with permissions.

5) The client will be configurable to hide header and footer information, as well as borders, so that only video is shown.

h. Cells can be configured to show video without borders such that the video is stretched to cover the available space on the screen without black borders on any side.

i. Cells can be configured to rotate the video stream 90, 180, -90, or -180 degrees.

F. Live View and Playback

1. A list of video and audio sources which users are authorized to access shall be displayed.

2. Each video source shall indicate a list of current viewers to a user with appropriate permissions.

3. Each video source that is being viewed shall display whether there are current alarms associated with the source.

4. The client shall indicate when there has been a reduction in video quality for the displayed video sources.

5. The client computer shall be able to connect to an unrestricted number of recorders simultaneously to display live and recorded video.

6. The client shall allow video streams to be selectable from a system tree which can be built by users with appropriate permissions.

7. The client shall playback audio associated with video sources for users with the correct permissions.

8. Users shall be able to seamlessly switch between live and recorded video on the fly.

9. Live View

    a. For live view, cells will be displayed at the highest quality possible, based on the bandwidth and client hardware. The Client application will use the primary stream from a video source as the default; if the bandwidth or client hardware are approaching the limit, the video quality of as many streams as necessary will then be streamed as secondary or at MJPEG quality.

    b. Cells 1/4 the size of the tab or larger shall display the primary stream, and cells smaller than 1/4 the size of the tab shall display the secondary stream to conserve bandwidth and processing power.

10. Bookmark

    a. The Client shall allow operators to bookmark video

        1) The operator shall be able to specify the name & description of the bookmark.

        2) The operator shall be able to lock video and audio around bookmark and set the time range for the bookmark.

    b. The Client shall allow operators to search bookmarks by name, description, or time range.

11. Pan Tilt Zoom (PTZ)

    a. Digital Zoom - An operator shall be able to digitally zoom in a video stream in live or playback mode.

b. Optical Zoom and Pan Tilt Control: Operators shall be able to control PTZ cameras.

c. The Client application shall be able to perform digital de-warping of Optera and Evo 180-, 270-, and 360-degree cameras.

12. Playback

a. The Client application shall enable synchronized playback of up to nine (9) streams simultaneously in one tab.

b. The Client application shall have the capability to playback several non-synchronized cameras at one time in different cells.

c. For viewing recorded video, cells 1/4 the size of the tab or larger shall display full-frame rate video, and cells smaller than 1/4 the size of the tab shall playback only I-Frames to conserve bandwidth and processing power.

d. When hovering over a recorded video time bar, an operator shall see a thumbnail representing the contents of the video stream at that point in time.

e. Available playback control functions:

1) date-time selection

2) synchronized playback of selected cells within a tab

3) play video at normal speed

4) pause video and advance one frame

5) pause video and rewind 0.5 second

6) fast forward video at speeds up to 128x

7) rewind video at speeds up to 128x

8) jump video forward or back in preset increments and initiates playback

9) forward video to live playback

10) take snapshot of the current frame

f. Hovering over a video playback cell with a mouse shall display the playback control menu.

13. The user shall be able to configure a rotating sequence of cameras, allowing the application to cycle through cameras relevant to the operator without intervention.

    a. Using keyboard input alone, the operator can type a camera number, a preset number, or a time (hhmm format) to jump to a selected camera. No mouse input is necessary.

14. The user shall be able to create a sequence of cameras by dragging and dropping camera names in a single user interface.

    a. The user shall be able to configure a rotating sequence of cameras, allowing the application to cycle through cameras relevant to the operator without intervention.

    b. The user shall be able to configure a sequence of cameras that appear on alarm, allowing the application to cycle cameras when an event or alarm relevant to the user occurs.

G. Investigations

1. An investigation mode shall be available to provide multiple layouts (1x1, 2x2, and 3x3) with synchronized playback controls, allowing users to fully investigate a scene from multiple angles.

2. The investigation mode shall display recording types for motion, analytics, and alarms in recorded video.

3. The investigation mode shall enable operators to synchronize video playback and export investigative playlists covering scenes of interest in forward or reverse at speeds up to 128 times normal playback.

4. Users shall be able to create playlists from multiple video clips encompassing selected scenes from an investigation. Audio shall be included any time it is associated with a video clip.

5. Operators shall be able to save an investigation, preserving the associated device list and any created clips for later recall.

    a. Saved investigations shall be capable of being shared with other operators.

6. Operators shall be able to export individual video clips or entire playlists.

7. Administrators can configure the system to save exports to a shared network drive for evidentiary safe-keeping and quick access.

8. Investigation mode shall allow video clips from cameras of interest to be clipped to shorter times to allow for smaller video exports.

9. Investigation mode shall be a built-in application, provided at no additional cost.

10. Investigation mode shall have the ability to create multiple clips, allowing views from any camera to be added to an exported playlist.

H. Export

1. The Client shall allow a user to preview the export playlist prior to creating the finished export.

2. The Client shall initiate an export on the server independent of the client workstation; allowing the user to logoff or use their workstation for other tasks.

3. An operator shall be able to create a JPG or PNG snapshot image of the current frame of video in a cell. The user shall be able to include the camera name and timestamp in the snapshot.

4. An operator shall be able to select encryption of exports prior to the export, and the export shall be able protected by the user-entered password.

5. The system shall save the export and permit the operator to download the export to any system-accessible media including locally to HDD, CD/DVD, Flash USB device, or to network storage.

I. Display

1. The Client application shall allow at least four (4) 1080p resolution streams per monitor and support 60 fps camera streams per monitor.

J. Events

1. The Client application shall enable an operator to respond to events.

2. The Administrator shall specify which Clients shall receive notifications by user role.

3. Certain events shall be configurable for acknowledgement.

a. Acknowledgement options:

1) snoozed

2) in process

3) acknowledged

K. Relays – For devices that have a physical relay that is enabled on the VMS System, the Client application shall enable operators to activate or deactivate relays.

L. Plugins – The Client application shall support an open interface that facilitates the creation and deployment of user interface plugins including, but not limited to, mapping, video information overlays, access control, license plate recognition, and video content analysis with the option to integrate other third-party applications (such as advanced GIS Mapping Interfaces).

M. System and Device Information

1. Information management

a. The Client application shall provide a mechanism to create and assign metadata to devices.

b. A primary device list shall be apparent in the Client application, and devices shall be assignable to folders.

1) The device list shall be sortable by device name or device number.

2) The device list shall be able to be filtered by the following terms:

a) simple text-based filter, matching the device name or device number

b) tag-based filtering, showing devices matching the intersection of all assigned tags

c) status-based filtering, showing devices with a particular status

2. User Roles, as assigned by a System Administrator, shall define the limits of a user's ability to access live or recorded video and to export video and other standard client operations.

a. Authorized users shall be able to share views, including window arrangements and camera selections, with other users, for purposes of collaboration.

3. When using a mouse to hover over a device in a listing, a popup shall appear with the following information:

a. Device name

b. Thumbnail image

c. Device state

d. Associated tags

e. IP Address

PART 3 – EXECUTION

3.1 CAMERA MOUNTING

A. Wall-Mounted Camera:

1. The wall mount shall be designed specifically for mounting camera on a wall, along with any accessories that may be required for a complete camera mount.

2. The camera mount shall be a manually adjustable tilt table extending up from the horizontal arm. The mount shall be supplied with a manually adjustable tilt table capable of unlimited 360 degrees pan adjustment and ±90 degrees tilt adjustment.

3. Provide stainless steel mounting hardware for supporting outdoor camera mounts.

3.2 WIRING AND INSTALLATION

A. All wiring shall be in conduit.

B. Identify all wire and cable at terminations and at every junction box. Identification shall be made as specified in previous sections.

C. Inspect areas to receive camera to verify suitability of application. Contact ENGINEER for any conflict that may present itself. Camera mounts shall be rigidly attached to structural members. All cameras and monitors are to be installed per the manufacturer's requirements.

D. All camera views shall be reviewed with OWNER and adjusted as requested.

3.3 TESTS

A. Completely test and adjust all camera locations to demonstrate complete operation of the system.

END OF SECTION

Case No. 2020-00283
Exhibit B

NORTHERN KENTUCKY WATER DISTRICT

Project

Fort Thomas Treatment Plant Residuals Handling Improvements Campbell County, Kentucky

184-4008

CERTIFIED STATEMENTS

Affidavit (B.1)

Franchises (B.2)

Plan Review and Permit Status (B.3)

Easements and Right-of-Way Status (B.4)

Construction Dates and Proposed Date In Service (B.5)

Plant Retirements (B.6)

State Debt Officer Notification (B.7)

Case No. 2020-00283
Exhibit B.1

NORTHERN KENTUCKY
WATER DISTRICT

Project

Fort Thomas Treatment Plant Residuals Handling Improvements Campbell County, Kentucky

184-4008

Affidavit

AFFIDAVIT

COMMONWEALTH OF KENTUCKY

SS:

COUNTY OF KENTON

Comes now affiant, Stacey Kampsen, after being first sworn, deposes, and states that she is the Finance Manager for the Northern Kentucky Water District, that she is authorized to submit this petition on behalf of Northern Kentucky Water District, and that the information contained in the petition is true and correct to the best of her knowledge and belief, except as to those matters that are based on information provided to her and, as to those, she believes that information to be true and correct.

Stacey Kampsen

Stacey Kampsen

This instrument was acknowledged, signed and declared by Stacey Kampsen to be her act and deed the 2ND day of SEPT., 2020.

Notary Public
Registration Number 577360

My Commission expires: May 6, 2021

COLLEEN KELLY MEDERT NOTARY PUBLIC STATE AT LARGE, KY. My Commission Expires 5/6/21

Case No. 2020-00283
Exhibit B.2,3,4,5,6

NORTHERN KENTUCKY
WATER DISTRICT

Project

Fort Thomas Treatment Plant
Residuals Handling Improvements
Campbell County, Kentucky

184-4008

Franchises (B.2)

Plan Review and Permit Status (B.3)

Easements and Right-of-Way Status (B.4)

Construction Dates and Proposed Date In Service (B.5)

Plant Retirements (B.6)

Franchises required – None

Plan Review and Permit Status –

The District has reviewed and approved the plans and specifications prepared by GRW, Inc., titled "Fort Thomas Treatment Plant Residuals Handling Improvements" dated April 2020, sealed by a P.E.

The Kentucky Division of Water indicated that approval is not required because it is a replacement of existing equipment.

Easements and Right-of-Way Status – No easements will be needed for this project.

Start date of construction – October 2020

Proposed date in service – January 2022

Plant retirements – There are no retirements as a result of this project.

Case No. 2020-00283
Exhibit ____B.7

NORTHERN KENTUCKY WATER DISTRICT

Project

Fort Thomas Treatment Plant Residuals Handling Improvements Campbell County, Kentucky

184-4008

State Debt Officer Notification

Northern Kentucky
Water District

August 31, 2020

Commissioner Dennis Keene and State Local Debt Officer
100 Airport Rd., 3rd Floor
Frankfort, Kentucky 40601

Re: Northern Kentucky Water District
Notice of Intent to Issue Securities

Dear Sir or Madam:

Pursuant to the regulations of the Kentucky Public Service Commission, specifically 807 KAR 5:001: Section 18(1)(g), please be advised that the Northern Kentucky Water District (the "District") hereby notifies the State Local Debt Officer that the District intends on issuing securities in the form of a bond anticipation note (a "BAN") in 2020 or 2021 for the purpose of funding several projects necessary for the District, including the Fort Thomas Treatment Plant Residuals Handling Equipment Replacement Project (and related improvements) with an estimated budget of $3,000,000.

We will file the appropriate documents with your office in accordance with the requirements of KRS 65.117 once the securities are issued.

Very truly yours,

The Northern Kentucky Water District

Lindsey Rechtin

By: Lindsey Rechtin,
Vice President of Finance and Support Services

2835 Crescent Springs Road, P.O. Box 18640, Erlanger, Kentucky (859) 578-9898 Fax (859) 442-0665

Case No. 2020-00283
Exhibit C

NORTHERN KENTUCKY WATER DISTRICT

Project

Fort Thomas Treatment Plant Residuals Handling Improvements Campbell County, Kentucky

184-4008

BID INFORMATION

Bid Tabulation (C.1)

Engineer's Recommendation of Award (C.2)

Board Resolution (C.3)

Case No. 2020-00283
Exhibit C.1

NORTHERN KENTUCKY WATER DISTRICT

Project

Fort Thomas Treatment Plant Residuals Handling Improvements Campbell County, Kentucky

184-4008

Bid Tabulation

BID TAB

Northern Kentucky Water District
Fort Thomas Treatment Plant
Residuals Handling Improvements

July 2, 2020

CONTRACTOR	BID AMOUNT
Building Crafts, Inc.	$2,177,000.00
EGC Construction Corp.	$2,396,346.00

Case No. 2020-00283
Exhibit C.2

NORTHERN KENTUCKY
WATER DISTRICT

Project

Fort Thomas Treatment Plant Residuals Handling Improvements Campbell County, Kentucky

184-4008

Engineer's Recommendation of Award

BURGESS & NIPLE

525 Vine Street | Suite 1300 | Cincinnati, OH 45202 | 513.579.0042

Mr. Kyle Ryan, PE
Northern Kentucky Water District
2835 Crescent Springs Road
P.O. Box 18640
Erlanger, KY 41018

-Re- NKWD FTTP Residuals Handling Improvements Project
Bid Tabulation and
Recommendation of Award

July 6, 2020

Dear Mr. Ryan:

Bids were received and opened for the contracts comprising the Northern Kentucky Water District Ft. Thomas Treatment Plant Residuals Handling project on July 2, 2020. This letter transmits bid summary comparison tables prepared by Burgess & Niple, Inc. (B&N). This letter also provides B&N's recommendation of award for this project.

> **Bids:** The attached bid summary table confirms the two sets of bids were complete and in order, without material omissions. The low bid was submitted by Building Crafts, Inc., at $2,177,000.00.

The bids received from these two contractors recognized the three addenda, contained adequate bid guaranty and contract bonds, had completed affidavits, and were free of monetary mathematical errors. Both of these bids were deemed responsive.

Based on B&N's direct, extensive experience with the performance of Building Crafts, Inc. on several water and wastewater construction projects, B&N recommends that Building Crafts, Inc. be awarded the project.

B&N's construction cost estimate for the project was $2,322,000, so the lowest bid was approximately 94-percent of the estimate and the high bid was approximately 103-percent of the estimate. We were able to get good competition and good bids with only two bidders submitting bids. Other prospective bidders mentioned there were a few other projects bidding around the same time which may have been a factor in why there were not more bids submitted.

B&N's construction and design staff looks forward to participating in the subsequent construction portion of this project. Although I'll be taking more of a technical support role during the construction phase, please always feel free to call or email me as you or other NKWD staff members require assistance.

Sincerely,

Jeffrey R. Eilers, PE
Project Manager

Case No. 2020-00283
Exhibit C.3

NORTHERN KENTUCKY
WATER DISTRICT

Project

Fort Thomas Treatment Plant Residuals Handling Improvements Campbell County, Kentucky

184-4008

Board Resolution

Northern Kentucky Water District
Board of Commissioners
Regular Meeting
July 16, 2020

A regular meeting of the Board of Commissioners of the Northern Kentucky Water District was held on July 16, 2020 via video teleconference, as permitted by KRS 61.826, due to the COVID-19 pandemic restrictions and recommendations. All Commissioners were present. Also present were Ron Lovan, Alex Mattingly, Kim Clemons, Stacey Kampsen, Aaron Smith, Matt Piccirillo, Kyle Ryan, Chris Bryant, and Johnathan Moor.

Commissioner Douglas Wagner called the meeting to order at 12:00 p.m., and Commission Wagner led the pledge of allegiance.

The Commissioners reviewed correspondence received and articles published since the last regular Board meeting on June 18, 2020.

On motion of Commissioner Fred Macke, seconded by Commissioner Patricia Sommerkamp, the Board unanimously approved the minutes for the regular Board meeting held on June 18, 2020.

The Board was provided a copy of the District's check registers, which included the check number, check date, payee, check amount and description of the reason for each payment, detailing the District's expenditures for the period June 1, 2020 through June 30, 2020. On motion of Commissioner Jody Lange, seconded by Commissioner Clyde Cunningham, and after discussion, the Board unanimously approved the expenditures of the District for the month of June 2020.

On motion of Commissioner Joseph Koester, seconded by Commissioner Lange, the Board unanimously accepted the bid of $405,396.95 from and awarded a contract to Rector Excavating for the Crowell Avenue & Eustace Avenue Water Main Replacement Project with a total project budget of $470,000, and authorized staff to execute the applicable contract documents.

On motion of Commissioner Sommerkamp, seconded by Commissioner Koester, the Board unanimously accepted the bid of and awarded a contract to Chemicals, Inc. for the purchase of sodium hypochlorite, and authorized the execution of the applicable contract documents.

On motion of Commissioner Sommerkamp, seconded by Commissioner Macke, the Board unanimously accepted the bid of $2,177,000 from and awarded a contract to Building Crafts, Inc. for the Fort Thomas Treatment Plant Residuals Handling Improvements with a total project budget of $3,000,000, and authorized staff to execute the applicable contract documents.

The Board reviewed the District's financial reports and Department reports.

Finance Manager Stacey Kampsen updated the Board on revenues and expenses and on the effect of the COVID-19 pandemic on customer payment rates and late fee revenue. Ms. Kampsen also noted that Bill McGrath was retiring at the end of July.

Engineering Manager for Construction and Design Kyle Ryan reviewed with the Board the status of on-going projects within the 5-Year Capital Budget, including highlighting four change orders and expenses incurred to date. Mr. Ryan reported the District's water loss rate for June was 16.2%.

President/CEO Ron Lovan gave an update on the status of the old Ky 8, and the needed repairs on this portion of state-maintained right-of-way.

Other matters of a general nature were discussed.

On a motion by Commissioner Cunningham, seconded by Commissioner Sommerkamp, the meeting was adjourned at 12:59 p.m.

_____ _____

CHAIRMAN SECRETARY

Case No. 2020-00283
Exhibit D

NORTHERN KENTUCKY WATER DISTRICT

Project

Fort Thomas Treatment Plant Residuals Handling Improvements Campbell County, Kentucky

184-4008

PROJECT FINANCE INFORMATION

Customers Added and Revenue Effect

Debt Issuance and Source of Debt

Additional Costs for Operating and Maintenance

USoA Plant Account

Depreciation Cost and Debt Service After Construction

Customers Added and Revenue Effect: There will be zero new customers added and no revenue effect as a result of the Fort Thomas Treatment Plant Residuals Handling Improvements Project.

Debt Issuance and Source of Debt: This project will be paid from the District's Five-Year Capital Budget, PSC No. 166 "FTTP Residuals Handling Improvements" with a budget of $3,000,000 which includes construction cost, engineering, and contingencies. A summary of the project costs is provided below:

o Design Engineering	$ 180,000
o Construction Engineering	$ 70,000
o Contractor's Bid	$2,177,000
o Misc. & Contingencies	$ 573,000
Total Project Cost	$3,000,000

USoA Accounts: The anticipated amounts for the project cost of $3,000,000 will fall under the following Uniform System of Accounts Codes:

Code 304 "Structures and Improvements"	$315,000
Code 320 "Water Treatment Equipment"	$2,685,000

Additional Costs and O&M: Additional annual operating and maintenance costs incurred for the project are as follows:

Power	$ 0
Labor	$ 0
Maintenance	$43,500 (2% of construction)
	$43,500

Depreciation and Debt Service: Annual depreciation and debt service after construction are as follows:

Depreciation: $8,400/year over 37.5 years for Code 304 "Structures and Improvements" and $89,500/year over 30 years for Code 320 "Water Treatment Equipment"

Annual Debt Service: $172,284 over 25 years (conventional 3.0% loan).

Case No. 2020-00283
Exhibit E

NORTHERN KENTUCKY WATER DISTRICT

Project

Fort Thomas Treatment Plant Residuals Handling Improvements Campbell County, Kentucky

184-4008

SCHEDULE OF MORTGAGES, BONDS, NOTES, AND OTHER INDEBTEDNESS

Northern Kentucky Water District		
Bonds & Notes		
6/30/2020		
Bonds		
USDA 2000	$1,641,000	
Series 2003C	$0	
Series 2004A	$0	
Series 2006	$0	
Series 2009	$0	
Series 2011	$22,435,000	
Series 2012	$33,675,000	
Series 2013A	$21,685,000	
Series 2013B	$12,840,000	
Series 2014A	$1,706,500	
Series 2014B	$4,650,000	
Series 2016	$33,155,000	
Series 2019	$17,310,000	
	$149,097,500	
KIA Notes Currently Servicing		
F08-07	$2,592,667	
F9-02	$16,661,798	
F13-012	$4,523,000	
F-14-015	$3,244,296	
F-15-011	$3,234,401	
B-15-003	$1,230,717	
F16-027	$947,240	
Total KIA	**$32,434,119**	
Other Notes		
Deferred Note Kenton County	$100,000	

Case No. 2020-00283
Exhibit F

NORTHERN KENTUCKY WATER DISTRICT

Project

Fort Thomas Treatment Plant Residuals Handling Improvements Campbell County, Kentucky

184-4008

CURRENT BALANCE SHEET AND INCOME STATEMENT

NORTHERN KENTUCKY WATER DISTRICT
STATEMENT OF NET POSITION
JUNE 30, 2020

ASSETS AND DEFERRED OUTFLOWS OF RESOURCES

Current Assets		
Cash and Cash Equivalents	$	32,537,861
Investments		4,354,438
Accounts Receivable		
Customers, Net		6,151,868
Unbilled Customers		6,500,000
Others		233,953
Assessments Receivable		155,813
Inventory Supplies for New Installation and Maintenance, at Cost		1,673,366
Prepaid Items		958,554
Restricted Assets - Cash and Cash Equivalents		
Debt Service Account		2,752,341
Total Current Assets		55,318,194
Noncurrent Assets		
Restricted Assets - Cash and Cash Equivalents		
Bond Proceeds Fund		1,926,369
Debt Service Account		14,010,196
Improvement, Repair and Replacement		749,492
Customer Deposits Fund		911,967
Restricted Assets - Investments		
Debt Service Reserve Account		19,231,343
Miscellaneous Deferred Charges		4,074,811
Capital Assets		
Land, System, Buildings and Equipment		507,946,320
Construction in Progress		13,265,383
Total Capital Assets		521,211,703
Less Accumulated Depreciation		179,411,093
Total Capital Assets, Net of Accumulated Depreciation		341,800,610
Total Noncurrent Assets		382,704,788
Total Assets		438,022,982
Deferred Outflows of Resources		
Deferred Outflows Related to Pension		4,558,221
Deferred Outflows Related to OPEB		2,110,885
Deferred Loss on Refundings		3,813,366
Total Deferred Outflows of Resources		10,482,472
Total Assets and Deferred Outflows of Resources	$	448,505,454

NORTHERN KENTUCKY WATER DISTRICT
STATEMENT OF NET POSITION
JUNE 30, 2020

LIABILITIES, DEFERRED INFLOWS OF RESOURCES, AND NET POSITION

Liabilities and Deferred Inflows of Resources		
Current Liabilities		
Bonded Indebtedness	$	12,070,628
Notes Payable		1,705,186
Accounts Payable		267,653
Accrued Payroll and Taxes		458,408
Other Accrued Liabilities		273,598
Accrued Interest Payable		2,752,341
Total Current Liabilities		17,527,814
Long-Term Liabilities (Net of Current Portion)		
Liabilities Payable-Restricted Assets		
Accounts Payable		149,718
Customer Deposits		911,967
Compensated Absences		1,257,041
Arbitrage Liability		322,268
Bond Indebtedness		149,349,171
Notes Payable		30,828,933
Net Pension Liability		23,269,110
Net Unfunded OPEB Liability		5,563,369
Total Long-Term Liabilities		211,651,577
Total Liabilities		229,179,391
Deferred Inflows of Resources		
Deferred Inflows Related to Pension		726,617
Deferred Inflows Related to Pension		2,058,313
Total Deferred Inflows of Resources		2,784,930
Total Liabilities and Deferred Inflows of Resources		231,964,321
Net Position		
Net Investment in Capital Assets		151,660,057
Restricted For		
Debt Service Funds		33,241,539
Capital Improvement Projects		2,526,143
Unrestricted		29,113,394
Total Net Position		216,541,133
Total Liabilities, Deferred Inflows of Resources, and Net Position	$	448,505,454

NORTHERN KENTUCKY WATER DISTRICT
STATEMENT OF REVENUES, EXPENSES AND CHANGES IN NET POSITION
12 MONTH PERIOD ENDED JUNE 30, 2020

Operating Revenues		
Water Sales	$	57,547,319
Forfeited Discounts		663,996
Rents From Property		562,865
Other Water Revenues		482,809
Total Operating Revenues		59,256,989
Operating Expenses		
Operating and Maintenance Expense		29,082,269
Depreciation Expense		12,200,138
Total Operating Expenses		41,282,407
Net Operating Income		17,974,582
Non-Operating Income (Expense)		
Investment Income		1,362,576
Miscellaneous Non-Operating Income		67,879
Loss on Abandonment of Mains		(670,860)
Interest on Long-Term Debt		(6,814,222)
Amortization of Debt Premiums and Bond Defeasance Costs		819,587
Bond Issuance Costs		(67,067)
Pension Expense		(2,476,972)
Other Post Employment Benefit Expense		(97,596)
Arbitrage Expense		(178,770)
Gain on Sale of Capital Assets		138,095
Total Non-Operating Expenses		(7,917,350)
Change in Net Position Before Capital Contributions		10,057,232
Capital Contributions		1,684,538
Change in Net Position		11,741,770
Net Position - Beginning of Year		204,799,363
Net Position - End of Year	$	216,541,133